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(54) Method and apparatus for making a building structure form with a flat stiffened plate part.

(57) A method for stiffening plate-like material for a spatial structural member, for example a cable trough, which stiffening takes place by locally pressing through the material to form ridges, wherein at least on one side of the ridge the thickness of the material is made smaller, whereby the material is extended, this such that internal tensions resulting from cold deformations in the plate are eliminated.

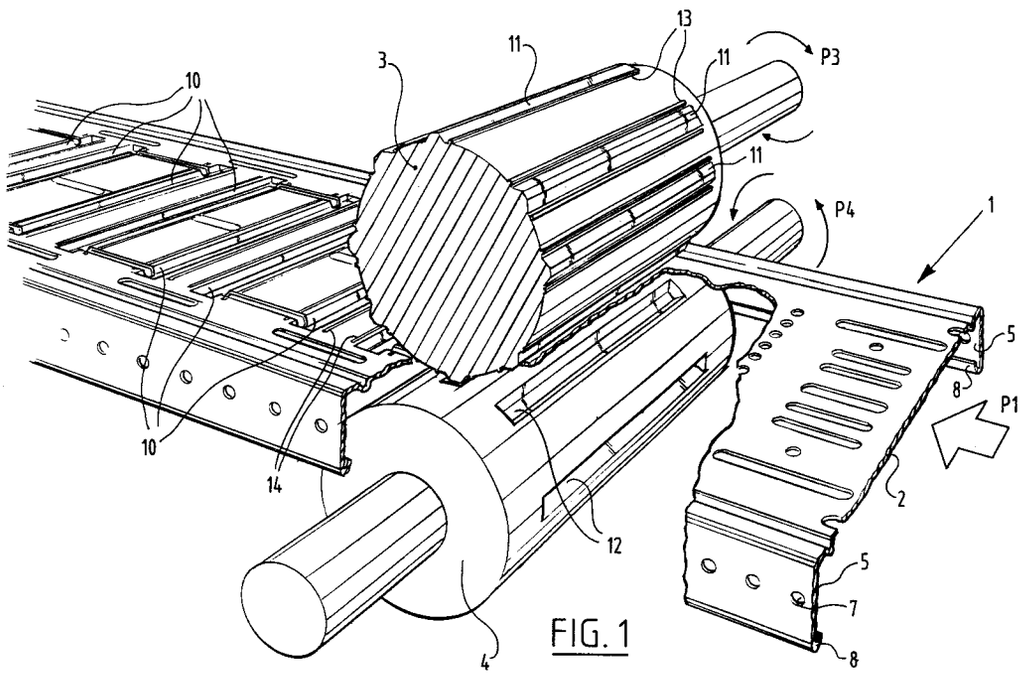

FIG. 1

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The invention relates to a method for stiffening plate-like material for a spatial structural member, for example a cable trough, which stiffening takes place by locally pressing through the material to form ridges.

Spatial building structures are frequently constructed from plate material, wherein the plate material is folded and wherein the wall parts have determined dimensions. These dimensions are determined by the strength, that is, the thickness and the span dimension, since the plate-like wall of the structural member may not deform unacceptably.

The object of the invention is to make the spatial structural members such that thinner material can for instance suffice, wherein the plate-like wall parts thereof will not bend or the like. For this purpose such a plate-like part of the structural member is stiffened with bending or ridges in order to obtain a profile-like plate part. The drawback to arranging such ridges is that the deformation of the plate material results in extra tensions in that plate-like part, whereby the structure does not remain in itself flat, but will easily deform through internal tensions.

The invention has the object of obviating the above drawback and provides to this end a method which is distinguished in that on at least one side of the ridge the thickness of the material is made smaller, whereby the material is made longer.

Due to the fact that the material necessary for making the stiffening ridges is now taken according to the invention from the same material by making this thinner locally, the internal tensions will be considerably reduced or reduced to zero.

The thickness reduction is preferably obtained according to the invention by arranging a flattened strip which runs parallel to the stiffening ridge.

