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## (54) Elongate hollow tubular mast

(57) An elongate hollow tubular mast (1) surrounding an interior space, the mast having a first wall opening (25) in a longitudinal section for access to the interior space, an inner tubular reinforcing member (15) within the longitudinal section bordering the first wall opening (25), and a second wall opening (27) in the reinforcing member in register with the first wall opening (25) defining an access opening (9) for the mast. The reinforcing member (15) includes an integrally formed, axially extending, longitudinally elongate, rib structure (17) projecting from an inner surface of the reinforcing member (15) opposite the access opening (9).

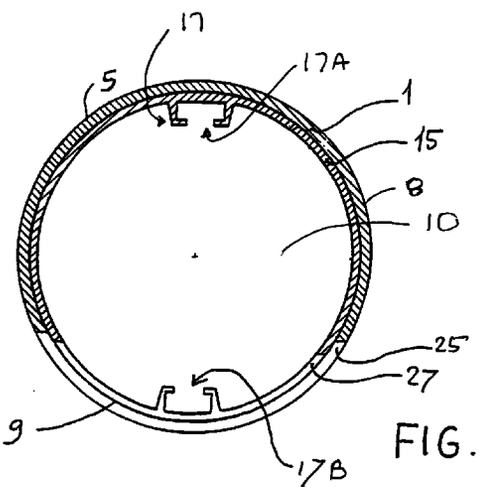


FIG. 3

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## Description

This invention relates to an elongate hollow tubular mast comprising: a tubular wall having a longitudinal section that includes a first opening giving access to an interior space of the mast; and a tubular reinforcing member that is fixedly attached to an inner surface of the outer wall bordering its first opening, said reinforcing member including a second opening in registration with the first opening to provide an access opening in the mast to its interior space.

Such masts are commonly used to support lighting fixtures and signs along roadsides and on man-made structures such as bridges. Such masts can also be used as flag poles and as columns to support various overhead structures. Such masts are further found on ships.

An example of such a reinforced mast is described in GB patent specification 1413334, and its structure has been used with reasonable success in counteracting structural weaknesses in the area of the mast's access opening. However, due to different demands for enlarging the access opening, even in the face of significant structural stresses caused by severe environmental conditions (particularly wind), the known reinforced tubular mast has sometimes been found to be inadequate.

An object of this invention is therefore to strengthen further the known elongate hollow tubular mast.

The mast of the present invention is characterised in that an integrally formed, axially or longitudinally elongate, first rib structure projects radially from an inner surface of the reinforcing member and is generally opposite, preferably diametrically opposite, the access opening. The first rib structure further reinforces the mast against weaknesses caused by its access opening and does so at a most effective location from the standpoint of the structural engineering of the mast.

Advantageously, the rear rib structure is formed so as to provide a mounting rail for accessory components to be fitted in the interior space of the mast. Usually lighting poles and flag poles require accessory components, such as fuse boxes and rope or cable clamps, to be fitted inside them. By appropriately shaping the first reinforcing rib structure, it can serve the additional function as a mounting rail for accessory components. Preferably the first rib structure is provided with an undercut groove that can accept fastener elements, such as bolts, for mounting of accessory components. Such an undercut groove is preferably provided by forming the first rib structure, in cross-section in the reinforcing member, as a pair of radially symmetrical L-shaped legs.

Desirably, the reinforcing member also comprises a longitudinally elongate, second rib structure that projects radially from an inner surface of the reinforcing member and is parallel to, and circumferentially spaced from, the first rib structure. It is advantageous that the second rib structure be diametrically opposite the first rib structure and be above and below the second opening in the reinforcing member. The second rib structure still further increases the strength of the reinforcing member, provides further means for attaching accessories to the interior of the mast and improves the manufacture of the mast. The second rib structure is advantageously identical to the first rib structure.

When the manufacturing process of GB patent specification 1413334 is used, the rib structure(s) of this invention allow the behaviour of the reinforcing member to be advantageously controlled during its expansion within the first longitudinal section of the mast. In this regard, when a non-uniform structure such as a hollow mast with a first opening cut in its tubular wall expands, the structure has a tendency to bend longitudinally, whereby it deflects laterally. Such a bending tendency can be in addition to, or compensate for, another bending tendency that occurs during expansion of the mast's reinforcing member. When the rib structures of the invention are positioned diametrically opposite to each other as is preferred, a reinforcing member can be made that has a neutral behaviour during such expansion of the reinforcing member in the mast according to GB 1413334, and also, the reinforcing member can be symmetrically shaped so that the position, in which it is inserted in the mast, is less critical.

