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54

Method for producing a construction element, in particular a tunnel element, having a watertight seal.

57

Method for producing a construction element, in particular a tunnel element, from a curing material, such as concrete, in a mould, said construction element being provided with a watertight seal on at least one side thereof, wherein a gasket is used comprising a deforming body which is produced from a yielding material, such as rubber. According to the invention a base is produced from a relatively strong material, which base may or may not be detachable from the deforming body. Said base with or without said deforming body is placed against an inner side of the mould, said curing material is cast in the mould, and said curing material is cured to form said construction element with said watertight seal.

Method for producing a construction element, in particular a tunnel element, having a watertight seal

The invention relates to a method for producing a construction element, in particular a tunnel
5 element, from a curing material, such as concrete, in a mould, said construction element being
provided with a watertight seal on at least one side thereof, using a gasket which is produced from
a yielding material, such as rubber.

An immersed tunnel is normally constructed from structural concrete elements approximately 100-
10 150 meters long, which are manufactured in a casting basin or dry dock. The tunnel elements are
provided with temporary bulkheads at both ends to ensure that the element is watertight and
capable of floating. On one end of each tunnel element, an endless gasket is mounted. When
manufacturing of the tunnel elements is completed, the dock is flooded and the elements floated.
Each element is towed to its final position and then immersed. The immersed tunnel element is
15 then pulled firmly up against the preceding immersed element with hydraulic jacks. The initial
contact of the gasket should be accomplished using a low pulling force. When the gasket has full
contact around the total circumference of the adjacent element, the water between the bulkheads is
pumped out. Due to pressure differential between the bulkheads and the hydrostatic pressure on the
outside of the tunnel, the gasket profile compresses and seals the joint. A secondary seal is then
20 clamped across the joint on the inside of the tunnel. In general the bulkheads are removed after
approval of the pressure test between the gasket and the secondary seal.

The supplier of the gasket needs to show by calculations based on the measured force-compression
curves that at all water pressures the selected gasket satisfies the following conditions within
25 agreed safety limits:

1. transfer of the hydrostatic loads at high water level is within the maximum compression
capacity of the gasket profile;
2. sealing at all water levels for all joints, including the effect of gap variations due to
variation in smoothness/flatness of the tunnel faces, rotation of immersed tunnel elements, creep
30 and shrinkage of the concrete material and temperature effects;
3. restoring moments to re-align misalignment of a tunnel element;
4. proper functioning of the gasket after re-alignment with respect to prevention of leakage
at the gap opening side and prevention of overload at the gap closing side;
5. sealing properties should incorporate the effect of relaxation on the rubber material of
35 the seal over the tunnel life time period; and

6. the gasket flange construction should be able to withstand additional loads without dislocation, due to shear of the compressed gasket in case of differential tunnel settlement.

5 According to prior art methods, the gaskets are mounted on the ends of the tunnel element using an end frame which is first attached to the ends of the tunnel element, and then one side of the gasket is mounted in the frame. The end frame is usually made of carbon or stainless steel. Mounting the end frames to the tunnel elements and mounting the gasket in the frames is however time consuming.

10 The aim of the invention is to provide a cheap, reliable and fast manner to produce and place construction elements such as tunnel elements.

15 According to the invention a gasket is produced comprising a deforming body which is produced from a yielding material, such as rubber, and a base which is produced from a relatively strong material, which base may or may not be detachable from the deforming body, wherein said base with or without said deforming body is placed against an inner side of the mould, said curing material is cast in the mould, and said curing material is cured to form said construction element with said watertight seal. In this manner the steel end-frames are eliminated and separate installation of the gasket is no longer required.

20

In a preferred embodiment said base is provided with anchors on one side thereof, said anchors extending into the curing material while said material is cured. Said anchors are preferably made of metal or carbon.

25 In a first further preferred embodiment said anchors extend from a plate which is at least partially surrounded by said yielding material of the gasket in order to hold said plate. Said plate is also preferably made of metal or carbon. Said anchors comprise bolts, which are screwed into said plate so as to extend therefrom.

30 In a second further preferred embodiment said anchors are plate shaped, wherein said plate shaped elements extend in or on the curing material parallel to the surface of the curing material.

Said construction element may be a tunnel element, a dry dock element, a storm surge barrier element, an offshore mooring element or a grout seal element.

35

The invention also relates to a construction element, in particular a tunnel element, produced by the method as described before.

5 The invention furthermore relates to a tunnel element produced by the method as described before, wherein said gasket is an endless gasket.

The invention furthermore relates to a tunnel wherein tubular tunnel elements produced by the method as described before are placed against one another with said seal in between the outer ends thereof. Preferably a secondary seal is provided over said seal against the inner side of said tunnel.
10

The invention will now be elucidated by means of preferred embodiments, as shown in the drawings, wherein:

Figure 1 shows a cross section of an immersed tunnel being built from tunnel elements;
15 Figure 2 is a perspective view of detail of an outer end of a tunnel element as indicated by arrow II in figure 1;
Figures 3, 4, 5 and 6 show various stages of the process of placing and sealing the outer ends of the tunnel elements of figure 1;
Figure 7 is a detail of the cross section as shown in figure 6 showing a prior art seal;
20 Figure 8 is a detail of the cross section as shown in figure 6 showing a seal in accordance with the invention;
Figure 9 is a sectional cross section of the seal as shown in figure 8 before the outer ends of the tunnel elements are placed and sealed;
Figure 10 is a longitudinal cross section of the seal as shown in figure 8 before the outer ends of
25 the tunnel elements are placed and sealed;
Figures 11, 12 and 13 are sectional cross sections of alternative embodiments of seals in accordance with the invention.

According to figure 1an immersed tunnel is constructed from structural concrete tunnel elements 1.
30 The tunnel elements 1 are provided with temporary bulkheads 2 at both ends to ensure that the element is watertight and capable of floating. Each tunnel element 1 is towed to its final position and then immersed. As shown in figures 2 and 3, on one end of each tunnel element 1, an endless gasket 3 is mounted. The immersed tunnel element 1 is pulled firmly up against the preceding immersed tunnel element 1, as shown in figure 4. When the gasket 3 has full contact around the
35 total circumference of the adjacent tunnel element 1, the water between the bulkheads 2 is pumped out as shown in figure 5. Due to pressure differential between the bulkheads 2 and the hydrostatic

pressure on the outside of the tunnel elements 1, the gasket profile compresses and seals the joint. A secondary seal 4 is then clamped across the joint on the inside of the tunnel elements 1. The bulkheads 2 are then removed as shown in figure 6.

5 Figure 7 shows a prior art seal of the joint between two tunnel elements 1. In this embodiment the endless gasket 3 is profiled, having a base mounting portion 31 and a compressing body 32. Between the mounting portion 31 and the compressing body 32 a slot is provided at both sides of the gasket 3, in which metal strips can engage in order to hold the gasket 3.

10 According to the prior art, the method for mounting the gasket to the tunnel element 1 is as follows. First an end-frame 5 is provided on the outer end of the cured concrete tunnel element 1. Then the endless gasket 3 is laid out in the correct rectangular shape, flat on a floor (for instance the roof of the tunnel element 1. A lifting beam with nylon straps engages the top section and the lower section of the gasket 3, and the gasket 3 is lifted to the vertical position. The gasket 3 is
15 placed in front of and against the end-frame 5 on the outer end of the tunnel element 1, and on both side of the gasket 3 a metal hooked profiled mounting strip 6 is inserted in the slot between the mounting portion 31 and the compressing body 32, whereafter the mounting strips 6 are attached to the end-frame 5 by means of bolts.

20 In accordance with the invention, the gasket 3 is directly casted with the tunnel element, eliminating the steel end-frame 5 and mounting strips 6 as shown in figure 7. Separate installation is no longer required. The gasket 3 is placed in a special mould. This mould is used to cast the front section of the tunnel element 1. After curing of the concrete and releasing of the mould the gasket 3 is permanently connected with the tunnel element 1.

25

In the embodiment of figures 8, 9 and 10 the gasket 3 comprises an endless compressing body 32 made from vulcanized rubber. The compressing body has a generally rectangular, almost square and slightly tapering, cross section. On the side of the compressing body 32 intended to contact the opposing tunnel element 1, which is the smallest of the two opposing sides, a rib 33 is formed
30 which can be easily be deformed upon first contact with the opposing tunnel element 1. On the other side, which is the largest of the two opposing sides, base elements 34 comprising plate shaped elements 341 are enclosed in the rubber material near or at the surface of the compressing body 32. In this embodiment the base elements 34 and the deforming body 32 are not detachable from each other thereby. In this example the plate shaped element 341 is made of carbon fibres.

35 Over the length of the plate shaped element 34 pairs of bolts 342 with bolt heads are screwed through the plate shaped element 341, so as to form anchors. On the other side of the plate shaped

elements 34 the bolts 342 are secured by nuts 343. The base elements 34 together with the deforming body 32 are cast integral with the concrete in accordance with the invention.

5 In the embodiment of figure 11 the gasket 3 comprises an endless compressing body 32 made from vulcanized rubber. The compressing body 32 has a generally rectangular, almost square and slightly tapering, cross section. On the side of the compressing body 32 intended to contact the opposing tunnel element 1, which is the smallest of the two opposing sides, a rib 33 is formed which can be easily be deformed upon first contact with the opposing tunnel element 1. On the other side, which is the largest of the two opposing sides, plate shaped mounting elements 321 are
10 formed integral with the compressing body 32. Base elements 34 in the form of plate shaped elements are cast integral with the concrete of the tunnel elements in accordance with the invention. The base 34 and the compressing body 32 are detachable from each other and are attached to each other by means of screws 35.