With such a method of arrangement the flattened strip and the stiffening ridge can be arranged simultaneously in the material, for example by doing this continuously using rollers or the like.

If the ridges do not run over the full width of the plate material but, as a consequence of the spatial structural member, must have a determined limited length, the invention also proposes to embody the flattened strip for reducing the thickness of the plate in the same order of magnitude as the length of the stiffening ridge.

According to the invention it is also possible to subject the remaining plate parts outside the zone stiffened by the stiffening ridges to a separate cold working, for example bending to standing wall parts or the like in order to form the desired spatial structural member. These parts do not have to comprise any stiffening elements or compensation therefor in the form of flattened strips. This cold deformation can be carried out either before or after the arrangement of the stiffening ridges in the plate-like material.

The invention further relates to an apparatus for performing a method, which apparatus is provided at least with a pair of rollers, which serve to arrange the stiffening ridges in the desired plate-like part that has to be stiffened. According to the invention the apparatus is provided therein with a pair of rollers embodied with a flattening member in the form of a rib.

This flattening rib can be arranged on the same pair of rollers as those suitable for arranging the stiffening rib, whereby the production process can take place continuously owing to the accurate positioning of the flattened strip relative to the stiffening rib in the plate material.

The invention further relates to a structural member manufactured according to the above stated method and which preferably has the form of a cable trough, the bottom part of which is provided with cold-formed transverse ridges as stiffening ridges, which extend perpendicularly of the longitudinal walls of the trough and wherein the flattened strips extend parallel and close to those stiffening ridges in the material.

The invention is further elucidated in the figure description hereinbelow of two embodiments of the invention. In the drawing:

Fig. 1 shows a perspective view of two co-acting rollers for making a stiffening ridge and provided with a flattening rib to obtain the length compensation in a spatial structural member in the form of a cable trough, which is seen here from the bottom;

fig.2 shows a schematic axial view of the rollers of fig. 1 in cross section with plate material deformed therebetween;

fig. 3 shows a perspective view corresponding with fig. 1 of a plate-like strip which is worked by a pair of rollers in an embodiment variant.

The plate-like material 1 which has to be worked in fig. 1 here takes the form of a cable trough, the bottom part 2 of which extends horizontally and is carried through between two rollers 3, 4 of a pair of rollers in the direction of the arrow P1. In the situation shown two downward facing longitudinal walls 5 connect to the bottom plate 2, wherein it is noted that both bottom plate 2 and longitudinal walls 5 can be provided with a determined perforation in the form of slotted holes 6 or round holes 7. The free edge of the wall strips 5 can further be bent over at 8, which can take place in random manner. It is noted here that in the position shown in fig. 1 the cable trough 1 is of course depicted in reverse sense, that is, it is viewed from the underside of the bottom plate 2.

The pair of rollers 3, 4 serves to arrange stiffening ridges 10 which run parallel to each other and which extend transversely of the longitudinal

direction, that is, transversely of the direction of forward movement P1. The plate material is therefore pressed through locally, this such that the stiffening ridges 10 avoid bending of the bottom plate 2 in transverse direction, whereby thinner plate material can suffice and wherein greater breadths of the bottom plate 2 can be obtained.

Arrangement of stiffening ridges 10 in bottom plate 2 is realized by the elevated ridges 11 on the roller 3 which co-act with recessed parts 12 in the roller 4. This is further elucidated in the cross section of fig. 2, which shows that when the rollers 3, 4 engage with each other, the elevated ridge presses through the plate 2 to form the stiffening rib 10.

It will also be apparent that by forming the stiffening ridges 10, a change in the length of the plate material will take place, which has an adverse effect on the total construction of a spatial structural member such as a cable trough according to fig. 1. This is as a result of the fact that the longitudinal walls 5 do not undergo a change in length, so that the bottom plate 2 acquires internal tensions which result in a deformation of the finished product.

