(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 060 134**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **26.11.86**

(51) Int. Cl.[4]: **E 03 F 3/06**, E 21 D 11/08, E 21 D 11/04

(21) Application number: **82301192.9**

(22) Date of filing: **09.03.82**

(54) **Lining of tubular structures.**

(30) Priority: **14.03.81 GB 8108058**
28.08.81 GB 8126401

(43) Date of publication of application:
15.09.82 Bulletin 82/37

(45) Publication of the grant of the patent:
26.11.86 Bulletin 86/48

(84) Designated Contracting States:
BE DE FR IT LU NL

(56) References cited:
DE-B-1 191 640
FR-A-1 194 978
FR-A-2 071 769
GB-A-1 188 280
US-A-1 347 247
US-A-1 572 197
US-A-1 642 417
US-A-1 683 025

(73) Proprietor: **DUNLOP LIMITED**
Dunlop House Ryder Street St. James's
London SW1Y 6PX (GB)

(72) Inventor: **Hinton, James Jones**
6 Waingate Bridge Haverigg
Millom Cumbria (GB)
Inventor: **Allen, William Thomas**
45 Fairwell Lane
Burntwood Staffs (GB)
Inventor: **Smith, John Liberty**
19 Attleboro Lane
Water Orton West Midlands (GB)

(74) Representative: **Badger, John Raymond et al**
Dunlop Limited Group Patent Department P.O. Box 504
Erdington Birmingham B24 9QH (GB)

EP 0 060 134 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European patent convention).

Courier Press, Leamington Spa, England.

Description

This invention relates to a method of and means for forming a lining in a preformed tubular structure, and in particular, though not exclusively, to the lining of tunnel-type structures such as sewers.

Many underground tunnels in the UK and overseas, and especially those used as sewers, were constructed some 80 to 150 years ago and it is now found that although the bricks used in construction of the tunnels are still in sound condition in many instances the mortar between the bricks in severely eroded.

In consequence of this erosion a tunnel's ability to withstand external ground pressure is substantially reduced and frequently a localised length of tunnel will collapse thus resulting in much inconvenience and the need for extensive and urgent repair work.

To guard against inadvertent collapse the brickwork can be repointed but this is a very time consuming and expensive operation, particularly for the smaller of the man entry type tunnels in which working space is very restricted.

The alternative approach of forming a new lining within the tunnel has the potential advantage of facilitating provision of a smooth surface having low fluid flow resistance, and also of reducing the requirement for extensive manual work within the restricted space of a tunnel. However, in the currently known lining techniques, the lining structure is relatively expensive, or time consuming to install, or there is a requirement for extensive ground excavation at intervals along the length of the tunnel in order to facilitate maneouvering of the lining structure into the tunnel.

A number of techniques are known for forming a tunnel structure but none are of particular suitability for forming a lining within an existing tunnel structure. Thus in French patent publication FR—A—2071769 there is described a method of making a large diameter tube or pipe by using a series of long length elements which are arranged to lie side-by-side to form the pipe and be held together by means of adhesive. It is described that a suitable material for the elements is ceramics, but because of the inflexible nature of such material the elements are not readily suitable for relining existing tunnel structures especially where there is only restricted access to the existing tunnel structure.

In German patent publication DE—B—1191640 it is described that a tunnel may be formed from a plurality of hollow blocks which are held together by cables extending in a circumferential direction in the resultant tunnel. However, external access is necessary to tension the cables and thus the structure is not suitable for construction from within an existing tunnel structure.

The present invention seeks to provide a method of lining an existing tubular structure, and lining elements therefor, in which the aforedescribed difficulties are mitigated or overcome.

In accordance with one aspect of the present invention a method of lining a tubular structure comprises feeding into the structure a plurality of longitudinally flexible elongate elements (10), at least some of which are of a kind having at least one cavity (16) and an opening (40) in a face member (11) of the element in communication with said cavity (16); arranging the elements to extend substantially parallel with the direction of the length of the structure with said openings (40) facing outwards towards the tubular structure, and with said elements disposed in a side-by-side and interlocking configuration to form a lining which conforms substantially to the internal surface of the tubular structure; and then injecting into said cavities a settable compound of a kind which becomes substantially rigid when set.

In addition to injecting settable compound into said cavities preferably a settable compound is injected between the internal surface of the tubular structure and the external surface of the lining of elongate elements.

The settable compound may be allowed to set before further compound is injected between the tubular structure and elongate elements, or settable compound may be caused to flow substantially simultaneously into the cavities and between the lining and tunnel structure.

Preferably the elongate elements are brought into side-by-side relationship by feeding successive lengths into the tubular structure in such a manner that they slide along and are guided by the edge of an elongate element which is already installed in the tubular structure. Preferably an elongate element is guided during insertion by means which also effects interlocking of successive elements.

Preferably the elongate element has a length substantially greater than the maximum cross-sectional dimension of the tubular structure being lined thereby to facilitate relatively speedy installation of a lining and minimise the need to effect numerous joints between the ends of successive lengths of the elongate elements.

Typically the length of each elongate element employed should be at least ten times, and preferably 50 or more times the maximum cross-sectional dimension of the element. Lengths of 100 metres or more are envisaged. Where, however, the requirements of the lining dictate otherwise, e.g. gaps in the lining for side entrant tunnels, use may be made of some elongate elements of shorter length.

Particularly where the elongate element is of a very long length, lubricant means, either a low friction material or lubricating fluid, may be employed to facilitate sliding movement of one element into position alongside another element.

Relative movement of an assembled pair of interlocked elements may be restrained by the use of an adhesive. Accordingly those elements which form a roof lining may be supported by adjacent elements with a need for only minimal, if any, temporary support. Preferably the adhesive is of a slow acting kind and incorporated in or serving as the aforementioned lubricant.

The elongate elements may be fed singly into

the tubular structure or two or more elements may be preassembled together in side-by-side relationship before being fed into the tubular structure.

Suitable settable compound for filling the cavities of the elongate elements to effect reinforcement thereof include:

grouts including cement based mixtures, and polymer and/or resin based materials.

Suitable settable compounds for injection between the lining of elongate elements and the internal surface of the tubular structure include those mentioned in the preceding paragraph.

In accordance with another aspect of the present invention an elongate element for use in lining a tubular structure comprises a pair of face members (11, 12) maintained spaced-apart to define therebetween at least one cavity (16) into which a settable compound may be injected, and a pair of substantially longitudinally extending formations (13, 14) at opposite edges of the face members thereby to facilitate interlocking said elongate element (10) in parallel side-by-side relationship with another elongate element (10, 20) characterised in that said element is longitudinally flexible and has an opening (40) provided in one of the face members (11) in communication with the cavity (16) for the flow of settable compound.

Preferably said formations are complementary shaped such that a pair of said elements may be interlocked directly together. Alternatively however a pair of elements with similar formations complementary to those at the edges of said pair of elements to be joined. The third element may be of a kind as defined in the preceding paragraph or it may be of a different construction.