In one particular embodiment, the second rib structure is intersected by the mast's access opening which is closed by a cover or lid, and a latch on the cover advantageously engages the front rib. This provides additional lateral fixing of the access door cover, which is desirable in areas prone to vandalism of such masts.

Two further rib structures, besides the first and second rib structures, may be positioned at opposite lateral sides of the access opening. With such further rib structures, additional reinforcement of the tubular reinforcing member can be obtained along the lateral sides of the access opening and circumferentially beyond the opening.

The tubular reinforcing member can advantageously be attached to the inner surface of the tubular longitudinal section by an interference fit. Alternatively the reinforcing member can be attached to the inner surface of the longitudinal section by means of an adhesive material.

In order that the present invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings in which:-

Figure 1 is a general elevation view of one embodiment of mast according to the invention.

Figure 2 is a transverse cross-sectional view of the mast taken along line II-II in Figure 1.

Figure 3 is a transverse cross-sectional view of the mast taken along line III-III in Figure 1.

Figure 4 is a partial longitudinal cross-sectional

view of the mast along line IV-IV of Figure 1, with a cover for the access opening shown in position.

Corresponding elements in these Figures are referred to by the same reference numbers.

Figures 1-4 show an elongate hollow tubular metal mast 1 suitable, for example, as a lighting pole or as a flag pole. A lower end 2 of the mast 1 is buried in the ground 3. However, this is only for illustrative purposes as the lower end 2 could also take the form of a pedestal mounted on a man-made structure such as a bridge or viaduct. Also optional is a cable entrance opening 4 in the lower end 2 of the mast which may only be required for a lighting pole.

The mast 1 has a tubular outer wall 5 with a longitudinal section 8 that is closer to the ground 3 than to the top of the mast. The longitudinal section 8 includes an opening, generally 9, normally in the front of the mast, giving access to an interior space 10 within the mast. The access opening 9 is closed by a cover 11 locked in position by a locking element 13.

In dash-dotted lines in Figure 1 is shown a tubular inner wall or reinforcing member 15 which is positioned within the interior of the mast 1 and within its longitudinal section 8 bordering the access opening 9. The reinforcing member 15 is fixedly attached to an inner surface of the outer wall 5.

As shown in Figure 2 (a transverse cross-section taken along line II-II of Figure 1), the reinforcing member 15 takes the form of a sleeve that snugly fits within the interior of the mast 1. Projecting radially inwardly from the inner surface of the reinforcing member 15 are one or more, preferably at least a pair of, parallel, circumferentially spaced, identical, rib structures, generally 17. Each of the rib structures 17 includes an undercut groove 19 which is preferably provided by forming the first rib structure, in cross-section in the reinforcing member 15, as a pair of radially symmetrical L-shaped legs 21 and 22. In this regard, the inwardly-directed free end portions of the L-shaped legs 21, 22 have oppositely directed, enlarged ends or feet 23, 24 that preferably extend towards each other so that the pairs of legs and feet 21,23 and 22,24 are mirror images of each other about the center of each rib structure 17. The undercut groove 19 in the rib structures can be used to mount accessory components by means of conventional fasteners.

As seen from Figure 3 (a transverse cross-section taken along line III-III of Figure 1, with the cover 11 removed from the access opening 9), the access opening 9 of the mast 1 comprises a first opening 25 in the longitudinal section 8 and a second opening 27 in the reinforcing member 15. The second opening 27 is in radial registration with the first opening 25.

Preferably, the first opening 25 is cut in the front of the outer wall 5 of the mast 1 prior to the insertion of the reinforcing member 15 in the mast. By cutting the second opening 27 in the reinforcing member 15 separately afterwards, the second opening 27 can, as is shown, be slightly smaller than the first opening 25 to provide a recessed abutment edge for the cover 11.

As also shown in Figure 3, each of the rib structures 17 preferably comprises a longitudinally elongate structure that projects radially from, and is integrally formed with, the inner surface of the reinforcing member 15. Preferably, one of the rib structures 17A is generally opposite, particularly diametrically opposite, the second opening 27 in the reinforcing member 1 and at the rear of the mast. This first or rear rib structure 17A preferably extends longitudinally along the full height of the reinforcing member 15. The rear rib structure 17A thereby reinforces further the mast against weaknesses caused by its access opening 9 and does so at a most effective location in the reinforcing member 15.