15 In the embodiment of figure 12 the gasket 3 comprises an endless compressing body 32 made from vulcanized rubber. The compressing body 32 has a generally rectangular, almost square and slightly tapering, cross section. On the side of the compressing body 32 intended to contact the opposing tunnel element 1, which is the smallest of the two opposing sides, a rib 33 is formed which can be easily be deformed upon first contact with the opposing tunnel element 1. On the
20 other side, which is the largest of the two opposing sides, the compressing body is formed with a base mounting portion 31. Between the mounting portion 31 and the compressing body 32 a slot is provided at both sides of the compressing body 32, in which metal strips can engage in order to hold the compressing body 32. Base elements 34 comprising plate shaped elements 341 are cast integral with the concrete of the tunnel elements in accordance with the invention. The base
25 element 34 further comprises a metal hooked profiled mounting strip 347 mounted on the plate shaped element 341 which can be inserted in the slot between the mounting portion 31 and the compressing body 32. The base 34 and the compressing body 32 are thus detachable from each other and are attached to each other by means of a separate metal hooked profiled mounting strip 37 which can be mounted on the plate shaped element 341 by means of screws 35.

30

In the embodiment of figure 13 the gasket 3 comprises an endless compressing body 32 made from vulcanized rubber. The compressing body 32 has a generally rectangular, almost square and slightly tapering, cross section. On the side of the compressing body 32 intended to contact the opposing tunnel element 1, which is the smallest of the two opposing sides, a rib 33 is formed
35 which can be easily be deformed upon first contact with the opposing tunnel element 1. On the other side, which is the largest of the two opposing sides, plate shaped mounting elements 321 are

formed integral with the compressing body 32, on both sides of the centre line. On the centre line of said side a V-shaped recess is provided, which allows for manual inward compression of the sides of the compressing body. Base elements 34 comprising plate shaped elements 341 are cast integral with the concrete of the tunnel elements in accordance with the invention. From the edges of the plate shaped element 341 extend strips 348 in the direction of the central-top part of the compressing body. The base 34 and the compressing body 32 are detachable from each other and are attached to each other by compressing the lower part of the compressing body 32 such that it can snap behind the edges of the strips 348 as shown in figure 13.

10 Apart from immersed tunnels, the invention also applies to other construction elements, such as:

Dry dock sealing: dock doors are closed and opened either mechanical or due to hydrostatic water pressure. The pressure acting on the gaskets mounted on these doors are compressing the gasket resulting in a watertight seal.

Storm surge barriers.

15 Offshore mooring devices. Seals are mounted on a flat surface in a closed circuit connected to a ships hull result into a differential pressure. This differential pressure is used to keep the mooring device in place and connected through a "soft" joint.

Grout sealing. The seal is used to create a void which can be grouted. Once the grout has hardened the seal becomes obsolete.

20 General sealing purposes.

The invention has thus been described by means of preferred embodiments. It is to be understood, however, that this disclosure is merely illustrative. Various details of the structure and function were presented, but changes made therein, to the full extent extended by the general meaning of the terms in which the appended claims are expressed, are understood to be within the principle of the present invention. The description and drawings shall be used to interpret the claims. The claims should not be interpreted as meaning that the extent of the protection sought is to be understood as that defined by the strict, literal meaning of the wording used in the claims, the description and drawings being employed only for the purpose of resolving an ambiguity found in the claims. For the purpose of determining the extent of protection sought by the claims, due account shall be taken of any element which is equivalent to an element specified therein.

Conclusies

1. Werkwijze voor het vervaardigen van een constructie-element van een uithardend materiaal, zoals beton, in een matrijs, waarbij het constructie-element wordt voorzien van een waterdichte afdichting aan ten minste een zijde daarvan,
 - 5 waarbij een pakking wordt vervaardigd omfattende een vervormend lichaam dat gemaakt is van een meegevend materiaal, zoals rubber, en een basis die is vervaardigd uit een relatief sterk materiaal, welke basis al dan niet losneembaar is van het vervormende lichaam;
 - 10 waarbij de basis met of zonder het vervormende lichaam tegen een binnenzijde van de mal wordt geplaatst,
 - waarbij het uithardend materiaal in de mal wordt gegoten, en
 - het uithardend materiaal wordt uitgehard voor het vormen van het constructie-element met de waterdichte afdichting.

- 15 2. Werkwijze volgens conclusie 1, waarbij de basis is voorzien van ankers aan een zijde daarvan, waarbij de ankers zich in het uithardende materiaal uitstrekken terwijl het materiaal wordt uitgehard.

- 20 3. Werkwijze volgens conclusie 2, waarbij genoemde ankers zijn gemaakt van metaal of koolstof.

4. Werkwijze volgens conclusie 1, 2 of 3, waarbij de ankers zich vanaf een plaat die ten minste gedeeltelijk wordt omgeven door genoemd meegevend materiaal van de pakking om de plaat te houden.

- 25 5. Werkwijze volgens conclusie 4, waarbij de plaat is gemaakt van metaal of koolstof.

6. Werkwijze volgens conclusie 4 of 5, waarbij de ankers bouten omvatten, die in de plaat worden geschroefd teneinde zich daarvan uit te strekken.

- 30 7. Werkwijze volgens een van de voorgaande conclusies 2 - 4, waarbij de ankers plaatvormig zijn, waarbij de plaatvormige elementen zich in of op het uithardend materiaal evenwijdig aan het oppervlak van uithardende materiaal uitstrekken.

- 35 8. Werkwijze volgens een van de voorgaande conclusies, waarbij het constructie-element een tunnelelement, een droogdokelement, een stormvloedkeringselement, een offshore afmeerelement of een groutafdichtelement is.

9. Een bouwelement, in het bijzonder een tunnelement, die is vervaardigd door de werkwijze volgens een van de voorgaande conclusies.
- 5 10. Een tunnelement vervaardigd door de werkwijze volgens een van de voorgaande conclusies, waarbij de pakking een eindloze pakking is.
11. Een tunnel waarbij buisvormige tunnelementen, die zijn vervaardigd door de werkwijze volgens een van de voorgaande conclusies, tegen elkaar zijn geplaatst met de afdichting tussen de uiteinden daarvan.
- 10 12. Een tunnel volgens conclusie 11, waarbij een secundaire afdichting wordt aangebracht over de afdichting tegen de binnenzijde van de tunnel.