The substantially longitudinally extending formations may serve also as guide means to facilitate one elongate member being slid into interlocking side-by-side relationship with another elongate element.

At least one of a pair of formations may be formed of a low friction material, or provided with means for facilitating lubrication of movement between two complementary shaped formations.

One of the formations may be hollow, or otherwise shaped such that a lubricant may be supplied therethrough to facilitate relative sliding movement between the complementary shaped formation.

Preferably said cavity within the element extends substantially continuously along the length thereof. The face members of the elements may be maintained spaced apart by dividers extending continuously along the length of the element, and said dividers may serve to define in part two or more cavities.

The elements may be of different shapes; elements of one shape may have a longitudinally extending rib-like formation and act as spacers which contact the wall of the tubular structure and maintain other successive elements spaced therefrom.

Not all of the elements used to form the lining of a tunnel need be elements of a kind in accordance with the present invention. Thus, some of the elongate elements, such as those used as wall spacers, need not be of a kind having cavities.

Suitable materials for forming the elongate elements include polyethylene, polypropylene, polycarbonates, and unplasticised PVC. Of these it is preferred for many applications to employ materials such as unplasticised PVC which are relatively light weight whilst also being of a relatively low coefficient of friction such that complementary shaped formations constructed integral with the elongate element readily facilitate relatively sliding movement of the two elements into side-by-side interlocking relationship.

Although the elongate element should be substantially rigid so as to be adequately self-supporting to form the lining of a tubular structure, at least when cavities thereof are filled with a settable compound which has been allowed to set, the element may be sufficiently flexible along its length so as to be coiled on a large diameter storage drum from which it may conveniently be unwound for feeding into the tubular structure. For this purpose the formation of an elongate element from a pair of face members which are maintained spaced apart by the aforementioned dividers, which preferably are relatively thin as compared with the face members, is particularly advantageous insofar as the resulting construction of the element is sufficiently rigid to be self-supporting when assembled to form the lining of a tubular structure, has a good strength to weight ratio, and is also capable of being wound on a large drum for storage prior to use.

If the materials or other features of the element result in it being insufficiently flexible for storage on a drum, the element(s) may be supplied in preselected discrete lengths.

In the case of those elongate elements of a kind having a cavity, openings may be provided in a wall of the cavity such that in use settable compound injected into said cavity can flow therefrom into any space between the lining and the inner surface of a tubular structure, e.g. a tunnel wall. Thus back grouting is effected substantially simultaneously with filling of the cavities.

Effecting back grouting substantially simultaneous with filling of the cavities results in the lining assembly being required to withstand external, or back, pressure before the lining elements have been strengthened by setting of the compound therein. The consequential need to temporarily support the lining elements may be reduced or avoided in some applications by providing openings of a suitable size and at a sufficient frequency to obviate the need to create localised grouting pressures as great as those required when the back grouting of a long length is effected from a single grout entry location.

To facilitate the flow of grout between the lining elements and internal surface of the tubular structure in the case of spacer elements, of a kind having rib-like spacer formations to space the

lining from the tubular structure, the spacer formations should be substantially discontinuous in the longitudinal direction.

The use of a substantially discontinuous spacer formation results in interconnection of the settable compound, either side of the spacer formation, at a substantial number of longitudinally spaced locations. When the grout has set there results a mechanical interlock between the grout and elongate elements by virtue of the spacer formations, thus providing a strong composite lining structure.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings in which:—

Figure 1 shows in perspective an end portion of an elongate lining element;

Figure 2 shows in perspective an end portion of an elongate spacer element;

Figure 3 is a cross-section of part of a tunnel structure lined with the elements of Figures 1 and 2;

Figure 4 is a perspective view of part of a tunnel lining assembly formed from the elements of Figures 1 and 2;

Figure 5 is a perspective view of a connector for longitudinally connecting lining elements;

Figure 6 is a perspective view of an end portion of a space element for use alongside the connector of Figure 5;

Figure 7 shows in perspective part of a lining element for conforming to a side entry junction;

Figure 8 shows in perspective an end portion of another elongate lining element in accordance with the present invention;

Figure 9 shows in perspective an end portion of another elongate spacer element in accordance with the present invention, and

Figure 10 is a view similar to that of Figure 9 of yet another elongate spacer element in accordance with the invention.

An elongate lining element 10 (see Figure 1) for lining a tunnel comprises a pair of face members 11, 12 maintained spaced apart by a pair of edge formations 13, 14 and a pair of wall dividers 15. The edge formations and wall dividers extend continuously along the length of the lining element and define therebetween, between the face members 11, 12, three longitudinally continuous cavities 16 each of substantially rectangular shape in cross-section.

One of the edge formations, 13, comprises a tubular formation 17 having a smooth external surface of a diameter slightly less than the spacing of the outer surfaces of the face members 11, 12. The edge formation 13 additionally comprises an edge strip 18 which is integral with the tubular formation 17 and extends between the neighbouring longitudinal edges of the face members.

The other edge formation 14 is in the form of a longitudinally extending groove the internal surface of which has a shape complementary to that of the tubular formation 17 such that the formation 13 of another element may slide in and be guided by edge formation 14.

The lining element above described is manufactured from unplasticised polyvinyl chloride (PVC) by extrusion, this material affording the edge formations 13, 14 a low coefficient of friction. The described element has a width of 150 mm and thickness of 20 mm.

An elongate spacer element 20 for interconnecting a pair of lining elements and maintaining them slightly spaced from a tunnel wall is shown in Figure 2.

The spacer element 20 comprises a side-by-side pair of longitudinally extending formations 21, 22 corresponding respectively to the tubular formation 17 and edge formation 14 of the aforedescribed lining element 10. The spacer element additionally comprises a formation 23 which is T-shaped in cross-section and the head portion 24 of which is maintained spaced from but parallel with a plane containing the formations 21, 22 by a tail portion 25.

The spacer element is also manufactured from PVC by extrusion.

To line a tunnel long lengths of the elongate lining and spacer elements may be stored on a pair of drums, and said drums positioned at the head of a trench cut in the ground to have a gradual slope extending down to an access point in the tunnel.

A length of the lining element is then drawn into the tunnel from the drum, the length being cut either to that of the length of the tunnel under renovation or the maximum length for which elements can satisfactorily be slid into engagement, whichever is the greater. The spacer element is then drawn from its supply drum and fed into the tunnel with an edge formation of the spacer element co-operating with an edge formation of the lining element so as to effect guiding of the spacer element relative to the lining element and interlocking therewith.

Alternatively where the elements are provided in preselected discrete lengths they may be fed into the tunnel in a similar manner to result in the required interlocking.

Particularly where elements of long length are being interconnected, liquid lubricant may be supplied through the tubular formation 17 of the lining element (or corresponding formation of the spacer element) in such manner as to apply lubricant to the surface of the complementary groove formation just prior to sliding thereof over the outer surface of the tubular formation.