As further shown in Figure 3, it is preferred that a second or front rib structure 17B be provided that is circumferentially spaced from the rear rib structure 17A in the reinforcing member 15 and preferably is diametrically opposite the rear rib structure 17A. It is especially preferred that the front rib structure 17B extend longitudinally above and below the second opening 27 in the reinforcing member , particularly to the top and bottom of the reinforcing member 15. In this regard, it is quite particularly preferred that the access opening 9 intersect radially the front rib structure 17B. (A particular advantage of such an arrangement will be explained below with respect to Figure 4 .) The front rib structure 17B still further increases the strength of the reinforcing member and makes it easier to locate properly the reinforcing member in the mast during its manufacture.

As shown in Figure 4 (a partial longitudinal cross-section through the mast along line IV-IV of Figure 1), the cover 11 is in an almost closed position. At the lower end of the cover 11 is a tongue 29 which engages the undercut groove 19 of the front rib structure 17B. At the upper end of cover 11 is the locking element 13 that includes a latch 31 and a latch bolt 33 which can be engaged by a suitable tool or key. The latch 31 also engages the sides of the groove 19 of the front rib structure 17B. The engagement of the tongue 29 and the latch 31 with the groove 19 of the front rib structure 17B gives an additional tangential retainment for the cover 11, which otherwise could only engage the lateral edges of the cover 11. This much improved lateral fixation of the cover meets a demand provoked by vandalism of such masts. In this regard, it has been possible for vandals to sideways kick out the covers of conventional lighting pole masts.

The positioning of the rear and front rib structures 17A and 17B on diametrically opposite sides of the reinforcing member 15 also allows the reinforcing member 15 to be fit within the longitudinal section 8 of the mast 1 by internal expansion as described in GB 1413334, without fear of the reinforcing member assuming a curved shape. Such curvature could result if the amount of material in the cross-sectional areas of either the rear

or front rib structure 17A or 17B were more resistant to expansion than the other cross-sectional areas of the reinforcing member. Of course, such a situation can be avoided if the reinforcing member has a symmetrical cross-section.

Alternatively the reinforcing member 15 can be given an initial outer diameter slightly in excess of the inner diameter of the mast 1. The reinforcing member can then be fitted, in a conventional manner, by heating the mast or by cooling the reinforcing member or by effecting both operations simultaneously.

Another method of fixing the reinforcing member 15 to the mast involves the use of an adhesive material between the reinforcing member and the mast. This can also be done in a conventional manner.

Irrespective of the method of fixing the reinforcing member 15 to the mast 1, the rear rib structure 17A, opposite the access opening 9, reinforces the finished mast 1 to overcome the weakening of the mast caused by the presence of the access opening. Additional reinforcement of the mast can be obtained from the front rib structure 17B, above and below the access opening 9. Still further reinforcement of the mast can be obtained by positioning two additional rib structures 17 along both lateral sides of the access opening. Not all the rib structures need be of the same shape or configuration, but the principal rear rib structure 17A opposite the access opening is preferably shaped to provide additionally an attachment rail for accessory components. All the rib structures according to the invention are preferably of a continuous cross-section so that the reinforcing member 15 can be produced by a metal extrusion process.

The invention is, of course, not limited to the above-described embodiment which may be modified without departing from the scope of the invention or sacrificing all of its advantages. For example, the rear and front rib structures 17A and 17B need not be identical, and if desired, the front rib structure 17B need not have feet 23 and 24 or an undercut groove 19, defined by such feet. Similarly, such feet 23 and 24, if initially present on rib structures 17 during the manufacture of the mast, can later be milled off of one or more of them to make the interior of the mast more accessible or to provide a stronger latch for the cover 9.

## Claims

1. An elongate hollow tubular mast comprising a tubular wall (5) having a longitudinal section (8) that includes a first opening (25) giving access to an interior space (10) of said mast and a tubular reinforcing member (15) fixedly attached to an inner surface of said wall (5) bordering said first opening, said reinforicing member (15) including a second opening (27) in registration with said first opening to provide an access opening (9) in said mast to said interior space, characterized in that an integrally formed, longitudinally elongate, first rib structure (17,17A) projects radially from an inner surface of said reinforcing member and is generally opposite said access opening (9).

2. A mast according to claim 1, characterised in that first rib structure (17) is diametrically opposite said access opening (9).