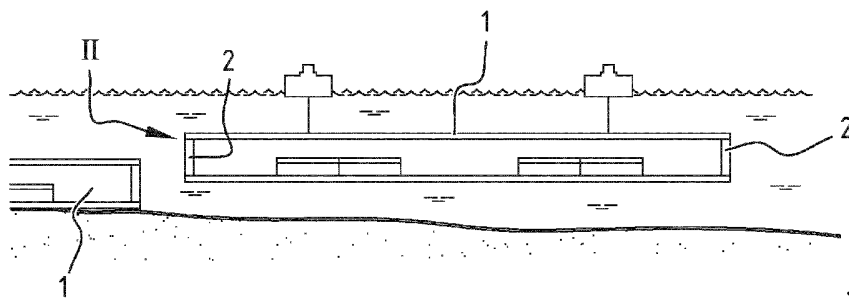


FIG. 1

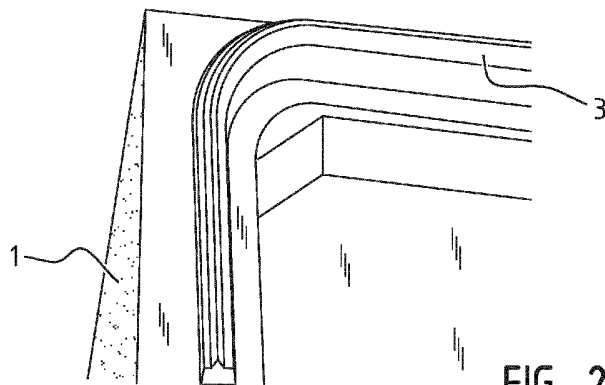


FIG. 2

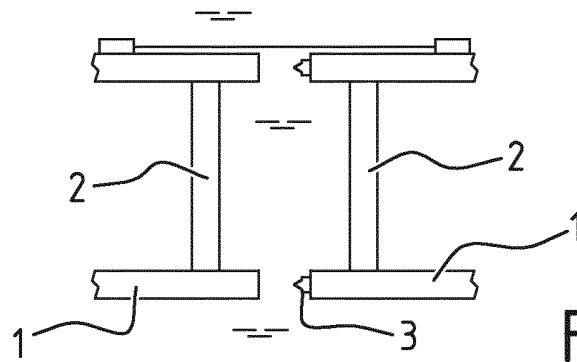


FIG. 3

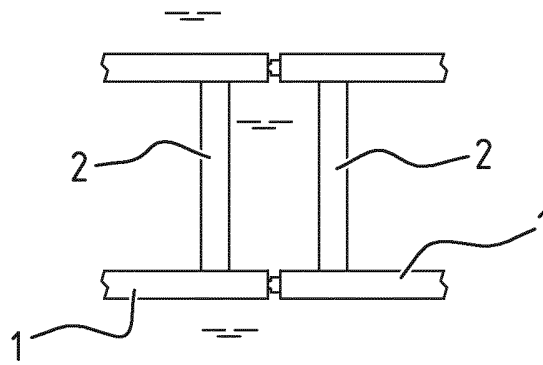


FIG. 4

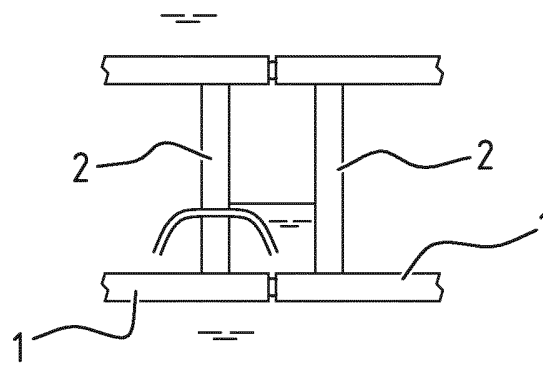


FIG. 5

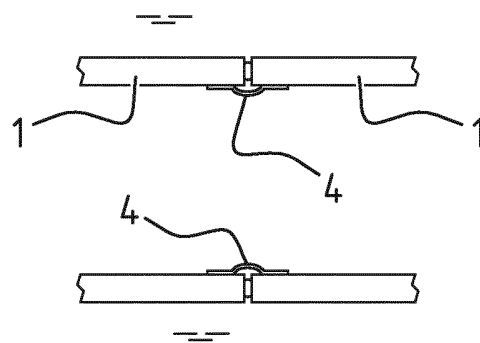


FIG. 6

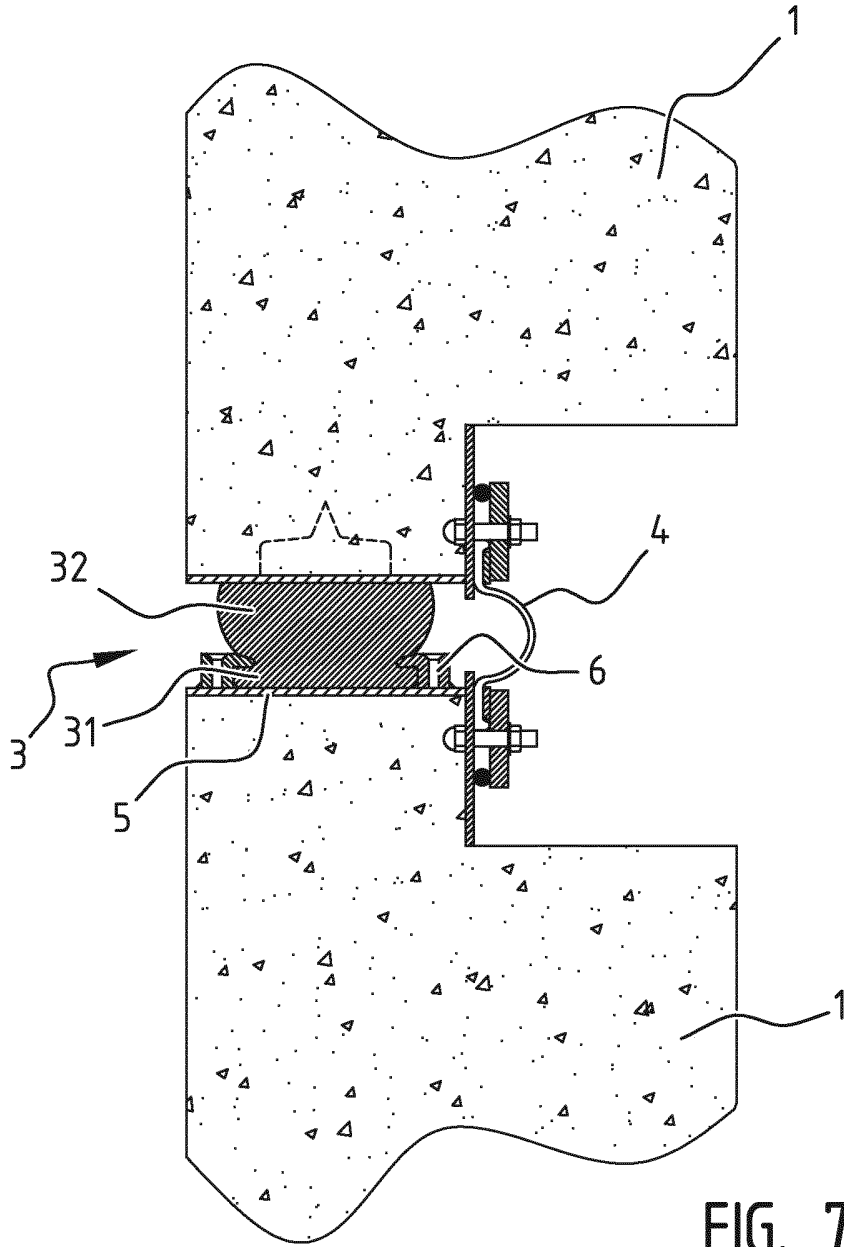


FIG. 7

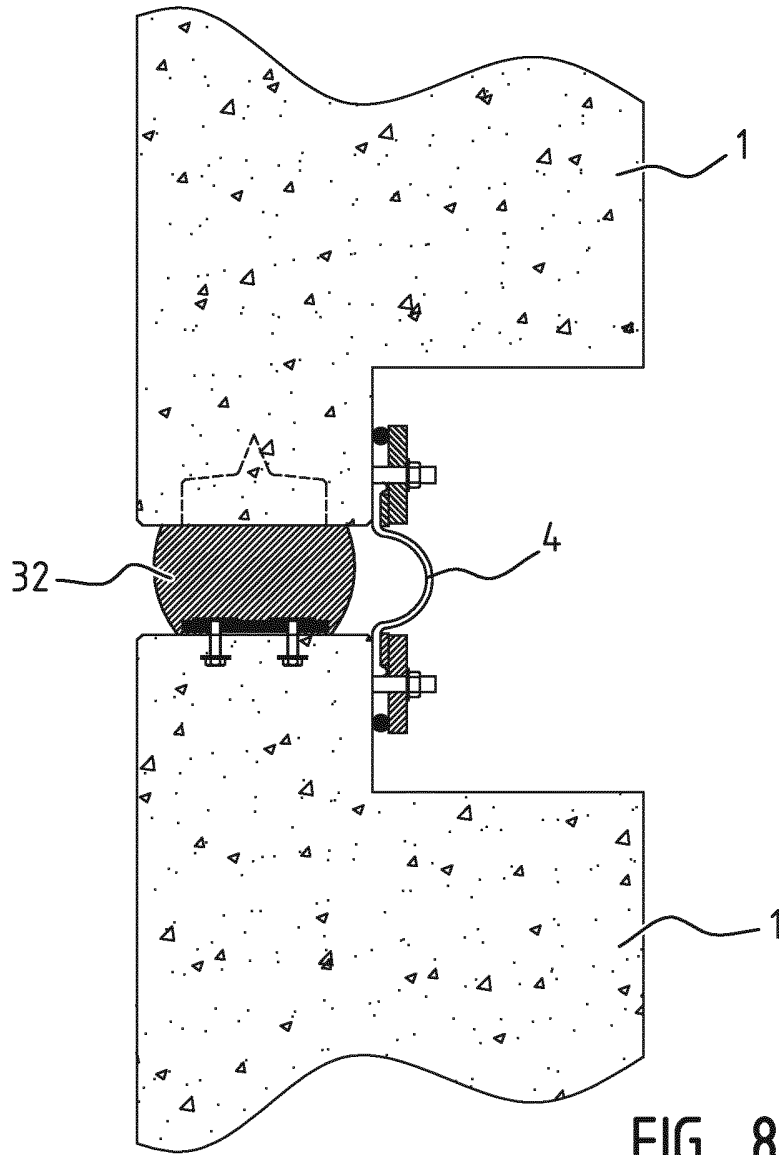


FIG. 8

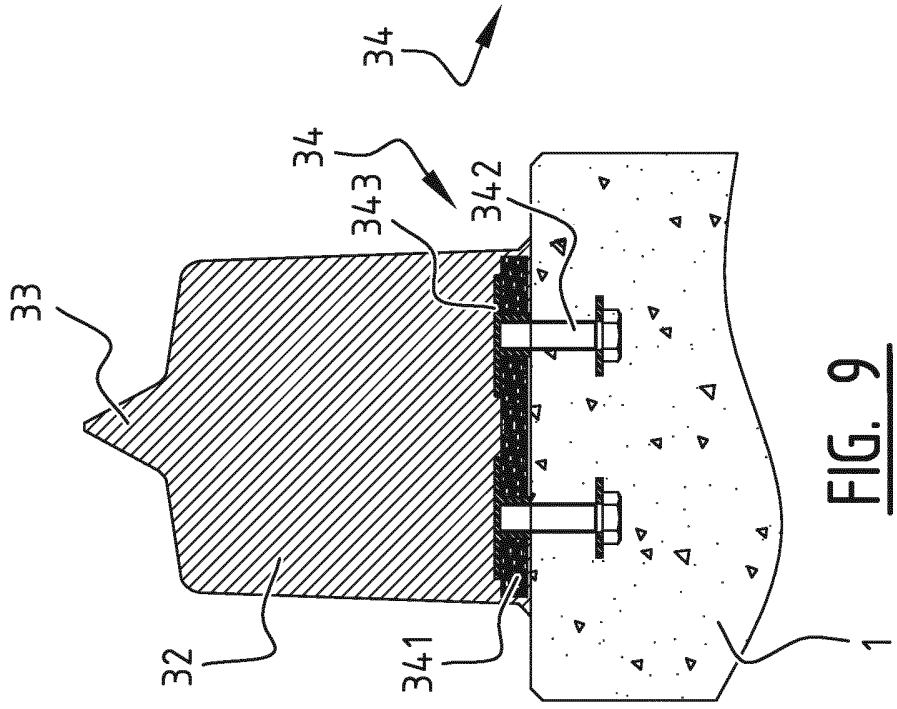


FIG. 9

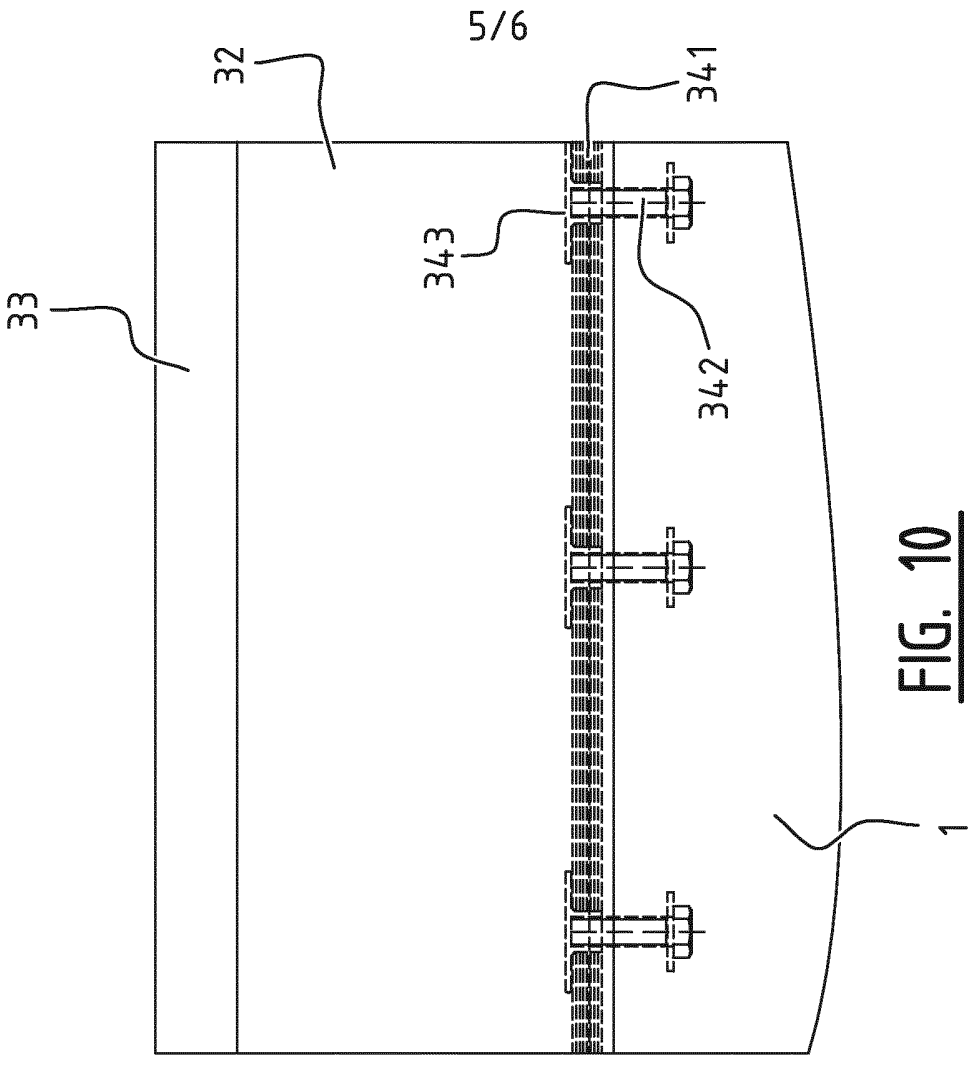


FIG. 10

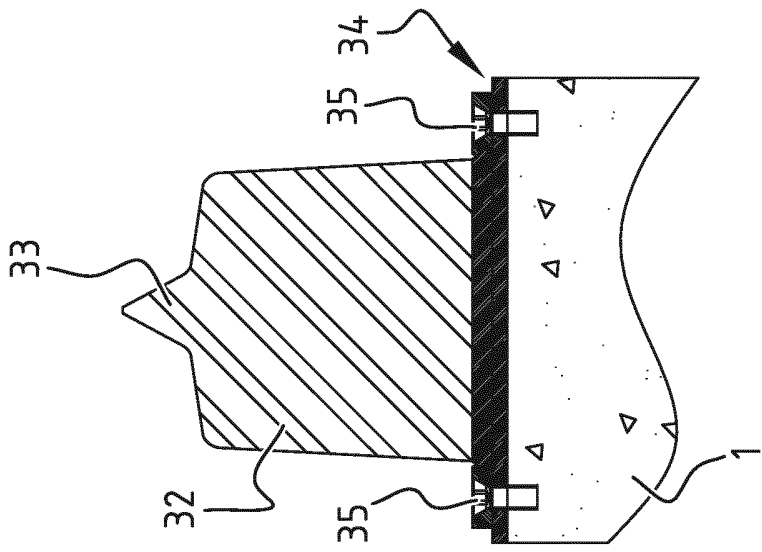


FIG. 11

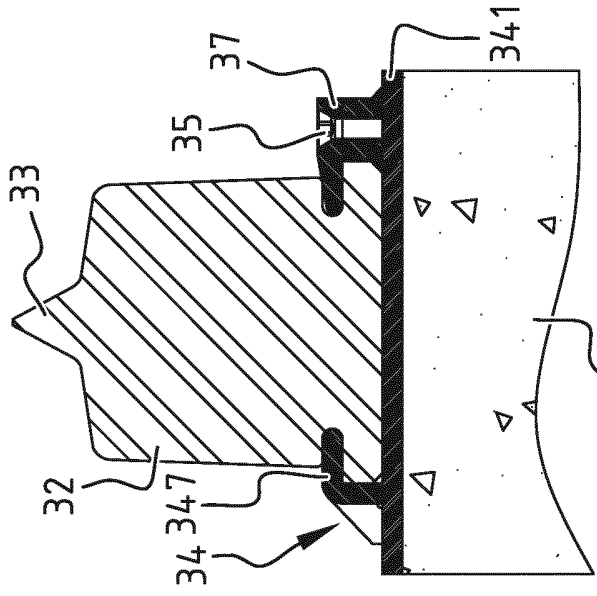


FIG. 12

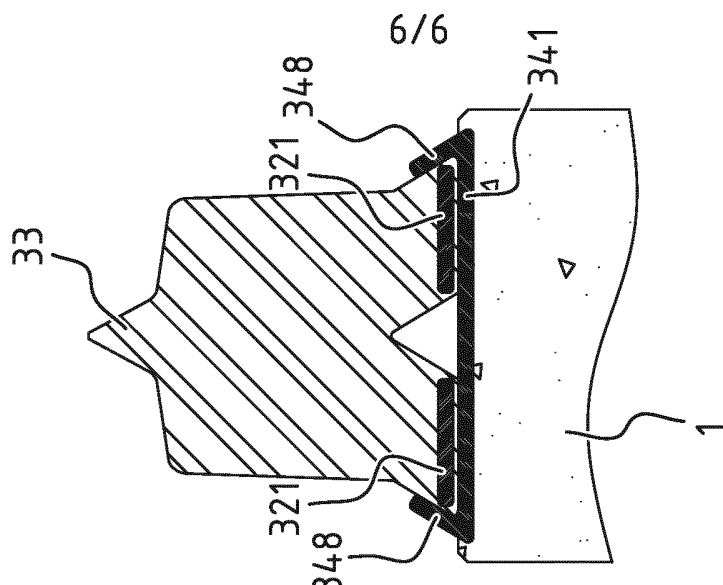


FIG. 13

Abstract

Method for producing a construction element, in particular a tunnel element, from a curing material, such as concrete, in a mould, said construction element being provided with a watertight seal on at least one side thereof, wherein a gasket is used comprising a deforming body which is produced from a yielding material, such as