Successive lengths of the two types of elements are then supplied so as to result, for most installations, in an alternating series of spacer and lining elements. Where, however, there is no requirement for a significant thickness of grout between the tunnel and lining, such as for example at the floor regions, lining elements may be directly interconnected.

Figure 3 shows the upper part of a tunnel 28 lined with an alternating series of lining elements 10 and spacer elements 20 with the spaces be-

tween the lining elements 10 and tunnel wall and also the lining elements per se being filled with grout 29.

To facilitate lining of the roof portion of the tunnel use may be made of temporary supports for the elements, these supports being removed after the required number of linings have all been inserted.

Alternatively or additionally successive elements may be restrained from hinging one relative to the other by means of adhesive acting between the complementary formations of a pair of the elements. The adhesive may be applied instead of the lubricant, may act as the lubricant, or be an additive to the lubricant fed through the tubular formations in the above-described manner when necessary to facilitate relative sliding movement.

Figure 4 shows an assembly of lining and spacer elements for lining the roof and side parts of a tunnel.

Where it is required to line a length of tunnel longer than the length of elements which can readily be slid one relative to the other, use may be made of end connectors 30 (see Figure 6) for joining the ends of successive lining elements. Each connector has edge formations 31, 32 corresponding to the formations 13, 14 of a lining element, and tapered tubular location portions 33 for engagement in the cavities 16 of a lining element. The connector 30 is of a hollow construction, typically formed by joining two injection moulded sections (having a joint line shown as 34), and thus permits grout to be fed directly from the cavity 16 or tubular formation of one element into another element.

Where spacer elements 20 interconnect a pair of the connector elements it is preferable that the T-shaped formation 23 is cut-away (see Figure 5) for a length corresponding to the longitudinal length of the connector. Thus when grout is fed to the space between the lining and tunnel wall there results a continuous reinforcing hoop of the grout around the joint region.

Having assembled the required lining and spacer elements, one end of each cavity bore of each tubular formation is blanked off (except for a small air vent orifice) and grout is pressure injected into the bores and cavities. When this has set it results in a substantial increase in strength of the lining, and further grout material can then be injected between the lining and tunnel wall to fill the gap therebetween and crevices in the tunnel brickwork without any risk of collapse of the lining. If it is required to provide a lining at a tunnel junction preferably the elements are either pre-cut (see Figure 7) or cut in situ in the tunnel before grout is injected either into the elements or between the elements and tunnel wall.

An elongate lining element in accordance with a further aspect of the invention is shown in the accompanying Figure 8, in which like reference numerals correspond to those used for similar details as shown in Figure 1.

One of the face members 11 is provided with three series of openings 40. Each series of openings 40 is aligned with a respective one of the three cavities 16, and the positions of the openings in adjacent series are staggered with respect to the longitudinal direction of the element.

In use the openings 40 provided in the wall of the cavities 16 enable settable compound injected into said cavitity to flow therefrom into the space between the lining and the inner surface of a tubular structure, e.g. a tunnel wall. Thus back grouting is effected substantially simultaneously with filling of the cavities.

Two embodiments of elongate elements having spacer formations which are substantially discontinuous are shown in part and in perspective in the accompanying Figures 9 and 10.

In Figure 9 there is shown an element 50 having a series of spacer formations 51 each comprising a head portion 52 for bearing against a tunnel wall and a tail portion 53 which interconnects between a head portion and main body portion 54 of the element.

In the embodiment of Figure 10 the tail portions 53 correspond to those of Figure 9 but the head portion 55 is longitudinally continuous. This type of construction is particularly useful when lining tubular structures having irregular lining surfaces because the continuous head portion acts as a smooth skid in the event of sliding contact between the element and inner surface of the tubular structure.

In a further embodiment, not illustrated, the spacer formations 51 may be provided on an elongate element of a kind having cavities, and preferably of a kind as shown in Figure 8 in which openings are provided for the flow of grout from a cavity.

The head portion(s) 52, 55 of the spacer formations of the preceding two above-described embodiments are particularly effective to provide a good mechanical interlock between the elements and grouting, whilst the discontinuous nature of the spacer formations permits a substantial degree of continuity of grouting material in a peripheral direction perpendicular to the length of the lining.

Claims

1. Method of lining a tubular structure characterised in that it comprises:—

feeding into the structure a plurality of longitudinally flexible elongate elements (10) at least some of which are of a kind having at least one cavity (16) and an opening (40) in a face member (11) of the element in communication with said cavity (16); arranging the elements to extend substantially parallel with the direction of the length of the structure with said openings (40) facing outwards towards the tubular structure, and with said elements disposed in a side-by-side and interlocking configuration to form a lining which conforms substantially to the internal surface of the tubular structure; and then

injecting into said cavities a settable compound of a kind which becomes substantially rigid when set.

2. Method according to claim 1 characterised in that settable compound is injected into a cavity (16) to flow through the opening (40) to between the internal surface of the tubular structure and the external surface of the lining formed by said elongate elements (10).

3. Method according to claim 1 or claim 2 characterised in that settable compound is injected between the internal surface of the tubular structure and the external surface of the lining formed by said elongate elements (10).

4. Method according to claim 3 characterised in that settable compound injected into the elements is allowed to set before settable compound is injected between the tubular structure and elongate elements.

5. Method according to any one of the preceding claims characterised in that the elongate elements (10) are brought into side-by-side relationship by feeding successive lengths into the tubular structure in such manner that they slide along and are guided by the edge of an element already installed in the tubular structure.

6. Method according to claim 5 characterised in that lubricant is employed to facilitate sliding movement of one element into position alongside another element.

7. Method according to any one of the preceding claims characterised in that relative movement of an assembled pair of interlocking elements is restrained by the use of an adhesive.

8. Method according to claim 7 characterised in that said adhesive is of a slow acting kind.

9. Method according to claim 7 or claim 8 characterised in that said adhesive is incorporated in or serves as the lubricant.

10. Method according to any one of the preceding claims characterised in that the lining of elongate elements comprises elements (20) of a kind each comprising a longitudinally extending rib-like formation (23) arranged in the tubular structure in interlocked relationship with other elongate elements (10) with the rib-like formations arranged to lie outwards of the lining whereby said other elongate elements (10) are maintained spaced from the internal surface of the tubular structure.

11. Elongate element for use in lining a tubular structure comprising a pair of face members (11, 12) maintained spaced-apart to define therebetween at least one cavity (16) into which a settable compound may be injected, and a pair of substantially longitudinally extending formations (13, 14) at opposite edges of the face members thereby to facilitate interlocking said elongate element (10) in parallel side-by-side relationship with another elongate element (10, 20) characterised in that said element is longitudinally flexible and has an opening (40) provided in one of the face members (11) in communication with the cavity (16) for the flow of settable compound.

