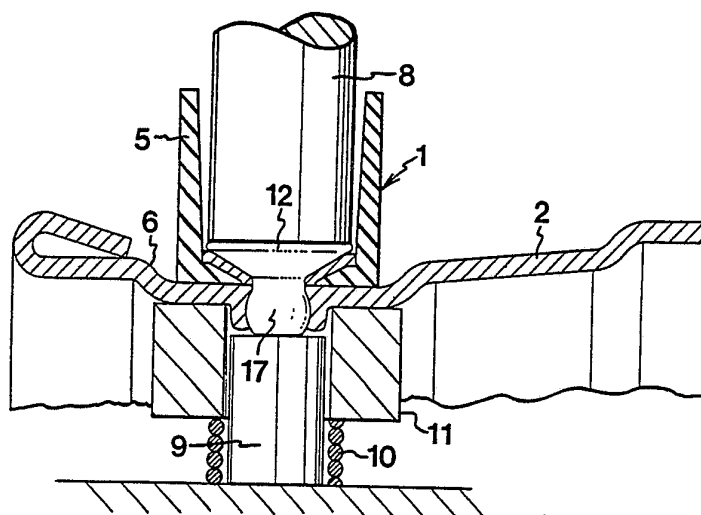




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(54) Title: METHOD AND DEVICE FOR MAKING A TUBULAR ELEMENT WITH EXTERNAL JOINT-SEALING MEANS



(57) Abstract

In a method for securing an elastic, circumferential seal (1) on a tubular element (2), a base portion (4) of the seal (1) is applied against the tubular element (2), whereupon a clamping strap (7) is tightened on the base portion (4) to clamp this portion against the tubular element (2) with sealing lips (5) projecting therefrom. The clamping strap (7) and thus the seal (1) are anchored by a pointed, piercing rivet (12, 13) being driven through the clamping strap (7), the base portion (4) and the wall of the tubular element (2), and upset against a fixed abutment (9). During the upsetting operation, the rivet shank (13) forms a bulge (17) whose transverse dimensions exceed the transverse dimension of the hole which is pierced through the wall of the tubular element (2) by the rivet (12, 13), whereby the rivet and the seal are prevented from being pulled off the tubular element. A device for carrying out the method comprises, in addition to the above-mentioned components, a stamping means and, cooperating therewith, an abutment means (9-11).

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METHOD AND DEVICE FOR MAKING A TUBULAR ELEMENT
WITH EXTERNAL JOINT-SEALING MEANS

The present invention is directed to a method for
5 securing an elastic, circumferential joint-sealing means
on the outside of a tubular element and more specifically
relates to a method as recited in appended claim 1.

The invention also relates to a device for securing
such a joint-sealing means as recited in the preamble of
10 appended claim 6.

The problem of providing efficient sealing in a tubu-
lar element to be inserted in another pipe or tube has
long been dealt with by those skilled in the art. Over the
last decades, a number of solutions have been proposed to
15 solve the particular problem of providing a seal between
two ventilation ducts inserted in each other with close
fit. In most cases, use is made of an elastic sealing
ring, generally of rubber, which is fixed externally on
the end portion of the first tube, on to which the second,
20 outer tube is to be passed. Thus, the sealing ring is
mounted on the inner tube and generally has one or two
radially projecting flanges, which are bent by the outer
tube when placed on the inner tube. Three different solu-
tions of this problem, representing relevant background
25 art to the present invention, have been elaborated in
Sweden and will be briefly discussed hereinafter.

US-A-3,955,834 (AB Svenska Fläktfabriken) discloses
a solution according to which a sealing ring of L-shaped
cross-section is attached to a tubular element by bending
30 the end portion of the tubular element outwardly and
clamping a base portion of the sealing ring, which further
has a radially projecting sealing lip. Although this con-
struction serves its purpose quite well in most applica-
tions, it suffers from certain limitations. The bending of
35 the end portion of the tubular element is quite difficult
to achieve technically speaking. In fact, it requires sub-
stantial bending to provide a safe grip about the base

portion of the seal. Further, it is suited primarily for seals with only one lip, which is an inconvenience, since double-lip seals are required in many cases, especially at high pressures in the ventilation ducts.