rubber. According to the invention a base is produced from a relatively strong material, which base may or may not be detachable from the deforming body. Said base with or without said deforming body is placed against an inner side of the mould, said curing material is cast in the mould, and said curing material is cured to form said construction element with said watertight seal.

EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

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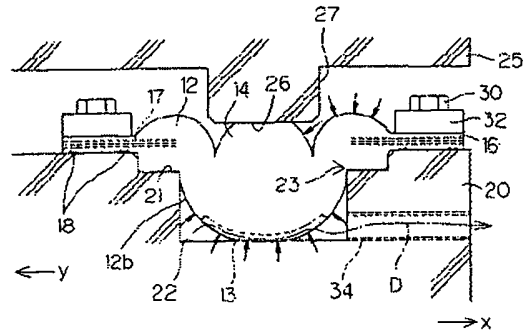
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APPLICATION NUMBER : 2003387058

APPLICANT : TAISEI CORP;

INVENTOR : TOYAMA MASAOKI;

INT.CL. : E02D 29/073

TITLE : JOIN STRUCTURE OF IMMERSED
TUNNEL ELEMENT



ABSTRACT : PROBLEM TO BE SOLVED: To provide a joint structure of immersed tunnel elements capable of providing excellent water cutting-off performance even when large joint opening occurs when joining them under low water pressure and after joining them.