12. Elongate element according to claim 11 characterised in that said longitudinally extending formations (13, 14) serve also as guide means for facilitating sliding of one elongate member (10) into interlocking side-by-side relationship with another elongate element (10, 20).

13. Elongate element according to claim 11 or claim 12 characterised in that at least the surface of at least one of a pair of formations (13, 14) is formed of low friction material.

14. Elongate element according to any one of claims 11 to 13 characterised in that said element is provided with a hollow longitudinally extending formation (17) for supply of lubricant therethrough.

15. Elongate element according to any one of claims 11 to 14 wherein the face members (11, 12) of the elements (10) are maintained spaced-apart by dividers (15) which extend along the length of the element such that said dividers (15) serve to define in part two or more cavities (16) characterised in that a plurality of longitudinally extending series of openings are provided in one of the face members (11), each series being provided in communication with a respective cavity (16).

16. Elongate element according to any one of claims 11 to 15 characterised in that it comprises a longitudinally extending rib-like formation (51).

17. Elongate element according to claim 16 characterised in that said rib-like formation (51) comprises a longitudinally continuous head portion (52) and a longitudinally discontinuous tail portion (53) between said head portion and the remainder (54) of the element.

18. Tunnel lining characterised in that it comprises a plurality of elongate elements (10) according to any one of claims 11 to 17.

19. Tunnel lining according to claim 18 characterised in that it comprises additionally an elongate element (20, 50) provided with a longitudinally extending rib-like formation (23, 51) arranged to maintain other elongate elements (10) spaced from the internal surface of a tunnel structure.

20. Tunnel lining according to claim 19 characterised in that said rib-like formation (51) is longitudinally discontinuous.

Revendications

1. Procédé de garnissage d'une structure tubulaire, caractérisé en ce qu'il consiste à introduire dans la structure une pluralité d'éléments allongés (10) longitudinalement flexibles et dont au moins certains d'entre eux sont d'un type comportant au moins une cavité (16) et une ouverture (40) mélangée dans une partie frontale (11) de l'élément en communication avec ladite cavité; à disposer les éléments de manière qu'ils s'étendent sensiblement parallèlement à la direction de la longueur de la structure de façon que lesdites ouvertures (40) soient dirigées vers l'extérieur en direction de la structure tubulaire, et avec lesdits éléments placés côte à côte et dans une configuration de liaison mutuelle pour former un garnissage qui épouse sensiblement le profil de la surface interne de la structure tubulaire; et ensuite

à injecter dans lesdites cavités un composé durcissable d'un type devenant sensiblement rigide lors de la prise.

2. Procédé selon la revendication 1, caractérisé en ce qu'un composé durcissable est injecté dans une cavité (16) de manière à s'écouler par l'intermédiaire de l'ouverture (40) jusqu'entre la surface interne de la structure tubulaire et la surface externe du garnissage formé par lesdits éléments allongés (10).

3. Procédé selon la revendication 1 ou la revendication 2, caractérisé en ce qu'un composé durcissable est injecté entre la surface interne de la structure tubulaire et la surface externe du garnissage formé par lesdits éléments allongés (10).

4. Procédé selon la revendication 3, caractérisé en ce que du composé durcissable injecté dans les éléments peut prendre avant que du composé durcissable soit injecté entre la structure tubulaire et des éléments allongés.

5. Procédé selon une quelconque des revendications précédentes, caractérisé en ce que les éléments allongés (10) sont placés côte à côte en introduisant des tronçons successifs dans la structure tubulaire d'une manière telle qu'ils coulissent le long et soient guidés par le bord d'un élément déjà installé dans la structure tubulaire.

6. Procédé selon la revendication 5, caractérisé en ce qu'un lubrifiant est utilisé pour faciliter le mouvement de glissement d'un élément jusque dans une position située à côté d'un autre élément.

7. Procédé selon une quelconque des revendications précédentes, caractérisé en ce qu'un mouvement relatif de deux éléments qui ont été assemblés l'un avec l'autre est empêché par utilisation d'un adhésif.

8. Procédé selon la revendication 7, caractérisé en ce que ledit adhésif est d'un type à action lente.

9. Procédé selon la revendication 7 ou la revendication 8, caractérisé en ce que ledit adhésif est incorporé dans le lubrifiant ou bien sert de lubrifiant.

10. Procédé selon une quelconque des revendications précédentes, caractérisé en ce que le garnissage en éléments allongés comprend des éléments (20) d'un type comprenant chacun une partie profilée (23) en forme de nervure s'étendant longitudinalement et disposée dans la structure tubulaire de manière à entrer en relation d'assemblage avec d'autres éléments allongés (10) dont les parties profilées (23) en forme de nervures sont disposées de façon à être placées à l'extérieur du garnissage, de telle sorte que lesdits autres éléments allongés (10) soient maintenus espacés de la surface interne de la structure tubulaire.

11. Elément allongé utilisable dans le garnissage d'une structure tubulaire, caractérisé en ce qu'il comprend une paire de parties frontales (11, 12) maintenues espacées l'une de l'autre pour définir entre elles au moins une cavité (16) dans laquelle un composé durcissable peut être injecté, et une paire de parties profilées (13, 14) s'étendant sensiblement longitudinalement sur des bords opposés des parties frontales de façon à faciliter ainsi un assemblage mutuel dudit élément allongé (10), dans une relation parallèle et côte à côte, avec un autre élément allongé (10, 20), caractérisé en ce que ledit élément est longitudinalement flexible et comporte une ouverture (40) ménagée dans une des parties frontales (11) en communication avec la cavité (16) pour l'écoulement du composé durcissable.

12. Elément allongé selon la revendication 11, caractérisé en ce que lesdites parties profilées (13, 14) s'étendant longitudinalement servent également de moyens de guidage pour faciliter le glissement d'un élément allongé (10) dans une relation d'assemblage côte à côte avec un autre élément allongé (10, 20).

13. Elément allongé selon la revendication 11 ou la revendication 12, caractérisé en ce qu'au moins la surface d'au moins une des deux parties profilées (13, 14) est formée d'un matériau à faible coefficient de frottement.

14. Elément allongé selon une quelconque des revendications 11 à 13, caractérisé en ce que ledit élément est pourvu d'une partie profilée creuse (17) s'étendant longitudinalement pour recevoir du lubrifiant.

15. Elément allongé selon une quelconque des revendications 11 à 14, dans lequel les parties profilées (11, 12) des éléments (10) sont maintenues espacées l'une de l'autre par des parties séparatrices (15) qui s'étendent sur la longueur de l'élément de telle sorte que lesdites parties séparatrices (15) servent à définir au moins deux cavités ou plus (16), caractérisé en ce que plusieurs séries, s'étendant longitudinalement, d'ouvertures sont ménagées dans une des parties frontales (11), chaque série étant disposée en communication avec une cavité respective (16).