In order to prevent this the roller 3 is embodied, in addition to the rib 11, with a flattening member 13 in the form of a small elevation on the outer surface of the roller 3, which extends parallel along the elevation 11 and which serves together with the counter-surface of the roller 4 to locally reduce the thickness of plate material 2 and thus provide material for the deforming of the stiffening ridge 10. This thickness reduction is therefore a length compensation of the plate part 2 of the spatial structural member, whereby the above stated internal tensions can be eliminated.

It will be apparent that the elevation 13 can also be arranged on the roller 4 instead of roller 3 or that it can still be placed on both rollers such that while the material is reduced in thickness it is not pressed through.

The degree of thickness reduction depends of course on the height of the stiffening ridge 10 and the material requirement involved herein.

An alternative embodiment is shown in fig. 3 wherein not only are ribs and flattened compensation strips 14 arranged transversely of the longitudinal direction, parallel to the direction of forward movement P1 of the material strip, but wherein a stiffening rib 20 is also obtained in the plate material parallel to the side edges by an elevation 21 running round roller 3. The thus created breadth reduction of plate 1 is compensated by arranging flattened strips 22 and 23 on either side of the longitudinal stiffening ridge which are obtained by the respective elevations 24 and 25 on roller 3.

The plate 1 according to fig. 3 is thus compensated not only in the length dimension but also in the breadth dimension.

The advantage of this compensation is that the longitudinal strips 26 along the outside edges of the plate 1 can undergo a random cold deformation, such as for instance bending to a longitudinal wall 5 as in fig. 1, but also by arranging beaded edges and the like without internal tensions being created in the total construction.

It is apparent that the invention is not limited to the above described embodiment, wherein the stiffening ridges 10 can of course take random forms, for example Z-shaped, can further enclose a different angle with the longitudinal edges, for example an angle of 45°, can be intersecting and so on, wherein it is noted that the flattened strips 14 for compensating for the length or breadth dimension can have the same form as the stiffening ridges because they extend substantially parallel thereto.

Claims

1. Method for stiffening plate-like material for a spatial structural member, for example a cable trough, which stiffening takes place by locally pressing through the material to form ridges, **characterized in that** at least on one side of the ridge the thickness of the material is made smaller, whereby the material is made longer.

2. Method as claimed in claim 1, **characterized in that** the thickness reduction is obtained by arranging a flattened strip parallel to the ridge.

3. Method as claimed in claim 2, **characterized in that** the ridge is arranged over a length shorter than the outer dimensions of the plate and the flattened strip is in the same order of magnitude as the length as the ridge.

4. Method as claimed in claim 3, **characterized in that** the ridges are arranged parallel to each other in a part surface of the plate material, wherein the adjacent part surfaces are previously or subsequently subjected to an extra cold deformation such as bending.

5. Method as claimed in any of the foregoing claims, **characterized in that** the plate material is pressed through to form a determined pattern of holes.

6. Apparatus for performing the method as claimed in any of the foregoing claims, which apparatus is provided with one or more pairs of rollers for arranging a ridge in the material, **characterized in that** at least one pair of

rollers is provided with a flattening member in the form of a rib.

7. Apparatus as claimed in claim 6, **characterized in that** the flattening member is arranged on the roller, which is also provided with an elevation which co-acts with a recessed part in the counter-roller of the pair.

8. Building structure form of plate material worked according to the method of any of the claims 1-5.

9. Building structure form in the form of a cable trough provided with a bottom part and two longitudinal walls extending along that bottom part, **characterized in that** the bottom part is provided with cold-formed transverse ridges perpendicularly of the longitudinal walls and flattened strips running parallel thereto.