SOLUTION: This immersed tunnel element is constituted so as to nip and hold a rubber gasket 10 provided with a gasket main body part 12 having substantially rectangular cross section, a protruding bar part 14 in contact with a top face 12a of the gasket main body part continuously, and a pair of flange parts 16 in contact with both side faces of the gasket main body part continuously between mutually opposing joining faces 21 and 26 of a pair of immersed tunnel elements 20 and 25. The flange part 16 is fixed by crossing a channel 22 provided on the joining face of the immersed tunnel element on one side, and the gasket main body part 12 is pressed into the channel 22. Consequently, it is possible to provide excellent water cutting-off performance even when large joint opening occurs when joining them under low water pressure and after joining them.

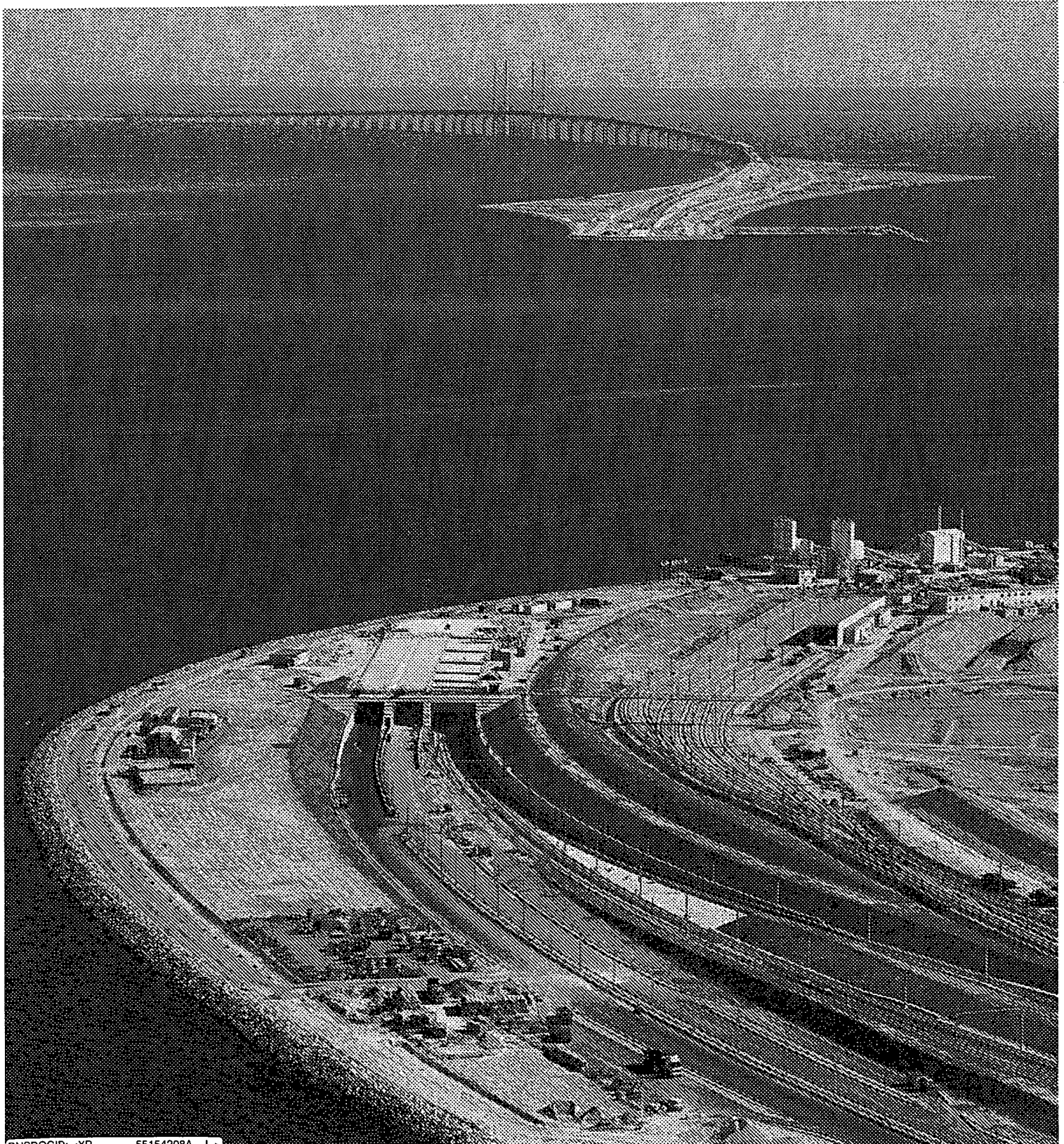
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TRELLEBORG

Gina Gasket

Trelleborg Ridderkerk BV





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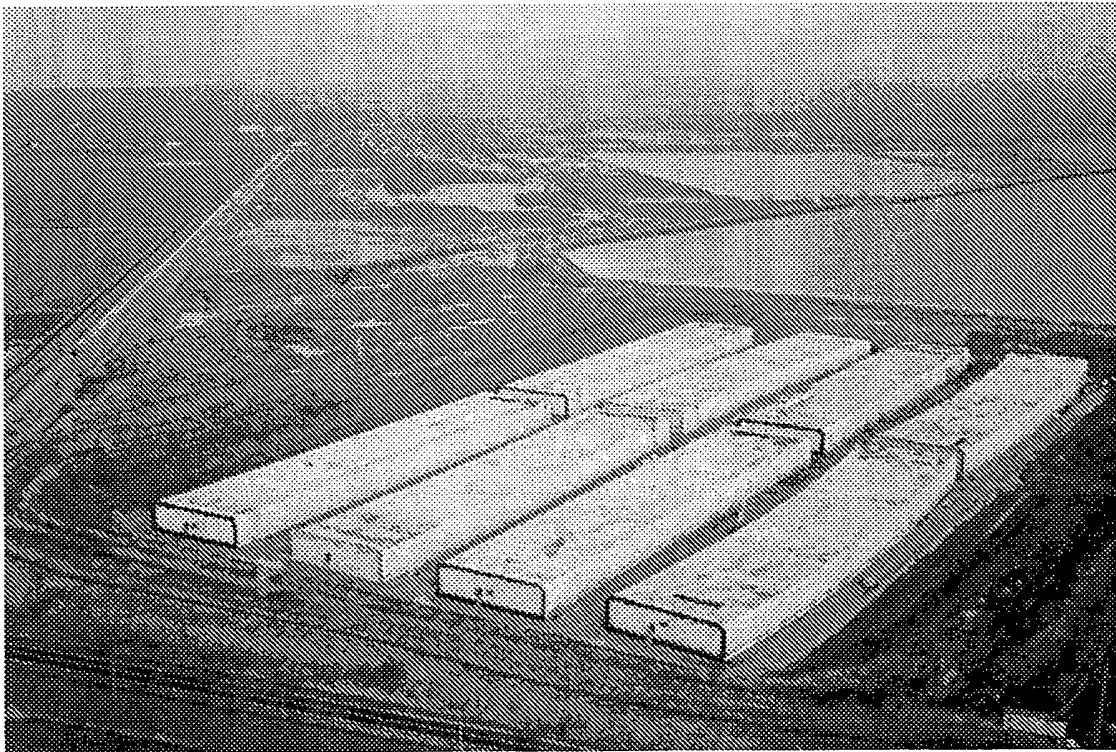
Cover picture: Entrance of tunnel of Öresund link between Denmark and Sweden.

1 Introduction

The Gina gasket and Omega seal are used between the sectional elements of immersed tunnels to prevent water ingress due to external water pressure. This combination of seals not only allows for sealing but also for the transfer of the hydrostatic loads and movements between the tunnel ends due to soil settlement, creep of concrete, temperature effects and if required earthquakes. The designs are generally based on the expected tunnel lifetime of 100 years.

Trelleborg Ridderkerk is the specialist in the design of Gina gaskets and Omega seals. Trelleborg Ridderkerk not only supplies these seals, but upon request also offers site assistance during installation.

Since the early sixties Trelleborg Ridderkerk has supplied a large number of seals for immersed traffic, cooling water, pipeline and cable tunnels in many countries all over the world. This brochure provides technical information for the use and installation of the Gina gasket.



Picture: Casting basin with tunnel elements - Piet Hein tunnel

by G. Coolens, Antwerpen

2 Application of the GINA gasket

An immersed tunnel is normally constructed from structural concrete elements approximately 100-150 meters long, which are manufactured in a casting basin or dry dock. The tunnel elements are provided with temporary bulkheads at both ends to ensure that the element is watertight and capable of floating. On one end of each tunnel element, an endless Gina gasket is mounted. When manufacturing of the tunnel elements is completed, the dock is flooded and the elements floated. Each element is towed to its final position and then immersed. The immersed tunnel element is then pulled firmly up against the preceding immersed element with hydraulic jacks. The initial contact of the Gina should be accomplished using a low pulling force. When the Gina has full contact around the total circumference of the adjacent element, the water between the bulkheads is pumped out. Due to pressure differential between the bulkheads and the hydrostatic pressure on the outside of the tunnel, the Gina profile compresses and seals the joint. A secondary seal, the so called omega seal, is then clamped across the joint on the inside of the tunnel. In general the bulkheads are removed after approval of the pressure test between the Gina and Omega.