16. Elément allongé selon une quelconque des revendications 11 à 15, caractérisé en ce qu'il comprend une partie profilée en forme de nervure (51) s'étendant longitudinalement.

17. Elément allongé selon la revendication 16, caractérisé en ce que ladite partie profilée en forme de nervure (51) comprend une portion de tête (52) longitudinalement continue et une portion de queue (53) longitudinalement discontinue et placée entre ladite portion et le reste (54) de l'élément.

18. Garnissage de tunnel caractérisé en ce qu'il comprend une pluralité d'éléments allongés (10) conformes à une quelconque des revendications 11 à 17.

19. Garnissage de tunnel selon la revendication 18, caractérisé en ce qu'il comprend additionnellement un élément allongé (20, 50) pourvu d'une partie profilée en forme de nervure (23, 51) s'étendant longitudinalement et agencée pour maintenir d'autres éléments allongés (10) espacés de la surface interne d'une structure de tunnel.

20. Garnissage de tunnel selon la revendication 19, caractérisé en ce que ladite partie profilée en forme de nervure (51) est longitudinalement discontinue.

Patentansprüche

1. Verfahren zum Auskleiden eines rohrförmigen Bauwerkes, dadurch gekennzeichnet, daß in das Bauwerk eine Vielzahl von in Längsrichtung flexiblen langgestreckten Elementen (10) eingeführt wird, von denen wenigstens einige wenigstens einen Hohlraum (16) und eine Öffnung (40) in einem Stirnelement (11) der Elemente in Verbindung mit dem Hohlraum (16) aufweisen, die Elemente so angeordnet werden, daß sie im wesentlichen parallel zur Richtung der Längserstreckung des Bauwerkes verlaufen, die Öffnungen (40) nach außen zum rohrförmigen Bauwerk gerichtet sind und die Elemente Seite an Seite und in einer gegenseitig verriegelten Form angeordnet sind, so daß eine Auskleidung gebildet ist, die im wesentlichen mit der Innenfläche des rohrförmigen Bauwerkes konform geht, und daß anschließend in die Hohlräume eine aushärtbare Masse eingespritzt wird, die dann, wenn sie aushärtet, im wesentlichen starr wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die aushärtbare Masse in einen Hohlraum (16) eingespritzt wird, so daß sie durch die Öffnung (40) in den Raum zwischen der Innenfläche des rohrförmigen Bauwerkes und der Außenfläche der Auskleidung fließt, die durch die langgestreckten Elemente (10) gebildet wird.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die aushärtbare Masse in den Raum zwischen der Innenfläche des rohrförmigen Bauwerkes und der Außenfläche der Auskleidung eingespritzt wird, die von den langgestreckten Elementen (10) gebildet wird.

4. Verfahren nach Anspruch 3, dadurch gekennzeichnet, daß die aushärtbare Masse, die in die Elemente eingespritzt wird, aushärten gelassen wird, bevor die aushärtbare Masse in den Raum zwischen dem rohrförmigen Bauwerk und den langgestreckten Elementen eingespritzt wird.

5. Verfahren nach einen der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die langgestreckten Elemente (10) in eine Anordnung Seite an Seite dadurch gebracht werden, daß aufeinanderfolgende Stücke in das rohrförmige Bauwerk derart eingeführt werden, daß sie an der Kante eines bereits im rohrförmigen Bauwerk angeordneten Elementes entlang gleiten und durch diese Kante geführt werden.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß ein Gleitmittel verwandt wird, um die Gleitbewegung eines Elementes in seine Lage längsseits eines anderen Elementes zu erleichtern.

7. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Relativbewegung eines montierten Paares von Verriegelungselementen durch die Verwendung eines Klebemittels beschränkt wird.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß das Klebemittel ein langsam wirkendes Klebemittel ist.

9. Verfahren nach Anspruch 7 oder 8, dadurch gekennzeichnet, daß das Klebemittel im Gleitmittel enthalten ist oder als Gleitmittel dient.

10. Verfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Auskleidung aus den langgestreckten Elementen Elemente (20) umfaßt, die jeweils ein längsverlaufendes rippenartiges Gebilde (23) umfassen, und in dem rohrförmigen Bauwerk mit anderen langgestreckten Elementen (10) verriegelt angeordnet sind, wobei die rippenartigen Gebilde so angeordnet sind, daß sie von der Verkleidung nach außen verlaufen, wodurch die anderen langgestreckten Elemente (10) im Abstand von der Innenfläche des rohrförmigen Bauwerks gehalten werden.

11. Langgestrecktes Element zur Verwendung beim Auskleiden eines rohrförmigen Bauwerkes, dadurch gekennzeichnet, daß es zwei Stirnelemente (11, 12), die im Abstand voneinander gehalten sind, um dazwischen wenigstens einen Hohlraum (16) zu begrenzen, in den eine aushärtbare Masse eingespritzt werden kann, und zwei im wesentlichen längsverlaufende Gebilde (13, 14) an den gegenüberliegenden Rändern der Stirnelemente umfaßt, um dadurch die Verriegelung des langgestreckten Elementes (10) parallel Seite an Seite mit einem anderen langgestreckten Element (10, 20) zu erleichtern, und daß das Element in Längsrichtung flexibel ist und eine Öffnung (40) aufweist, die in einem der Stirnelemente (11) in Verbindung mit dem Hohlraum (16) für den Fluß der aushärtbaren Masse vorgesehen ist.

12. Langgestrecktes Element nach Anspruch 11, dadurch gekennzeichnet, daß die längsverlaufenden Gebilde (13, 14) auch als Führungseinrichtung zum Erleichtern des Gleitens eines langgestreckten Elementes (10) in eine verriegelte Seite-an-Seite-Lage mit einem anderen langgestreckten Element (10, 20) dient.

13. Langgestrecktes Element nach Anspruch 11 oder 12, dadurch gekennzeichnet, daß wenigstens die Außenfläche von wenigstens einem von zwei Gebilden (13, 14) aus einem Material mit niedriger Reibung gebildet ist.

14. Langgestrecktes Element nach einem der Ansprüche 11 bis 13, dadurch gekennzeichnet, daß das Element mit einem hohlen längsverlaufenden Gebilde (17) versehen ist, um dahindurch ein Gleitmittel zuzuführen.

15. Langgestrecktes Element nach einem der Ansprüche 11 bis 14, wobei die Stirnelemente (11, 12) der Elemente (10) im Abstand durch Teilstücke (15) gehalten sind, die längs des Elementes verlaufen, so daß die Teilstücke (15) dazu dienen, zum Teil zwei oder mehr Hohlräume (16) zu begrenzen, dadurch gekennzeichnet, daß eine Vielzahl von längsverlaufenden Reihen von Öffnungen in einem der Stirnelemente (11) vorgesehen ist, wobei jede Reihe in Verbindung mit einem jeweiligen Hohlraum (16) vorgesehen ist.