3. A mast according to claim 1, characterised in that first rib structure comprises means (19-24) providing a mounting rail for accessory components to be fitted in said interior space

4. A mast according to claim 3, characterised in that means (19-24) providing a mounting comprises an undercut groove (19) in said rear rib structure.

5. A mast of according to claim 4, characterised in that undercut groove is provided by forming said rib structure, in cross-section in said reinforcing member, as a pair of radially symmetrical L-shaped legs (21,22).

6. A mast according to claim 5, characterised in that L-shaped legs (21,22) have inwardly-directed free end portions with oppositely directed, enlarged feet (23,24) that extend towards each other so that said legs and said feet (23,24) are mirror images of each other about the centre of said rib structure.

7. A mast according to any preceding claim, characterised in that reinforcing member (15) also comprises an, integrally formed, longitudinally elongate, second rib structure (17B) projecting radially from an inner surface of said reinforcing member and parallel to, and circumferentially spaced from, said first rib structure (17A).

8. A mast according to claim 7, characterised in that said second rib structure (17B) is diametrically opposite said first rib structure (17A).

9. A mast according to claim 8, characterised in that first and second rib structures are identical.

10. A mast according to any preceding claim, characterised in that said access opening (9) is closed by a cover (11), and latch means (13) on said cover engage said second rib structure (17B), which is intersected by said access opening (9).

11. A mast according to any preceding claim, characterised in that said reinforcing member also comprises two further, integrally formed, radially projecting, longitudinally elongate rib structures that are positioned at opposite lateral sides of said access opening.

**12.** A mast according to any preceding claim, characterised in that said reinforcing member (15) is attached to an inner surface of said longitudinal section (8) by an interference fit.

**13.** A mast according to any preceding claim, characterised in that said reinforcing member (15) is attached to the inner surface of said longitudinal section (8) by means of an adhesive material.