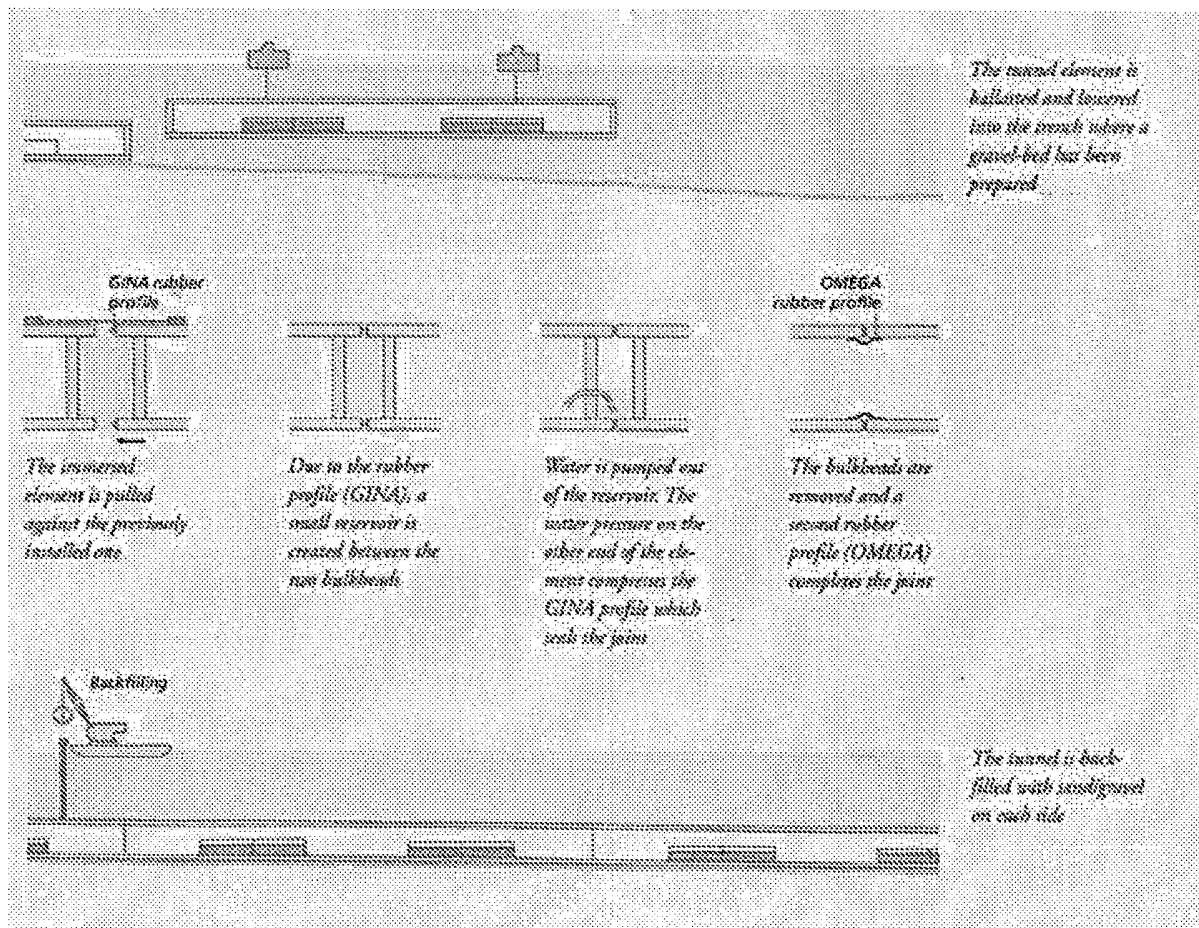


Illustration of Magazine: Design & Construct – Øresund Konsortiet



3 Design philosophy

This chapter presents the design philosophy for Gina gaskets. In order to select a Gina profile the following technical information is required:

- number of joints
- cross section size of steel mounting frames
- lengths of tunnel elements
- water depth at each joint
- tide variations
- specific weight of water
- all movements and gap variations of the joint in axial and lateral directions
- specific conditions for installation

In general Trelleborg Ridderkerk is requested to assist in product selection.

Design specification

The supplier of the Gina gasket needs to show by calculations based on the measured force-compression curves that at all design water pressures, the selected Gina gasket satisfies following conditions within agreed safety limits:

1. transfer of the hydrostatic loads at high water level within the maximum compression capacity of the Gina profile;
2. sealing at all water levels for all joints, including the effect of gap variations due to variation in smoothness/flatness of the tunnel faces, rotation of immersed tunnel elements, creep and shrinkage of the concrete material and temperature effects;
3. calculation of the restoring moments to re-align misalignment of a tunnel element;
4. calculation of the proper functioning of the Gina gasket after re-alignment with respect to prevention of leakage at the gap opening side and prevention of overload at the gap closing side;
5. above mentioned sealing properties should incorporate the effect of relaxation on the rubber material of the seal over the tunnel life time period;
6. the Gina flange construction should be able to withstand additional loads without dislocation, due to shear of the compressed Gina gasket in case of differential tunnel settlement.

Safety against leakage

The supplier should show by calculations, that during the total lifetime of the tunnel, the contact pressure between the Gina and tunnel face is sufficiently larger than the outside water pressure.

Clamping system

The supplier should present calculations for the steel clamping system to show that all stresses and strains of steel clamps and bolts are within specified limits.

Expected tunnel lifetime

For the expected tunnel lifetime period, often at least 100 years, the supplier should show the correct functioning of the Gina gasket system even at the end of this period, by incorporation of the effect of relaxation on the sealing properties.



Materials

The Gina gasket is to be manufactured from a blend of SBR and NR rubber. This material should satisfy the material specifications, as valid at the time of production in the Trelleborg materials programme.

Lifetime of materials

The supplier should show by material tests that the expected material lifetime of the rubber seal exceeds the tunnel lifetime by a considerable margin.

Storage

Supplier should present storage instructions according to the international standard ISO 2230.

Installation manual

The supplier should provide an installation manual to ensure proper installation of the Gina seal.

Quality assurance and control

The supplier should have a Quality System that is certified for engineering and manufacturing of technical rubber products according to standard ISO 9001 and 14001.

References

The supplier should verify and demonstrate their capability to design and manufacture the required type of Gina seals by references for comparable tunnel projects.

4 Product range

Trelleborg Ridderkerk currently has 3 standard types of Gina gaskets, see table below.

Table: Standard range of Gina type

| Type | Drawing | Standard radius [mm] | Standard corners [degrees] | Weight [kg/m] |
|----------------|---------------|----------------------|----------------------------|---------------|
| ETS-130-160 | AA4-96-4317 | 400 | 90 & 135 | 18.3 |
| ETS-180-220 | AA4-96-4318 | 500 | 90 & 135 | 34.9 |
| ETS-200-260 SN | AA4-96-4183 B | 500 | 90 & 135 | 42.4 |

The gaskets are vulcanised in straight lengths to a max. of 12 m. Corner pieces are vulcanised to the required radius and/or angle. Each type of Gina gasket has a standard bending radius. Radii other than the standard radii are possible, but are less economic. The total gasket is constructed from selected straight and curved elements by vulcanising the joints.

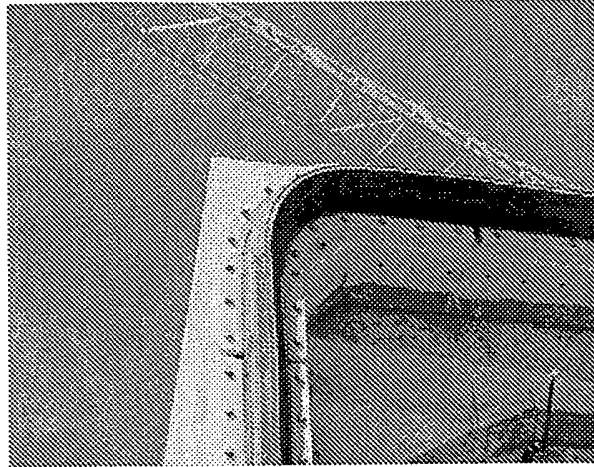
Besides these standard types Trelleborg Ridderkerk has the capability to design and manufacture custom made solutions.

The selected rubber compound is normally a blend of NR (natural rubber) and SBR (styrene-butadiene rubber). The blend combines excellent mechanical properties with low water absorption and good resistance against chemical and bacteriological attack.

The selected rubber should match the required lifetime of the tunnel. The low values for relaxation, i.e. decrease in reaction force at constant deformation, of our compound, provides a desirable long-term behaviour of the sealing system.

5 Clamping system

The gaskets are mounted on the ends tunnel using bolted clamping strips. A typical design of the clamping system is given in appendix 6 for ETS 130-160 and in appendix 7 for ETS 180-220 and 200-260 SN. By request, we are able verify the dimensions of the clamping system for specific cases.