16. Langgestrecktes Element nach einem der Ansprüche 11 bis 15, dadurch gekennzeichnet, daß es ein längsverlaufendes rippenartiges Gebilde (51) umfaßt.

17. Langgestrecktes Element nach Anspruch 16, dadurch gekennzeichnet, daß das rippenartige Gebilde (51) einen in Längsrichtung durchgehenden Kopfteil (52) und einen in Längsrichtung unterbrochenen Schwanzteil (53) zwischen dem Kopfteil und dem Rest (54) des Elementes umfaßt.

18. Tunnelauskleidung dadurch gekennzeichnet, daß sie eine Vielzahl von langgestreckten Elementen (10) nach einem der Ansprüche 11 bis 17 umfaßt.

19. Tunnelauskleidung nach Anspruch 18, dadurch gekennzeichnet, daß sie zusätzlich ein langgestrecktes Element (20, 50) umfaßt, das mit einem längsverlaufenden rippenartigen Gebilde (23, 51) versehen ist, das so angeordnet ist, daß es die anderen langgestreckten Elemente (10) im Abstand von der Innenfläche eines Tunnelbauwerkes hält.

20. Tunnelauskleidung nach Anspruch 19, dadurch gekennzeichnet, daß das rippenartige Gebilde (51) in Längsrichtung unterbrochen ist.