5 Another solution is described in US-A-4,050,703 (Lindab AB) in which a double-lip seal of U-shaped cross-section is anchored in a circumferential channel in a tubular element. The seal is fastened by a clamping strap being applied and tightened on the U-web of the seal, 10 whereupon the strap is anchored practically by spot welding, especially in an overlapping portion thereof. In terms of sealing, this solution is highly satisfactory whereas in terms of manufacture it suffers from certain inconveniences. First, a distinct operation is required 15 for providing holes in the U-web of the seal in those places where spot welding to the tubular element is to be carried out. Second, spot welding may be disadvantageous, in that it may look reliable on ocular inspection, yet prove insufficient when subjected to load, such that the 20 clamping strap may become loose and the anchorage of the seal on the tubular element be jeopardised. A particular drawback is encountered in spot welding on a painted or plastic-coated tubular element, since the paint or plastic must then be ground off from the place where spot welding 25 is to be done. The grinding must be carried out in a special operation.

 Yet another solution is disclosed in WO 90/14544 (Stifab Plåt AB) where a seal of L-shaped cross-section is fastened by applying a hook-shaped portion thereof around 30 the free outer end of the tubular element, whereupon a thread or wire is strapped around a foot portion of the seal to clamp it on to the tubular element. This way of mounting the seal is however quite difficult to apply in practice, especially regarding the provision of a safe 35 grip of the seal about the end of the tubular element, which may be considered the reverse application of the bending technique disclosed in the above-mentioned publi-

cation US-A-3,955,834. Also, the application of the clamping thread may in this respect be considered a complicated and perhaps even superfluous operation. Finally, it should be noted that this construction, too, generally has but
5 one sealing lip.

A similar sealing function is disclosed in US-A-3,400,954 where a circumferential seal is caused to grip about the outer end of a tubular element.

Another example of pertinent background art is SU-A-
10 972,197 disclosing a device for interconnecting two ventilation ducts. This device comprises a flexible strap which is applied around the joint between two tubular elements to be connected. Internally, there is provided an insert element which is fastened to the flexible strap by
15 means of rivets and washers. However, this device has no external sealing lips.

Thus, there is a need to provide a method which is not as complex as the solutions discussed above, yet highly reliable, for anchoring a joint seal on a tubular element, while ensuring a high sealing effect by means of
20 sealing lips. There is of course also a need for a simple and reliable device for carrying out the method. The invention is directed in particular, but not exclusively, to the fastening of double-lip seals (according to US-A-
25 4,050,703), since such seals provide optimum sealing effect.

One object of the present invention thus is to overcome the above-mentioned drawbacks by providing a method for fastening an elastic, circumferential joint-sealing
30 means on the outside of a tubular member without any appreciable risk of the seal coming loose after mounting. According to another aspect of the invention, this method should involve as few and as simple operations as possible. According to a special aspect of the invention, the
35 method should allow fastening the sealing means on painted or plastic-coated tubular elements without necessitating any additional previous operations, such as grinding.

The invention also has for its object to provide a simple and reliable device for carrying out the method. Further, the invention aims at providing a tubular element equipped with joint-sealing means secured thereto in a far more reliable manner than hitherto possible.

These and other objects, which will appear from the following description, have now been achieved by a method which is of the type described in the introduction to the specification, and which, in addition, comprises the distinctive steps of the invention as recited in the characterising clause of appended claim 1.

The objects of the invention are also achieved by means of a device which is of the type described in the introduction to the specification, and which, in addition, has the distinctive features of the invention as recited in the characterising clause of appended claim 6.

Further, the objects of the invention are achieved by means of a tubular element as recited in appended claim 9.

Other objects of the invention are recited in the dependent claims reciting particularly preferred variants and embodiments of the invention.