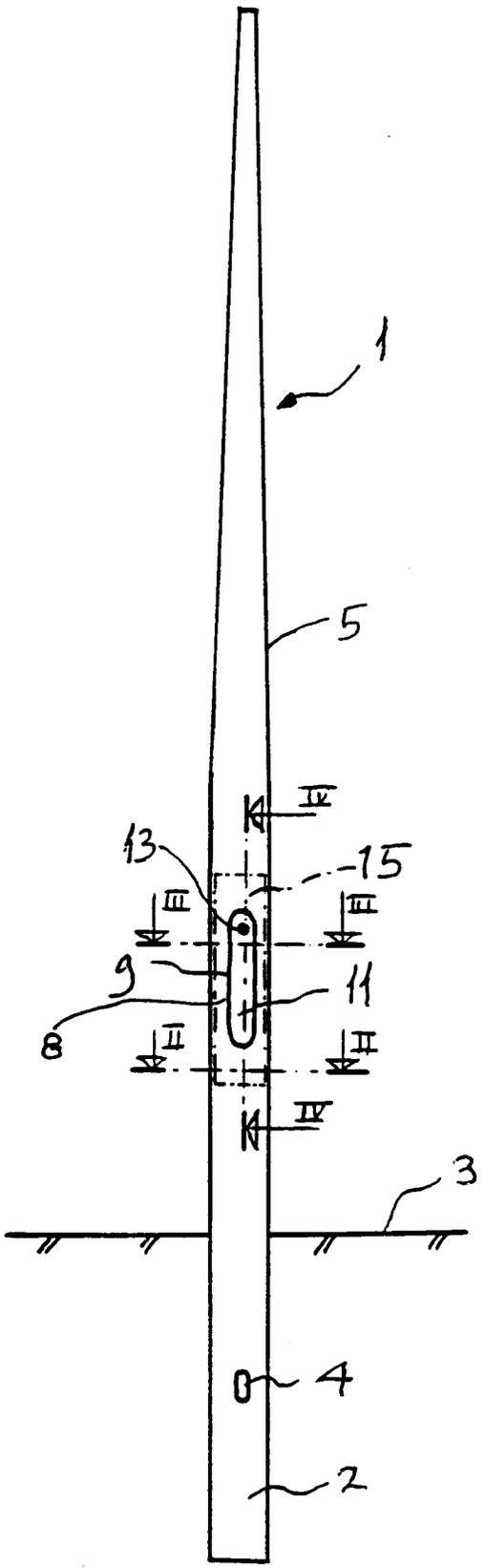


FIG. 1

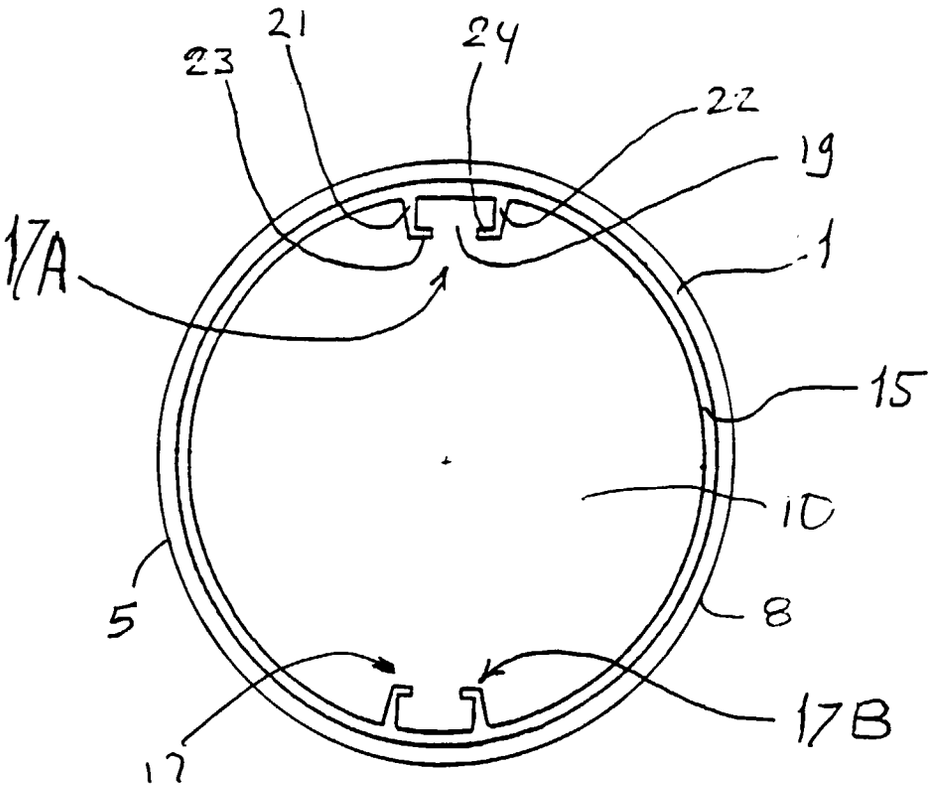


FIG. 2

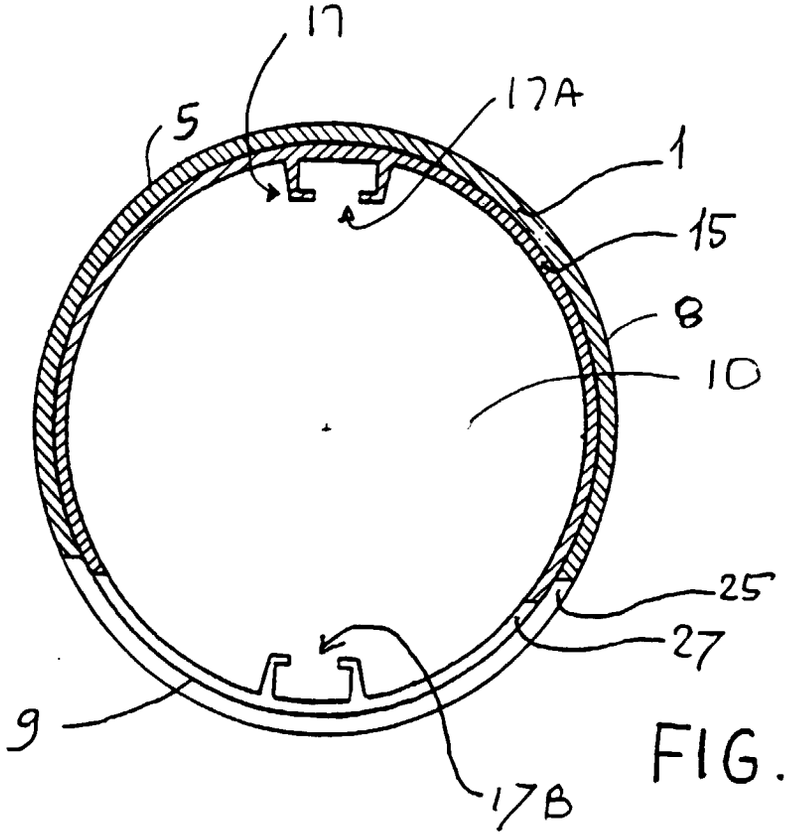


FIG. 3

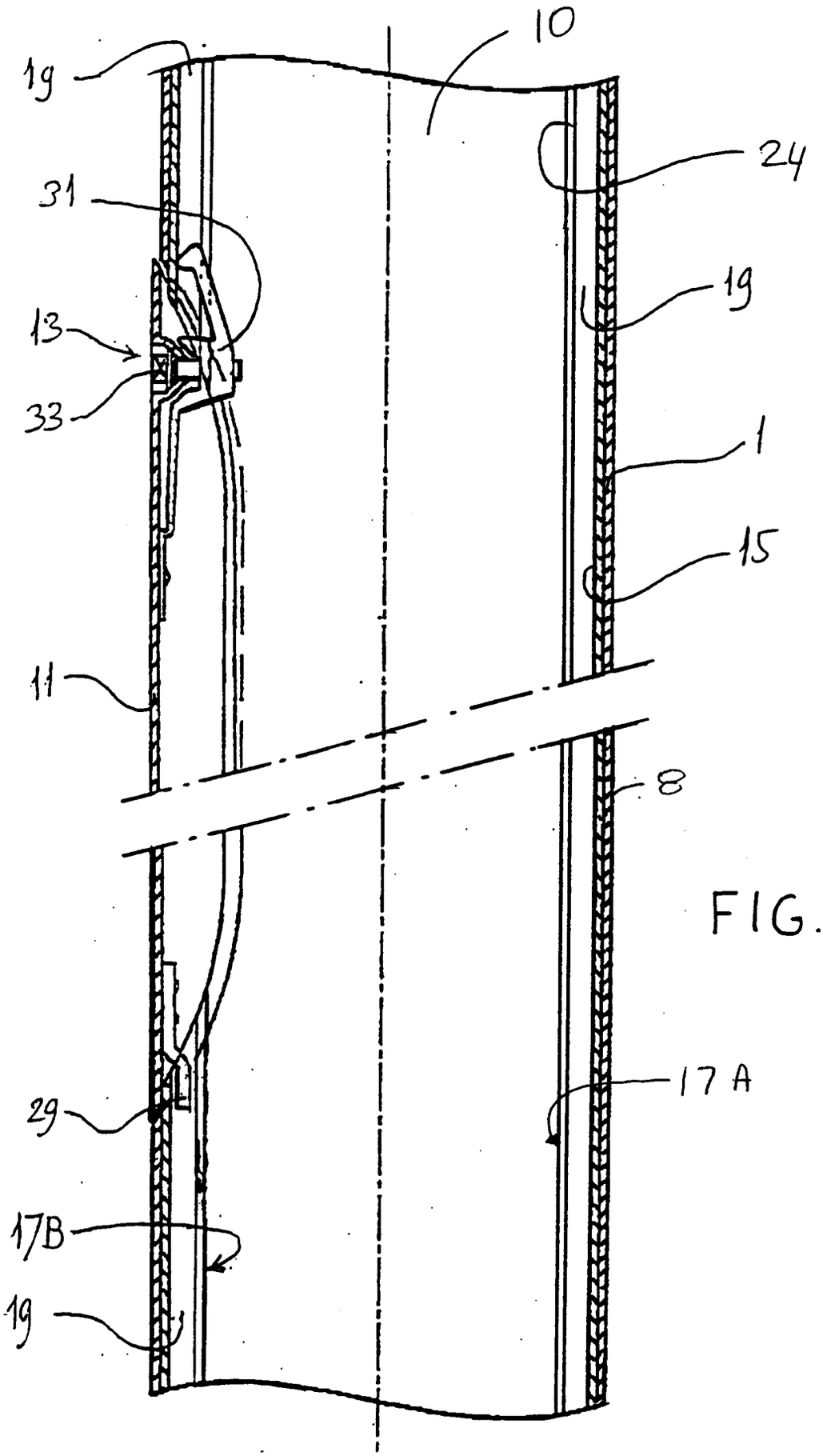


FIG. 4

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# EUROPEAN SEARCH REPORT

Application Number
EP 97 31 0696

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 4 May 1998 | Kriekoukis, S |

CATEGORY OF CITED DOCUMENTS

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