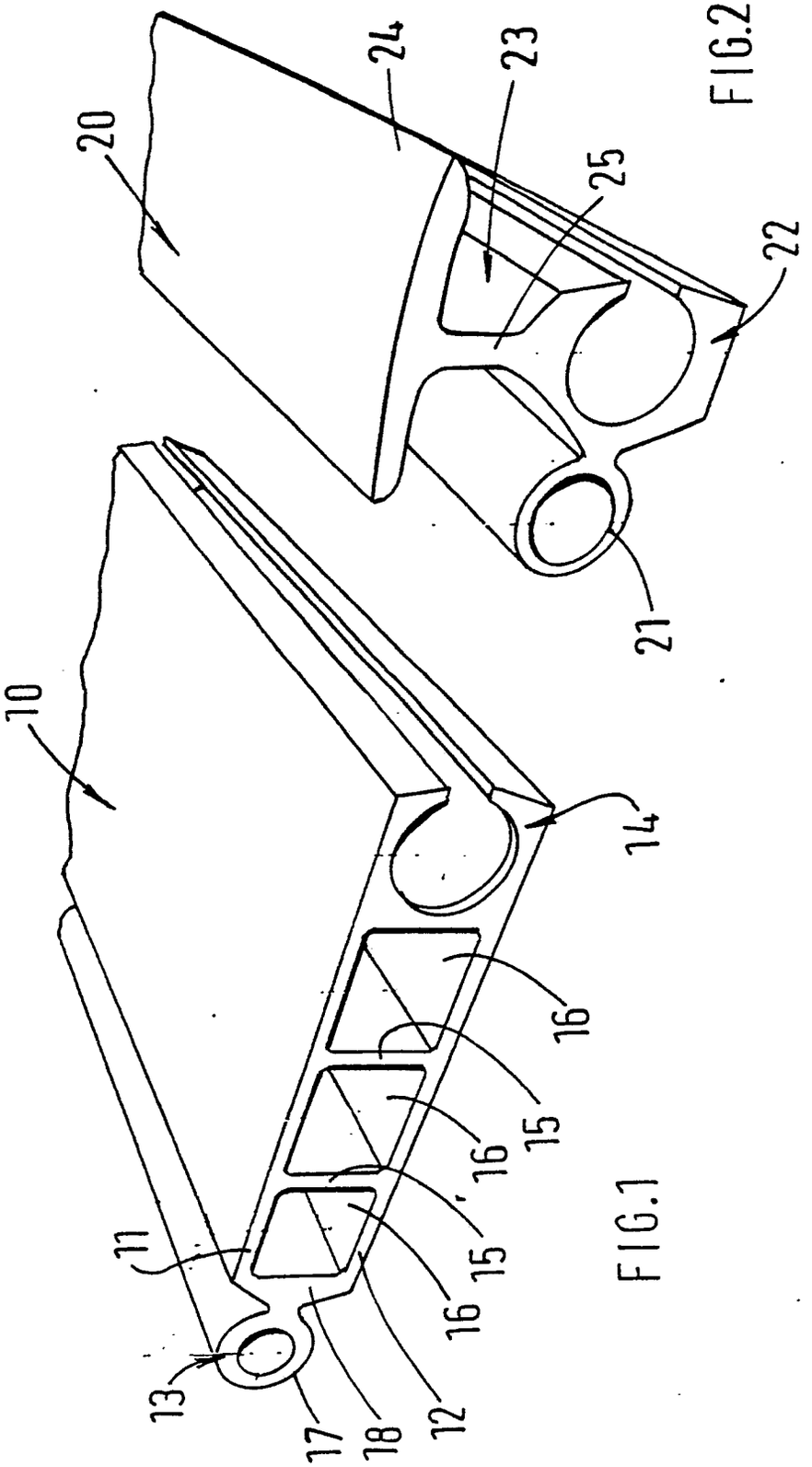


FIG.1

FIG.2

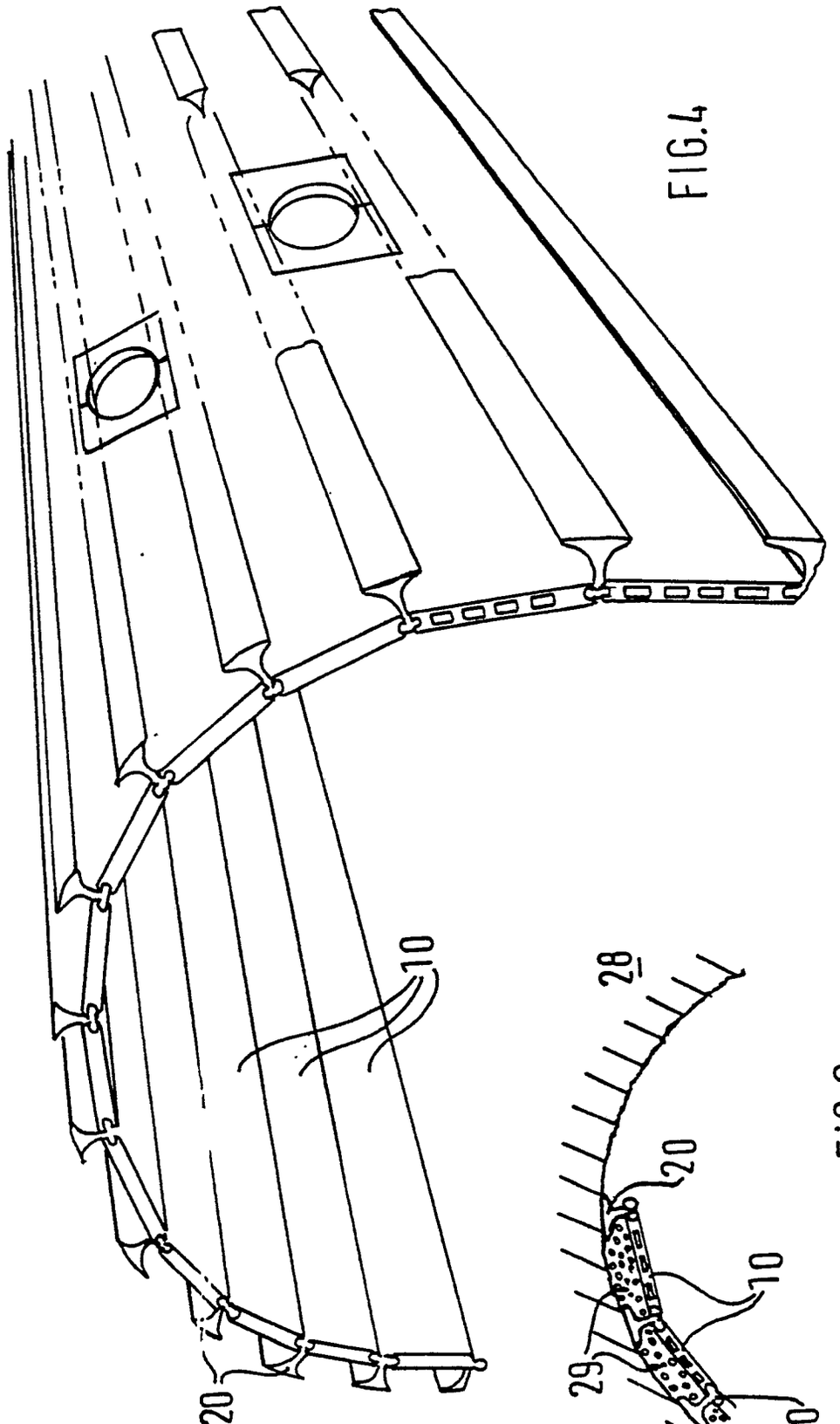


FIG.4

FIG.3

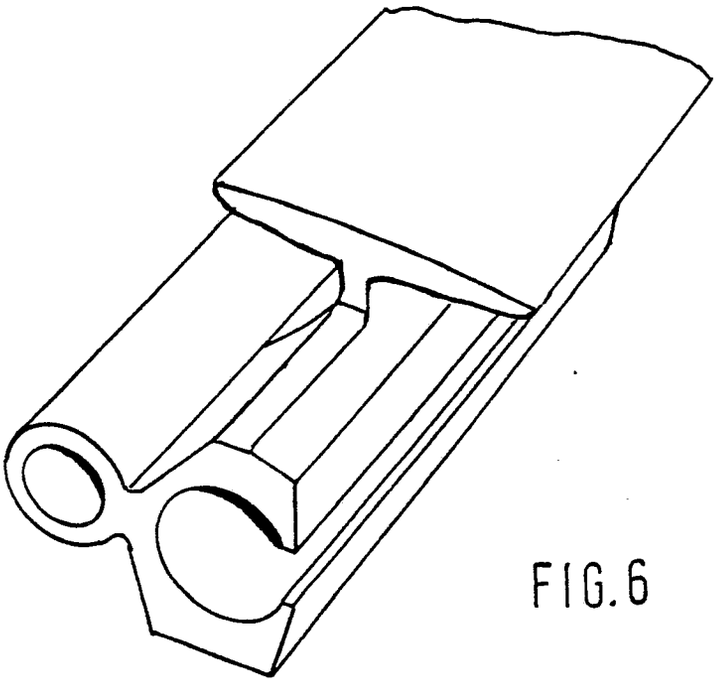


FIG.6

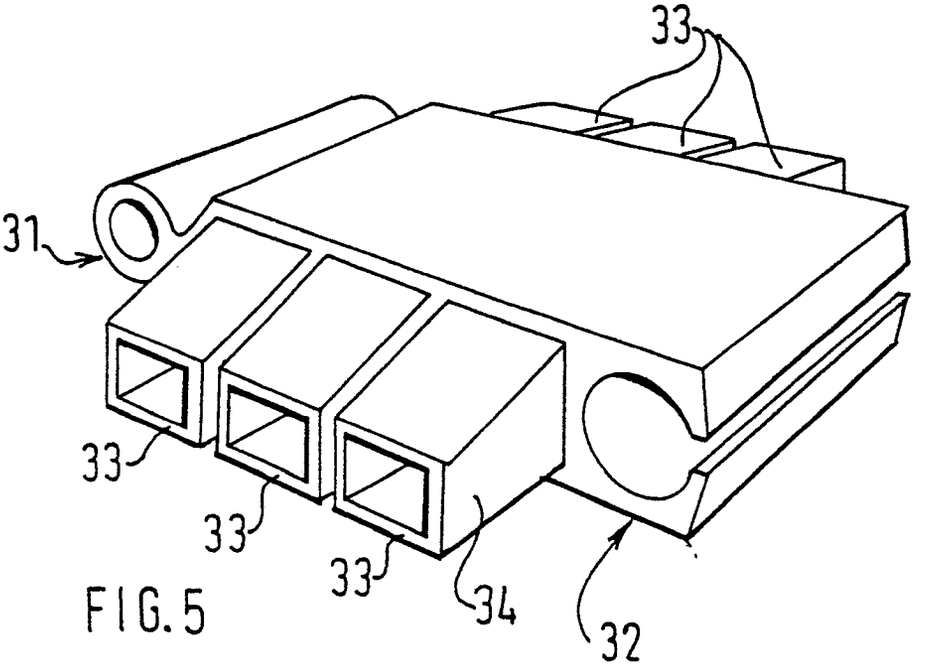