The invention confers a number of advantages, such as shorter total cycle time for fastening the sealing means on the tubular element and very high resistance of the connecting means ensuring the anchorage of the sealing means. The high resistance of the connecting means is linked particularly with the fact that the seal is secured by connecting means extending through the wall of the tubular element, whereby locking action is achieved by the parts of the rivet projecting on the inside and on the outside of the tube wall, that is, the rivet head and the upset rivet shank.

Embodiments of the invention will be described in more detail hereinbelow with reference to the accompanying drawings.

Fig. 1 schematically shows a device for carrying out the method according to the invention in a partial section of the end portion of a tubular element, on which a joint-sealing means is to be anchored by means of a pointed
5 rivet.

Fig. 2 is a similar part sectional view of an intermediate step in which the rivet is driven through the sealing means and the wall of the tubular element.

Fig. 3 is a similar part sectional view of the
10 finished rivet joint.

Fig. 4 is a view, similar to Figs 1-3, illustrating how the tubular element is inserted in another tube.

Figs 1-3 shows a device for carrying out the method of the invention, in which an external, elastic, circumferential joint-sealing means 1 is mounted on the outer side
15 of a tubular element 2, which is part of e.g. a ventilation system. The tubular element 2 is intended in known manner to be partly inserted in another tube 3, especially a ventilation duct, as schematically shown in Fig. 4. In
20 the illustrated embodiment, the sealing means 1 is a double-lip seal of U-shaped cross-section and of the type disclosed in the publication US-A-4,050,703 stated in the introduction to the specification and here included by reference.

25 The seal 1, preferably of rubber, thus has a web or base portion 4 to be applied against the outside of the tubular element 2, and two sealing lips 5 projecting from the base portion 4 and extending substantially radially outwards with respect to the tubular element 2. Prefer-
30 ably, the tubular element 2 has in known manner a circumferential channel 6 which has a smaller diameter than the rest of the tubular element 2 and in which the seal 1 is placed. The seal 1 is clamped by means of a clamping strap 7, as will be described in greater detail hereinafter. The
35 device according to the invention comprises additional components which will be discussed further on, namely a stamp 8, schematically shown in Fig. 1, and abutment means

cooperating with the stamp 8 and including a fixed column 9 and an annular holder or die 11 supported by a spring 10. The components 8-11 are used for driving a rivet having a head 12 and a shank 13 through the clamping strap 7, the base portion 4 and the wall of the tubular element 2.

The anchorage of the seal 1 according to the invention is accomplished in the following way. First, the elastic sealing ring 1 is forced on to the tubular element 2, whereupon the clamping strap 7 is applied and tightened around the base portion 4 so as to clamp the seal 1 against the tubular element 2. With the strap 7 thus tightened, the tubular element 2 is taken to a riveting station where the tubular element 2 is placed on the die 11 (see Fig. 1). The pointed rivet 12, 13 is positioned between the sealing lips 5 at the point where a rivet joint is desired, preferably in an overlapping portion of the strap 7 (for greater clarity, however, the Figures show only one strap layer). The rivet 12, 13, or the rivets as the case may be, is automatically fed to the riveting station by means of a special feed device (not shown). The reciprocating stamp 8 is thereafter caused, in a single operation, to drive the rivet shank 13 through the clamping strap 7, the base portion 4 of the seal 1 and the wall of the tubular element 2.

Fig. 2 shows the intermediate position in which the point of the rivet 12, 13 hits the free end of the column 9 after having pierced a hole through the strap 7, the base portion 4 and the tube wall. In this manner, the wall portion of the tubular element 2 immediately around the pierced hole is deformed as a collar 14 directed towards the interior of the tubular element 2 and surrounding the rivet shank 13. Similarly, the clamping strap 7 is deformed immediately around the pierced hole as a collar 15 directed towards the outer side of the tubular element 2 and in this position also surrounding the rivet shank 13. Fig. 2 also clearly shows how the column 9 defines together with the interior of the die 11 a space 16 in which the

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rivet shank 13 is deformed or upset during the continued stroke of the stamp 8 (see Fig. 3).