Picture: Top corner of mounted Gina frame – Øresund tunnel

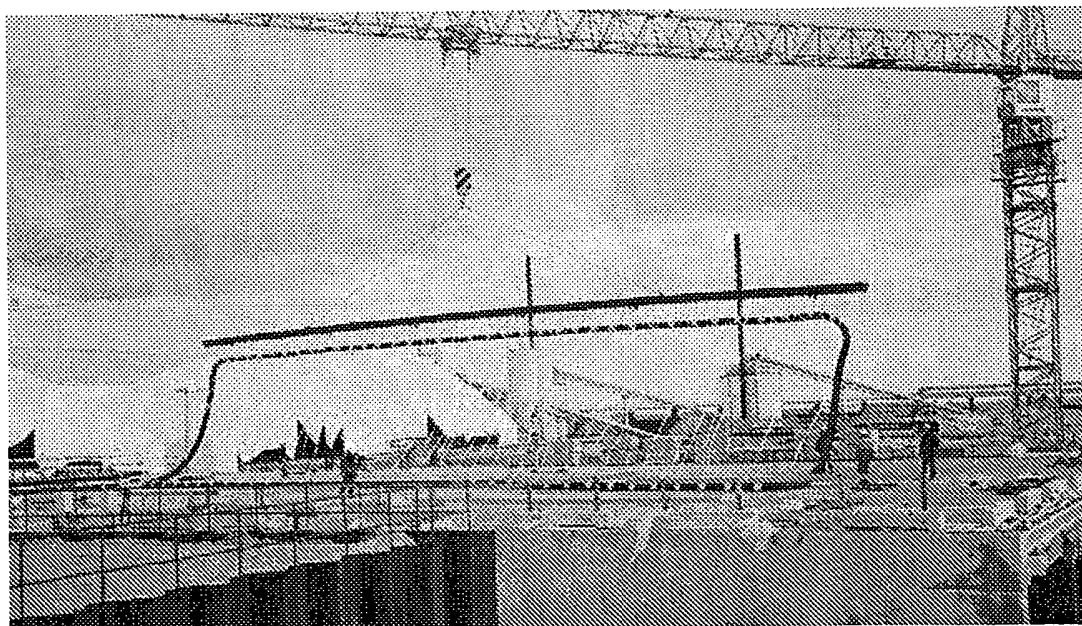
6 Storage, transport & installation

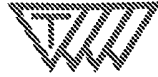
During storage it is important to prevent damage such as ozone cracking. Products damage may also occur during transport or unpacking. Trelleborg Ridderkerk therefore is able to provide storage and transport procedures, which are based on an ISO specification.

In general a specially constructed hoisting beam is used to lift the Gina gasket into place. The gasket should be hung from the hoisting beam by a large number of nylon slings. Extra protection caps may also be required to prevent damage to the relative soft nose section of the Gina profile.

The hoisting operation should be executed very carefully to prevent local damage and overloading of the seal due to its own weight. Trelleborg Ridderkerk is able to provide an installation procedure and guidelines to ensure correct installation. Upon request, supervision of the installation may be carried out by a Trelleborg Ridderkerk specialist.

Picture: Hoisting of Gina frame – Øresund tunnel





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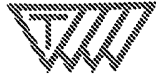
7 Policy quality, environment, safety and health

The policy of Trelleborg Ridderkerk BV is to design, produce and deliver rubber products which are in accordance with the customers' requests, needs and expectations.

The starting point of our policy is the Trelleborg Group policy statement 'Code of Conduct' on our website www.trelleborg.com.

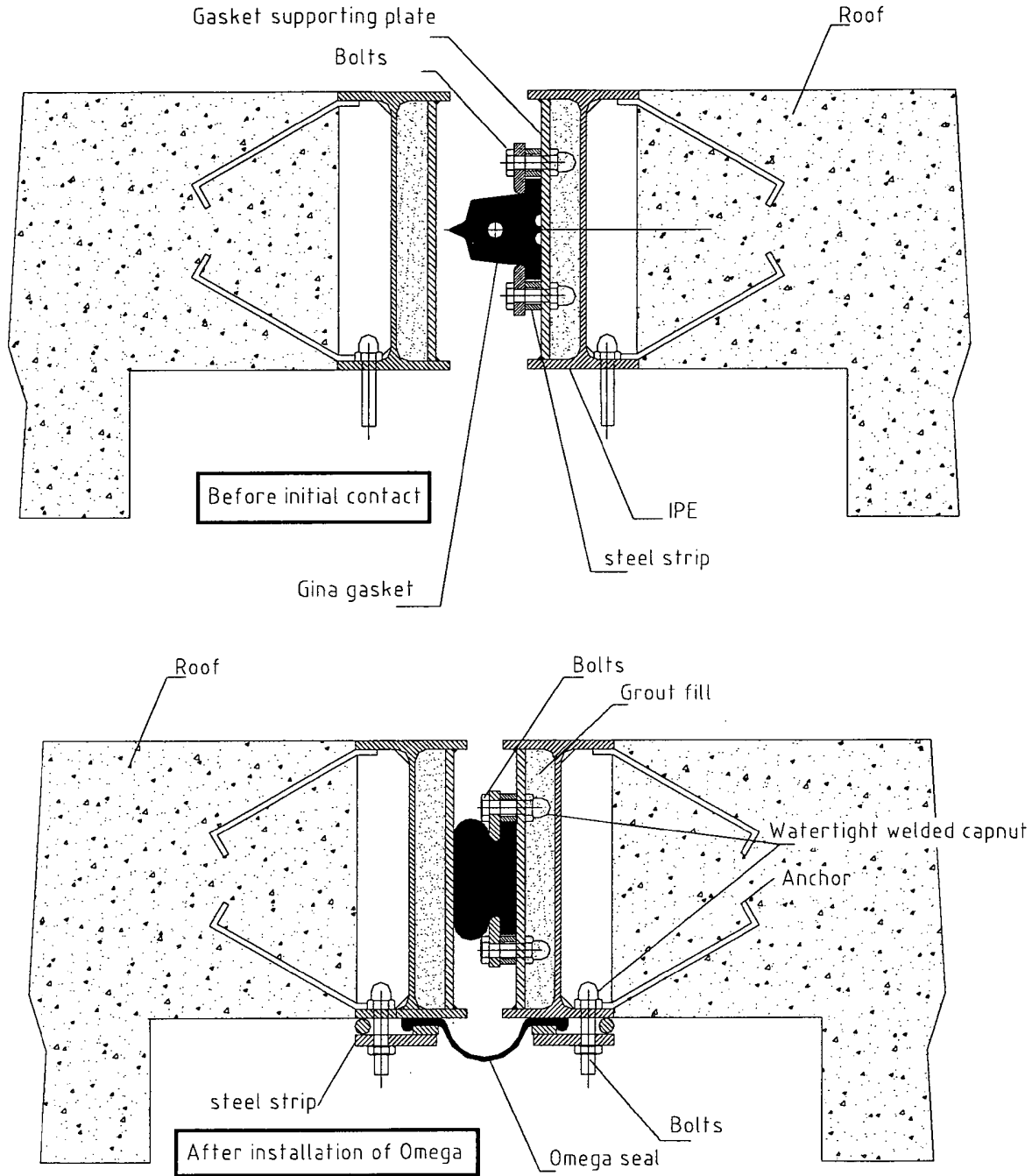
During the development of products and processes the environment, safety and health are integral to the process.

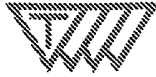
Trelleborg Ridderkerk BV is using an integrated management system which complies to international standards such as ISO 9001, ISO 14001 and SCC**.



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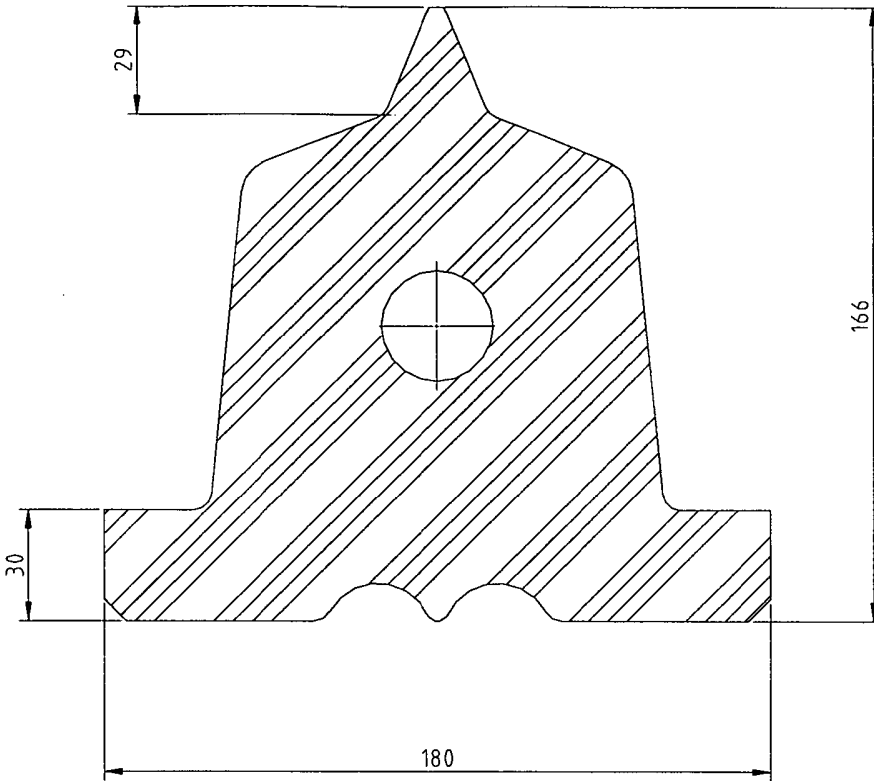
Appendix 1. Gina gasket mounted to the tunnel end