FIG.5

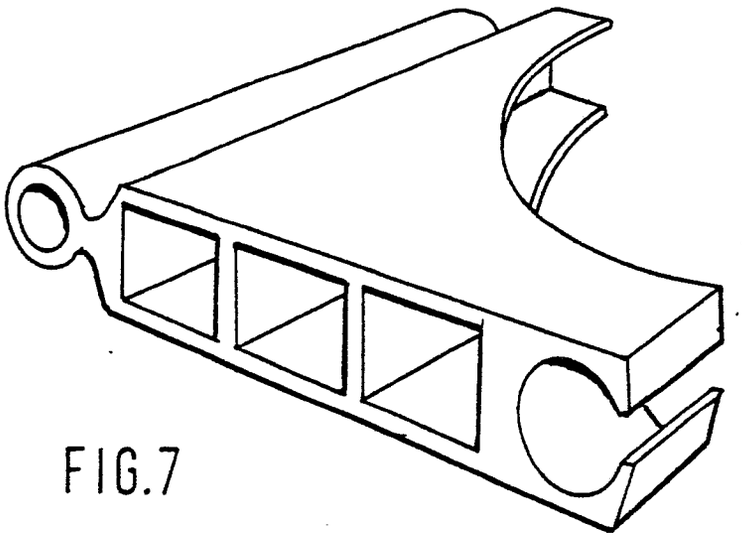


FIG.7

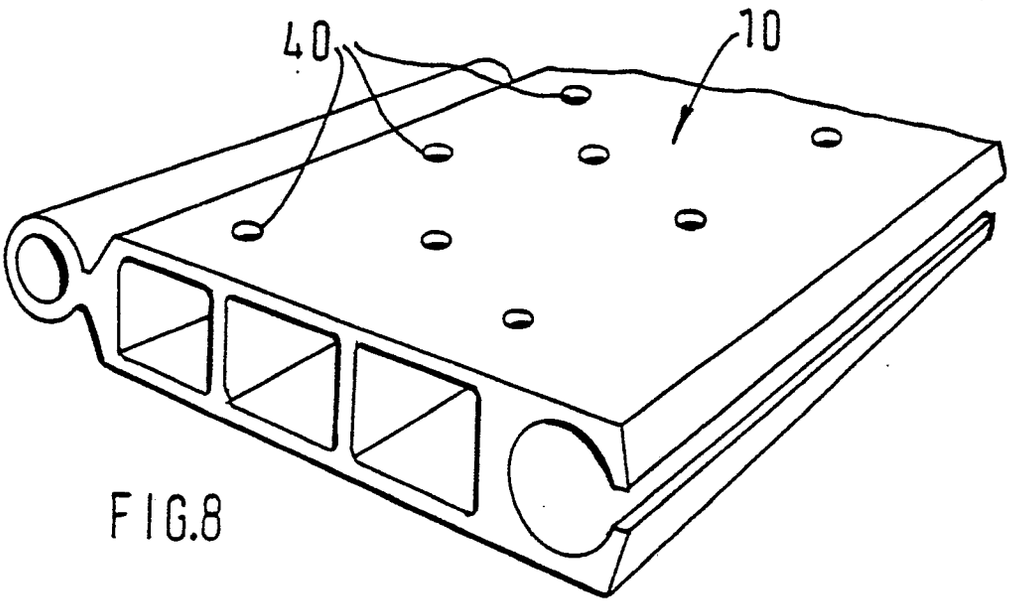


FIG.8

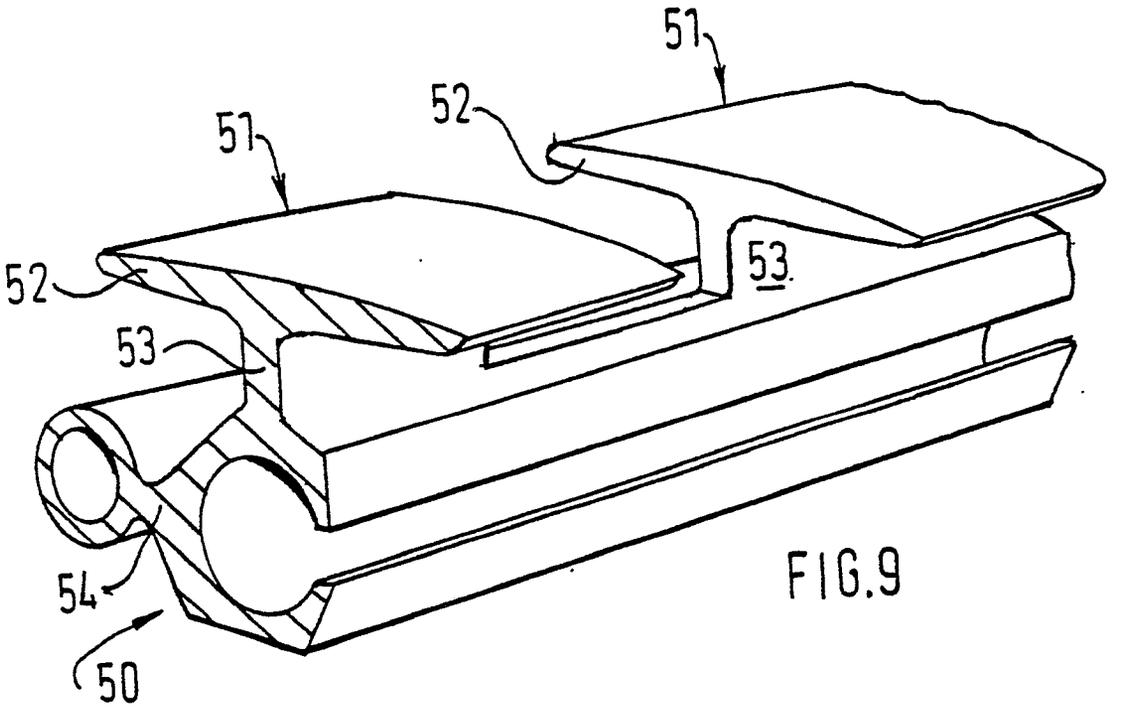


FIG.9

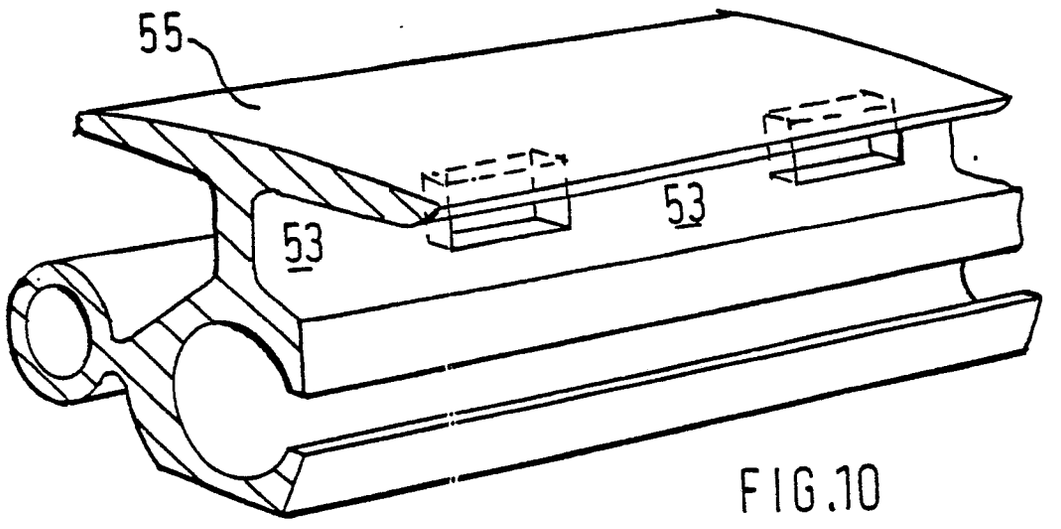


FIG.10