During the final part of the stroke of the stamp 8, the rivet shank 13 is deformed in a manner which clearly appears from a comparison of Figs 2 and 3, while the die 11 supporting the tubular element 2 is resiliently moved downwards against the action of the spring 10, preferably being a helical spring mounted around the column 9. In this final motion, when the stamp 8 strikes the piercing rivet 12, 13 on the column 9, the pointed rivet shank 13 is deformed or upset in a manner to form a bulge 17 within the space 16. The transverse dimensions of the bulge 17 exceed the transverse dimension of the hole pierced by the rivet shank 13 through the wall of the tubular element 2, while the rivet head 12 is retained on the outside of the tubular element 2. This results in a highly reliable joint preventing the rivet 12, 13 and thus the seal 1 from being pulled off the tubular element 2. In this manner, the seal 1 is anchored in a highly reliable fashion.

During the upsetting, the rivet shank 13 is forcefully urged against the boundary wall of the pierced hole. At the same time, the rivet head 12 is urged against and deforms the clamping strap 7 on the outside of the tubular element 2, while clamping the base portion 4 of the seal 1 therebetween. The inwardly directed collar 14 formed by the wall portion of the tubular element 2 immediately around the pierced hole forcefully engages the bulge 17 and contributes to strengthening the joint. Also, the collar 15 resulting from the deformed clamping strap 7 further contributes to a reliable anchorage of the seal 1.

After completed riveting, the rivet 12, 13 should have been struck as far into the channel 6 that the rivet head 12 does not constitute an obstacle to the outer tube 3 when being passed on to the inner tube 2, as shown in Fig. 4. This Figure also shows how the two sealing lips 5 are bent in known manner when the outer tube 3 is placed

on the inner tube 2, with good fit between the two tubes 2, 3.

In the foregoing it has been described how the point and the shank of the rivet are deformed against abutment means including a fixed abutment column surrounded by a resiliently supported die. To bring about the upset or bulge of the rivet, the movable stamp strikes on the fixed column.

According to a modified embodiment of the invention (not shown), the die is replaced by an expandable holder which in a first step is expanded radially outwards against the inside of the tubular element. The clamping strap is thereafter applied and a rivet is positioned in front of the stamp which drives the rivet shank through the clamping strap, the seal web and the tube wall. The stamp is thereafter maintained in this position, that is against the rivet head, and a movable abutment means strikes the rivet point and deforms it so as to form a bulge as described above. According to this variant, the stamp thus forms the abutment for an impact coming from inside, in this case from the movable abutment means, preferably having a column corresponding to the column of the fixed abutment means described above. It should be pointed out that the upsetting of the rivet shank is performed also in this modified embodiment in a space defined by the column and a through hole in the expandable holder or die.

The variant of the invention described above is especially well suited for use in riveting in automatic machines.

To conclude, it should be noted that the invention is by no means restricted to the measures and components described hereinbefore, but several modifications are conceivable within the scope of the inventive concept as recited in the appended claims. In particular, it should be mentioned that several rivet joints can be provided around the seal to further secure the anchorage thereof.

Moreover, the seal itself may be of other designs, e.g. have an L-shaped cross-section, in which case one leg of the L forms the base portion while the other leg forms a radial sealing lip, as described in the publications US-A-
5 3,955,834 and WO 90/14544 stated by way of introduction.

It is of course also evident that the seal may have more than two lips, in which case clamping straps are suitably tightened around all the base portions between the lips for reliable anchorage of the seal.

10 To those skilled in the art it is also evident that some of the steps to be performed in the method according to the invention can be carried out in different order. For instance, it is conceivable to first place the tubular element on the die in the riveting station and then apply
15 the seal and tighten the clamping strap in place.