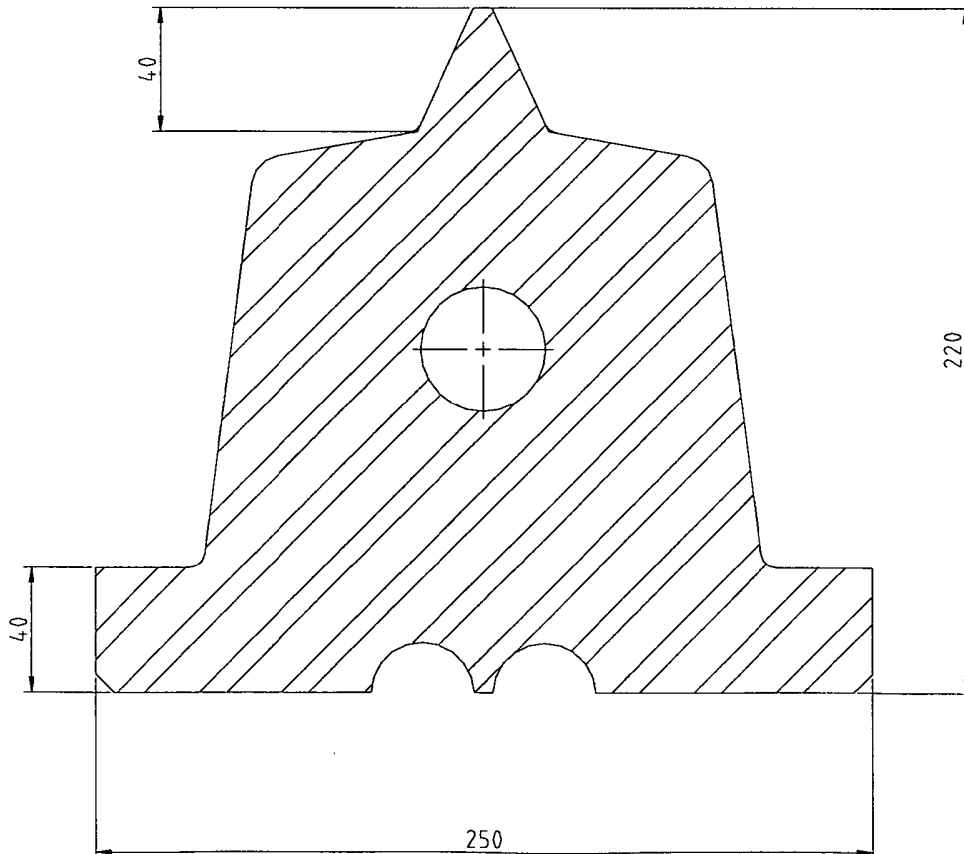


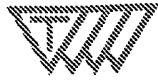
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Appendix 2. GINA-profile: ETS 130-160



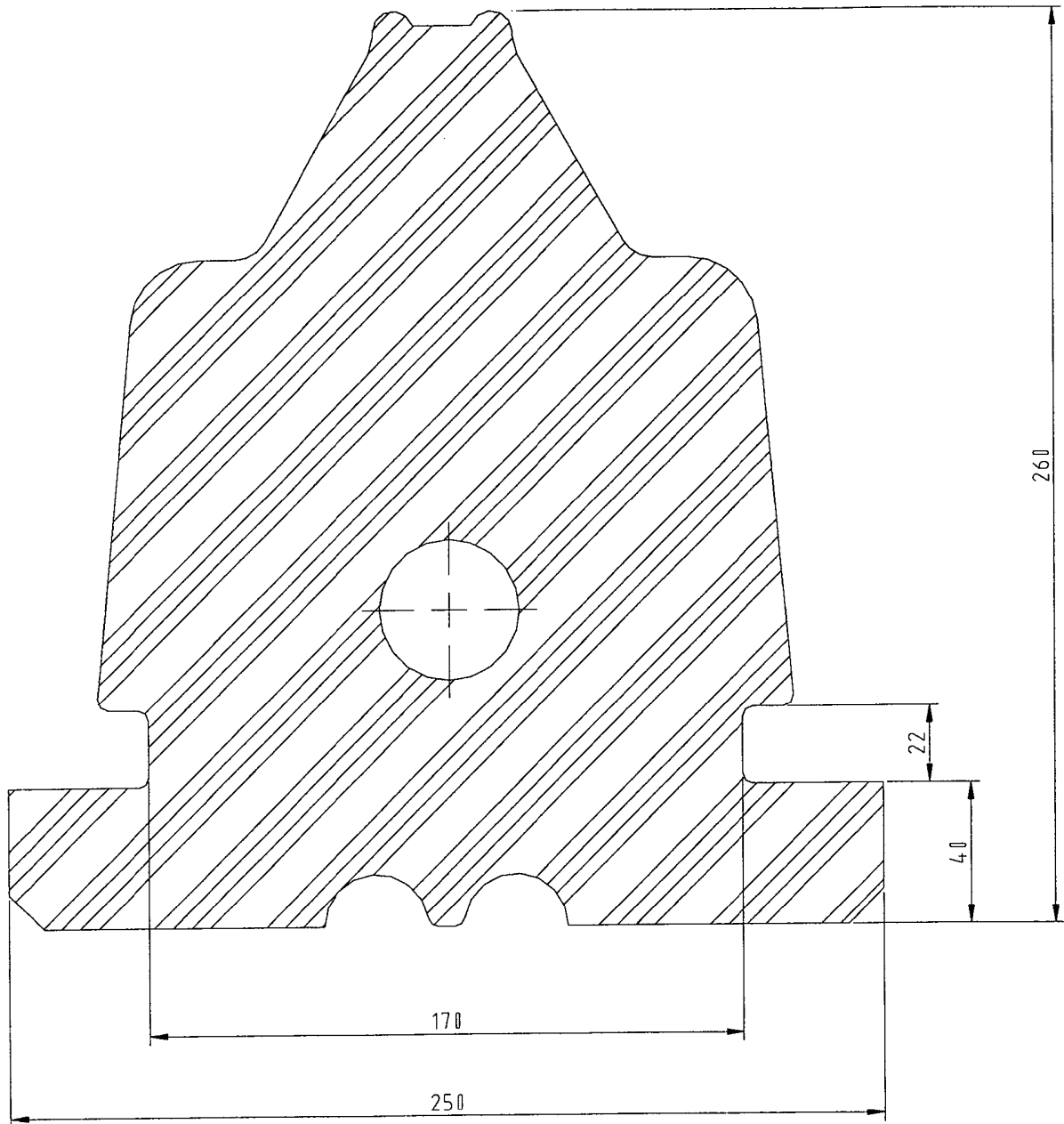
Appendix 3. GINA-profile: ETS 180-220

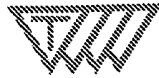




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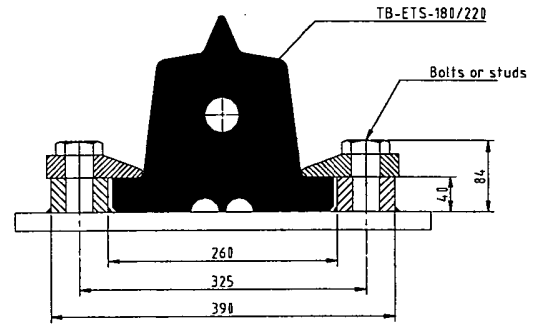
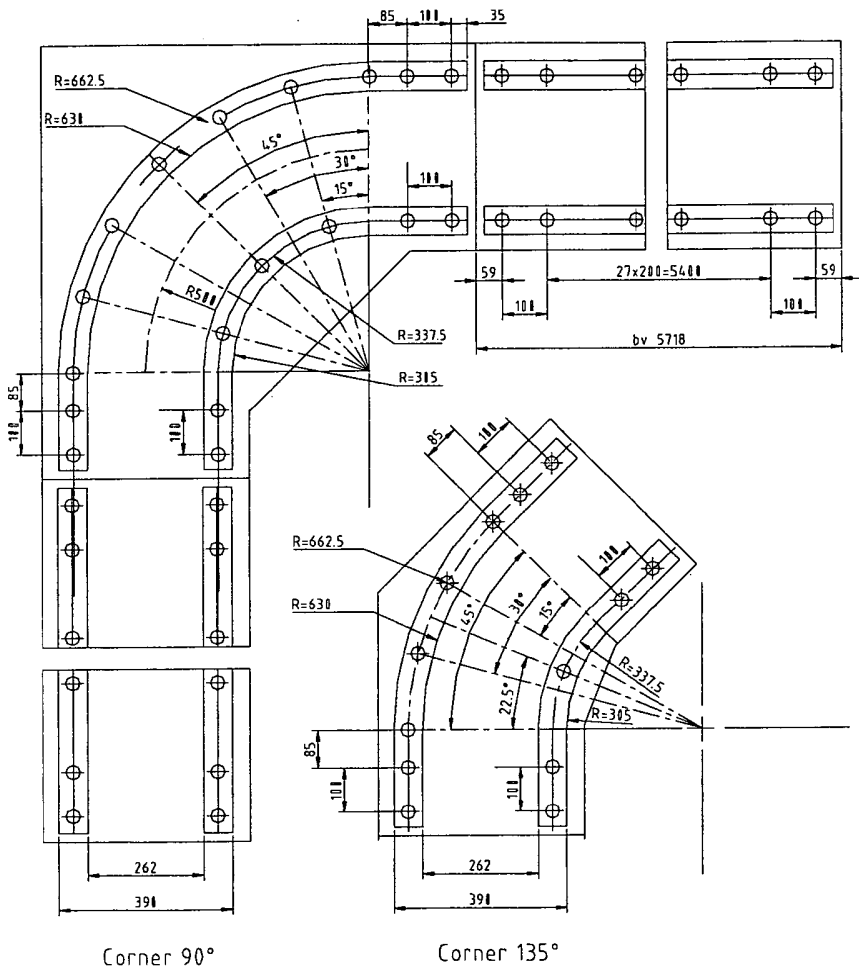
Appendix 4. GINA-profile: ETS 200-260-SN



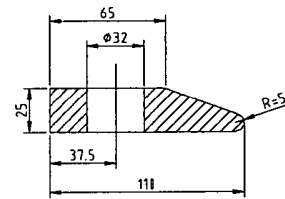


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Appendix 6. Typical clamping system ETS 180-200 & ETS 200-260 SN



Cross section



detail strip



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