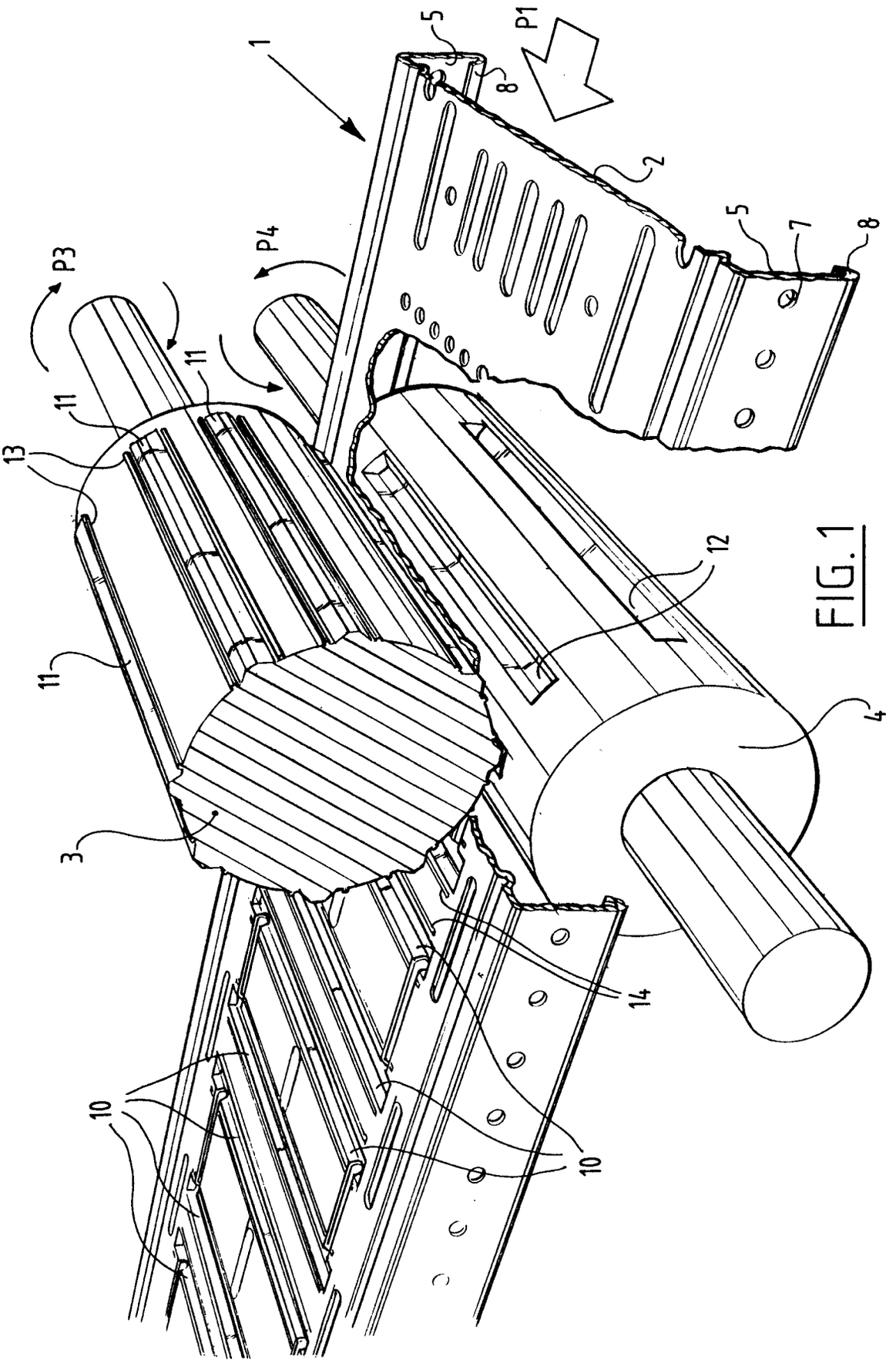


FIG. 1

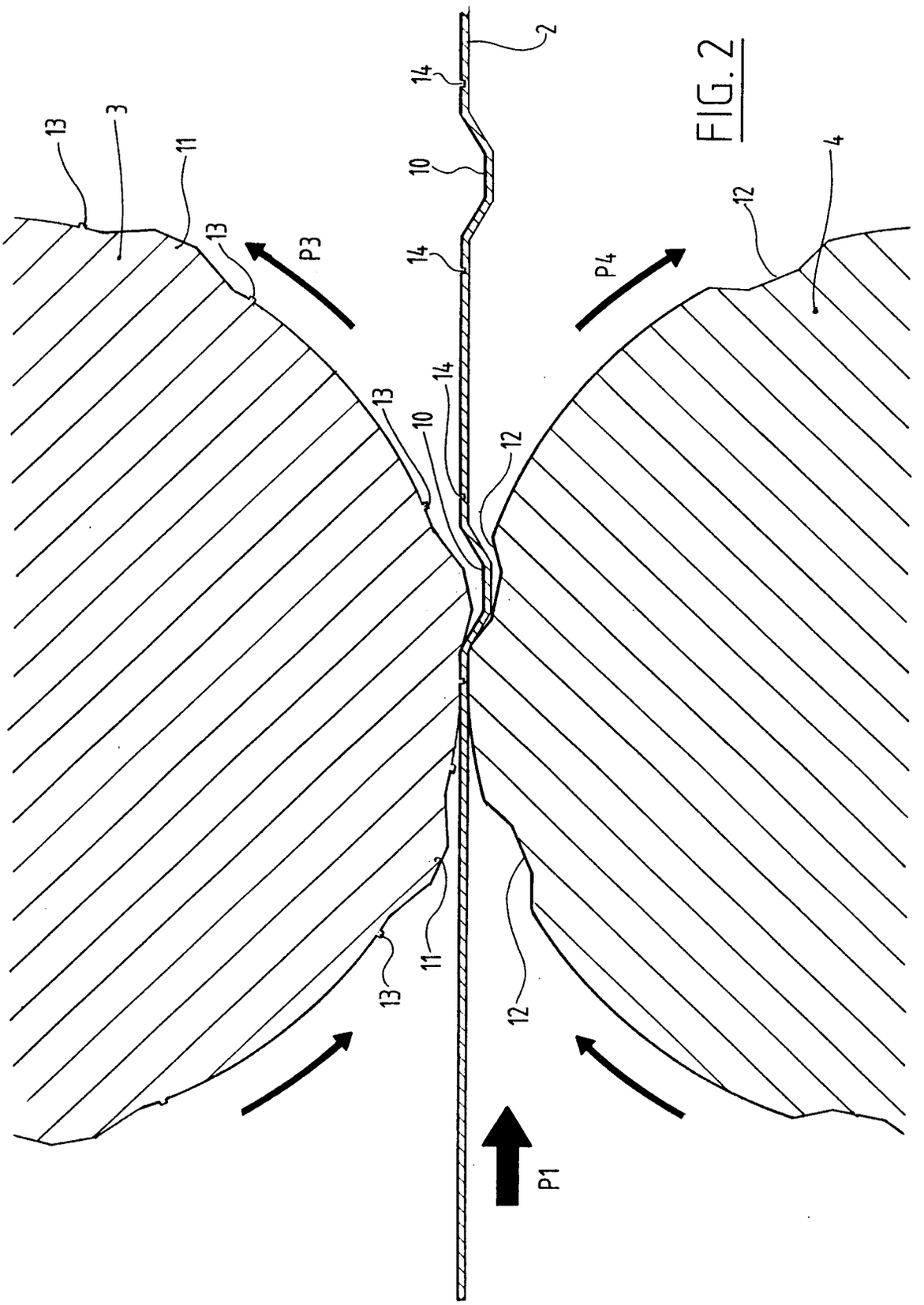
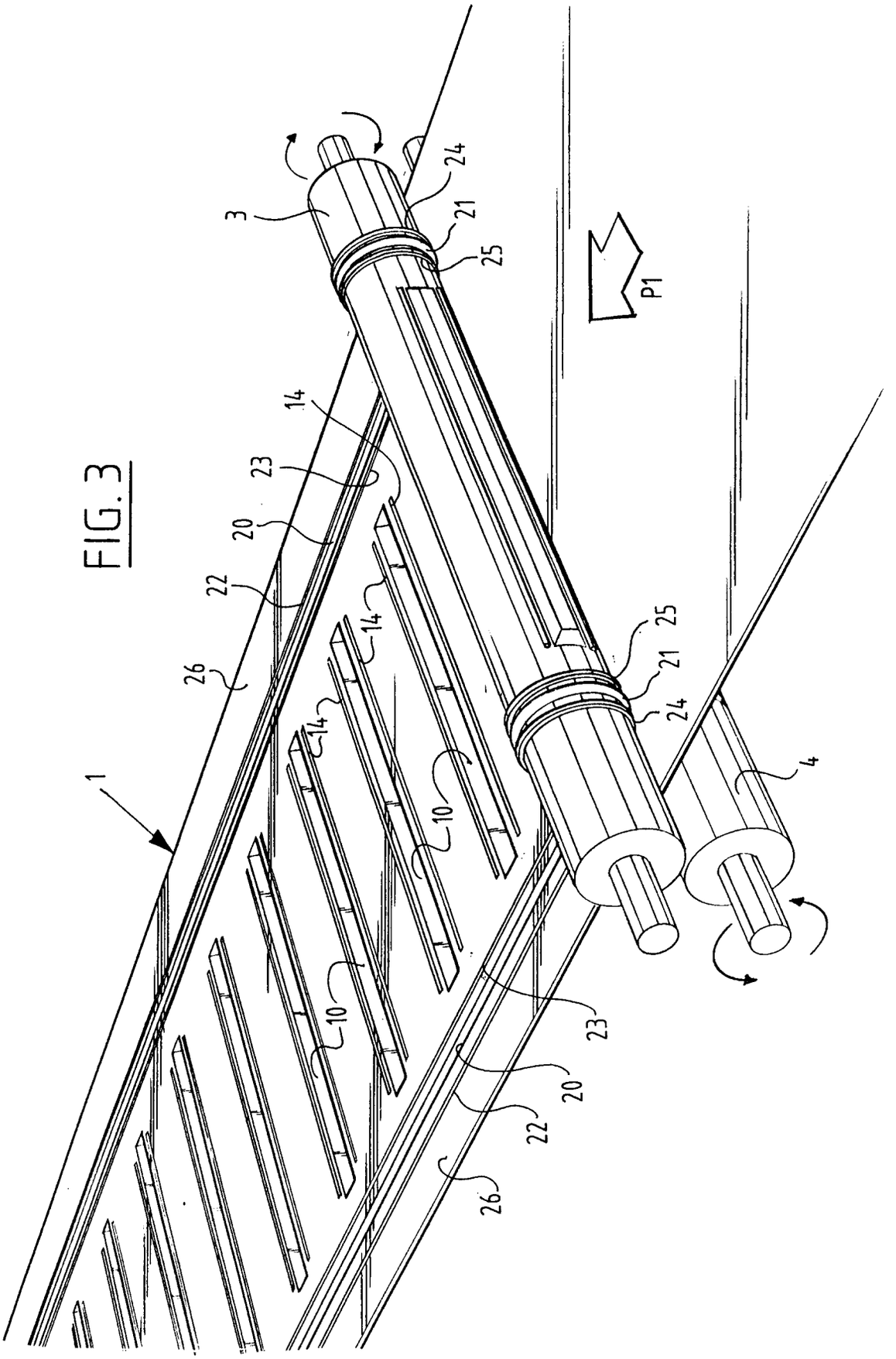


FIG. 2

FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 1157

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)
A	US-A-4 418 558 (BANTAM SYSTEMS) * the whole document * ---	1,6,9	B21D31/04 B21D13/04
A	GB-A-2 252 069 (NIPPONDENSO) * the whole document * ---	1,6,9	
A	US-A-3 673 838 (BROWNBUILT LIMITED) -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 August 1995	Peeters, L

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