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CLAIMS

1. A method for making a tubular element (2) with external, elastic, circumferential joint-sealing means (1), the tubular element being intended to be inserted in another tube (3) with a seal therebetween, said sealing means (1) having in cross-section at least one base portion (4) to be applied to the outer side of the tubular element (2), and at least one sealing lip (5) projecting from said base portion and extending substantially radially outwards with respect to the tubular element, the method comprising the steps of placing the sealing means (1) on the tubular element (2) with the base portion (4) applied thereto; applying a clamping strap (7) on said base portion (4); tightening the clamping strap (7) in a manner to clamp the base portion (4) against the tubular element; and anchoring the clamping strap (7) in the tightened position so as to secure the sealing means (1) around the tubular element (2); c h a r a c t e r i s - e d by the further steps of anchoring the clamping strap (7) and thus the sealing means (1) with the aid of at least one rivet having a head (12) and a pointed, piercing shank (13) which is driven through the clamping strap (7), preferably in an overlapping portion thereof, through said base portion (4) and through the wall of the tubular element (2); and deforming or upsetting the rivet shank (13) by abutment means (9) such that the deformed rivet shank (13) on the inside of the tubular element (2) forms a bulge (17) whose transverse dimensions exceed the transverse dimension of the hole pierced through the wall of the tubular element (2) by the rivet shank (13), while maintaining the rivet head (12) on the outside of the tubular element (2), whereby the rivet (12, 13) and thus the sealing means (1) are prevented from being pulled off the tubular element.

2. A method as claimed in claim 1, wherein the rivet shank (13) by the upsetting is forcefully urged against

the boundary wall of the pierced hole, and the rivet head (12) is pressed against and deforms the clamping strap (7) on the outside of the tubular element (2), while clamping the base portion (4) of the sealing means (1) there-
5 between.

3. A method as claimed in claim 1 or 2, wherein the wall portion of the tubular element (2) immediately around the pierced hole is deformed as a collar (14) which is directed towards the interior of the tubular element and
10 which is forcefully urged against and engages around said bulge (17).

4. A method as claimed in claim 3, wherein the clamping strap (7) immediately around the pierced hole is deformed as a collar (15) which is directed towards the
15 outer side of the tubular element (2) and which is forcefully pressed against the rivet head (12) and partly against the rivet shaft (13), and which is also pressed against said base portion (4) immediately around the pierced hole.

20 5. A method as claimed in any one of the preceding claims, wherein the sealing means (1) is applied in a circumferential channel (6) formed in the tubular element (2) and having a smaller diameter than the rest of the tubular element.

25 6. A device for making a tubular element (2) with external, elastic, circumferential joint-sealing means (1), the tubular element being insertable in another tube (3) with a seal therebetween, said sealing element (1) having in cross-section at least one base portion (4)
30 which can be applied against the outer side of the tubular element (2), and at least one sealing lip (5) projecting from the base portion (4) and extending substantially radially outwards with respect to the tubular element (2), the device comprising a clamping strap (7) to be applied
35 on and tightened around the base portion (4) for clamping it against the tubular element (2), and means for anchoring the clamping strap (7) in the tightened position to

safely secure the sealing element (1) around the tubular element (2), c h a r a c t e r i s e d in that said anchoring means comprises reciprocating stamping means (8) for producing impacts on a rivet having a head (12) and a
5 pointed, piercing shank (13), to drive the rivet shank (13) through the clamping strap (7), preferably in an overlapping portion thereof, through said base portion (4) and through the wall of the tubular element (2), and abutment means (9) against which the rivet shank (13) is to be
10 deformed or upset to form a bulge (17) on the inside of the tubular element (2), the transverse dimension of the bulge (17) exceeding the transverse dimension of the hole pierced by the rivet shank (13) through the wall of the tubular element (2), while maintaining the rivet head (12)
15 on the outside of the tubular element (2), thereby preventing the rivet (12, 13) and thus the sealing means (1) from being pulled off the tubular element.

7. A device as claimed in claim 6, wherein the abutment means comprises a column (9) on the free end of which
20 the rivet shank (13) strikes, and a holder or die (11) with a hole for the column (9), the inner side of the tubular element (2) engaging the outer side of the die (11) during said riveting and upsetting operation.

8. A device as claimed in claim 7, wherein the die
25 (11) and the column (9) together define a space (16) in which said deformation or upsetting of the rivet shank (13) takes place with said bulge (17) forcefully pressed against the boundary wall of the pierced hole.

9. A tubular element, c h a r a c t e r i s e d in
30 that it is produced by a method as claimed in any one of claims 1-5.

10. A tubular element as claimed in claim 9, wherein
the joint-sealing means (1) is an annular double-lip seal, i.e. a sealing ring of U-shaped cross-section, whose two
35 U-flanges (5) or U-lips project at right angles from the U-web forming said base portion (4).

1/2

FIG.1

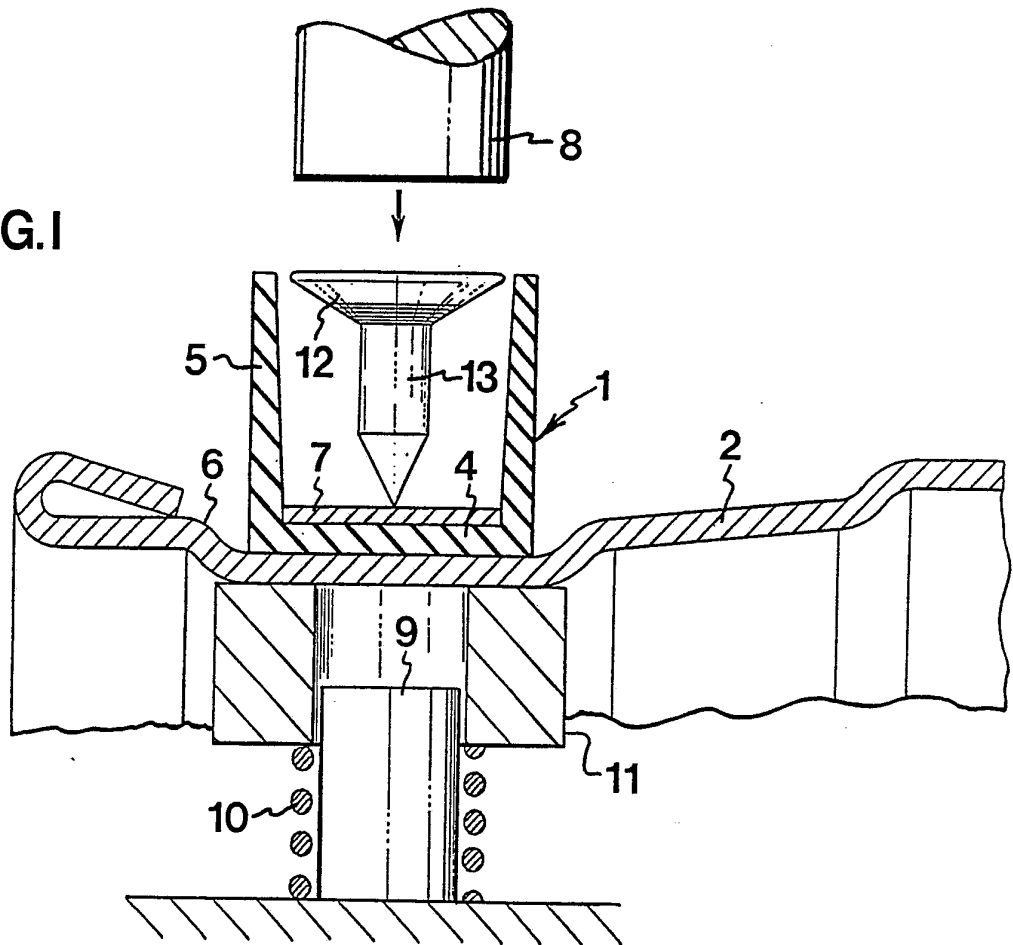
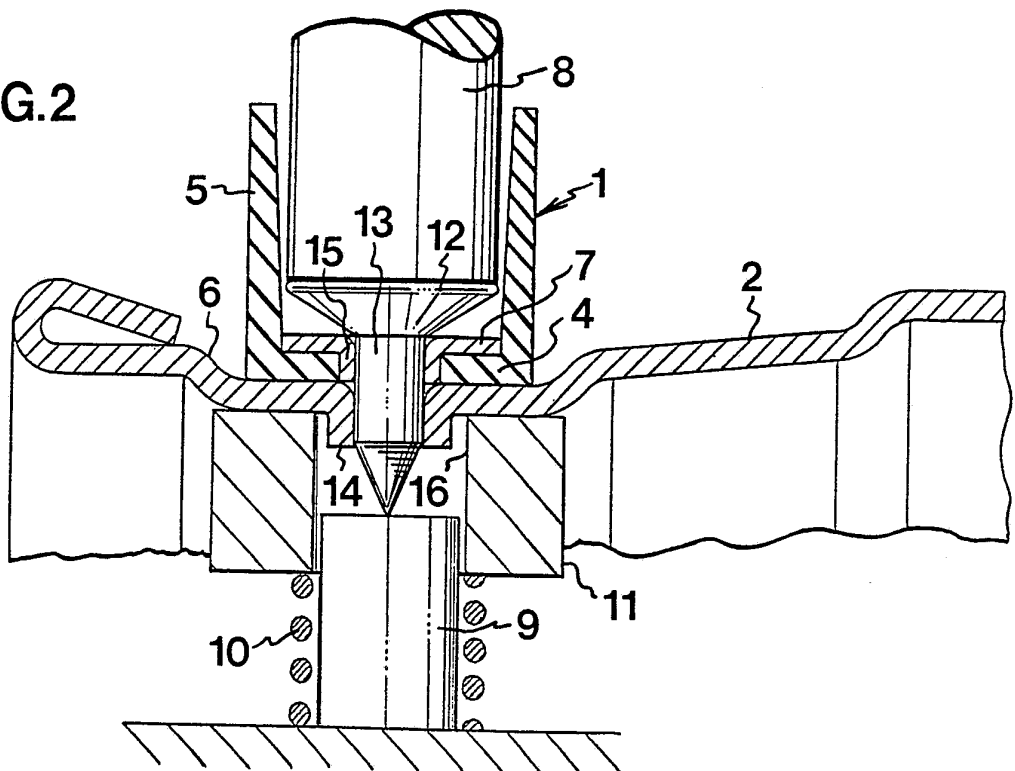


FIG.2



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 92/00888

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: F 16 L 21/035																	
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%; border: 1px solid black; text-align: left;">Classification System</th> <th style="border: 1px solid black; text-align: left;">Classification Symbols</th> </tr> <tr> <td style="border: 1px solid black; height: 40px; vertical-align: bottom;">IPC5</td> <td style="border: 1px solid black; vertical-align: bottom;">F 16 L</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched⁸</div> <p>SE,DK,FI,NO classes as above</p>			Classification System	Classification Symbols	IPC5	F 16 L											
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III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; text-align: left;">Category *</th> <th style="width: 60%; text-align: left;">Citation of Document,¹¹ with indication, where appropriate, of the relevant passages¹²</th> <th style="width: 30%; text-align: left;">Relevant to Claim No.¹³</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;">Y A</td> <td>US, A, 4050703 (TUVESON ET AL) 27 September 1977, see figures 1-4 <div style="text-align: center;">---</div></td> <td style="vertical-align: top;">9,10 1-8</td> </tr> <tr> <td style="vertical-align: top;">Y A</td> <td>US, A, 3400954 (J.L. BROWN) 10 September 1968, see figure 2 <div style="text-align: center;">---</div></td> <td style="vertical-align: top;">9,10 1-8</td> </tr> <tr> <td style="vertical-align: top;">A</td> <td>WO, A1, 9014544 (STIFAB PLÅT AB) 29 November 1990, see the whole document <div style="text-align: center;">---</div></td> <td style="vertical-align: top;">1-10</td> </tr> <tr> <td style="vertical-align: top;">A</td> <td>US, A, 3955834 (AHLROT) 11 May 1976, see the whole document <div style="text-align: center;">-----</div></td> <td style="vertical-align: top;">1-10</td> </tr> </tbody> </table>			Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	Y A	US, A, 4050703 (TUVESON ET AL) 27 September 1977, see figures 1-4 <div style="text-align: center;">---</div>	9,10 1-8	Y A	US, A, 3400954 (J.L. BROWN) 10 September 1968, see figure 2 <div style="text-align: center;">---</div>	9,10 1-8	A	WO, A1, 9014544 (STIFAB PLÅT AB) 29 November 1990, see the whole document <div style="text-align: center;">---</div>	1-10	A	US, A, 3955834 (AHLROT) 11 May 1976, see the whole document <div style="text-align: center;">-----</div>	1-10
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A	US, A, 3955834 (AHLROT) 11 May 1976, see the whole document <div style="text-align: center;">-----</div>	1-10															
<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>* Special categories of cited documents:¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 48%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>																	
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border: 1px solid black; padding: 5px;"> Date of the Actual Completion of the International Search 10th February 1993 </td> <td style="width: 50%; border: 1px solid black; padding: 5px;"> Date of Mailing of this International Search Report <div style="text-align: center; font-size: 1.2em;">23 -03- 1993</div> </td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;"> International Searching Authority <div style="text-align: center;">SWEDISH PATENT OFFICE</div> </td> <td style="border: 1px solid black; padding: 5px;"> Signature of Authorized Officer <div style="text-align: center;">Axel Lindhult</div> </td> </tr> </table>			Date of the Actual Completion of the International Search 10th February 1993	Date of Mailing of this International Search Report <div style="text-align: center; font-size: 1.2em;">23 -03- 1993</div>	International Searching Authority <div style="text-align: center;">SWEDISH PATENT OFFICE</div>	Signature of Authorized Officer <div style="text-align: center;">Axel Lindhult</div>											
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International Searching Authority <div style="text-align: center;">SWEDISH PATENT OFFICE</div>	Signature of Authorized Officer <div style="text-align: center;">Axel Lindhult</div>																

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE¹

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers....., because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claim numbers.....⁹, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
 Claim 9 is obscure and does not define the invention (PCT Rule 6.3; Article 6).

3. ☐ Claim numbers....., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING²

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the the claims. It is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 92/00888**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on **08/01/93**.
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US-A- 4050703	77-09-27	AT-B-	354819	79-01-25
		AU-D-	8744975	77-07-07
		BE-A-	836224	76-04-01
		CA-A-	1023407	77-12-27
		CH-A-	600231	78-06-15
		DE-A-C-	2553526	76-06-16
		FR-A-B-	2294382	76-07-09
		GB-A-	1516160	78-06-28
		NL-A-	7514483	76-06-15
		SE-B-C-	382675	76-02-09

US-A- 3400954	68-09-10	NONE		

WO-A1- 9014544	90-11-29	EP-A-	0428678	91-05-29
		SE-B-	463888	91-02-04
		SE-A-	8901867	90-11-26

US-A- 3955834	76-05-11	AT-B-	323956	75-08-11
		AU-D-	5185473	74-08-08
		BE-A-	794805	73-05-16
		CA-A-	983971	76-02-17
		DE-A-	2305936	73-08-30
		FR-A-B-	2171388	73-09-21
		GB-A-	1423382	76-02-04
		JP-C-	1012571	80-08-29
		JP-A-	48089414	73-11-22
		JP-B-	55004997	80-02-02
		NL-A-	7301861	73-08-14
		SE-B-	360451	73-09-24