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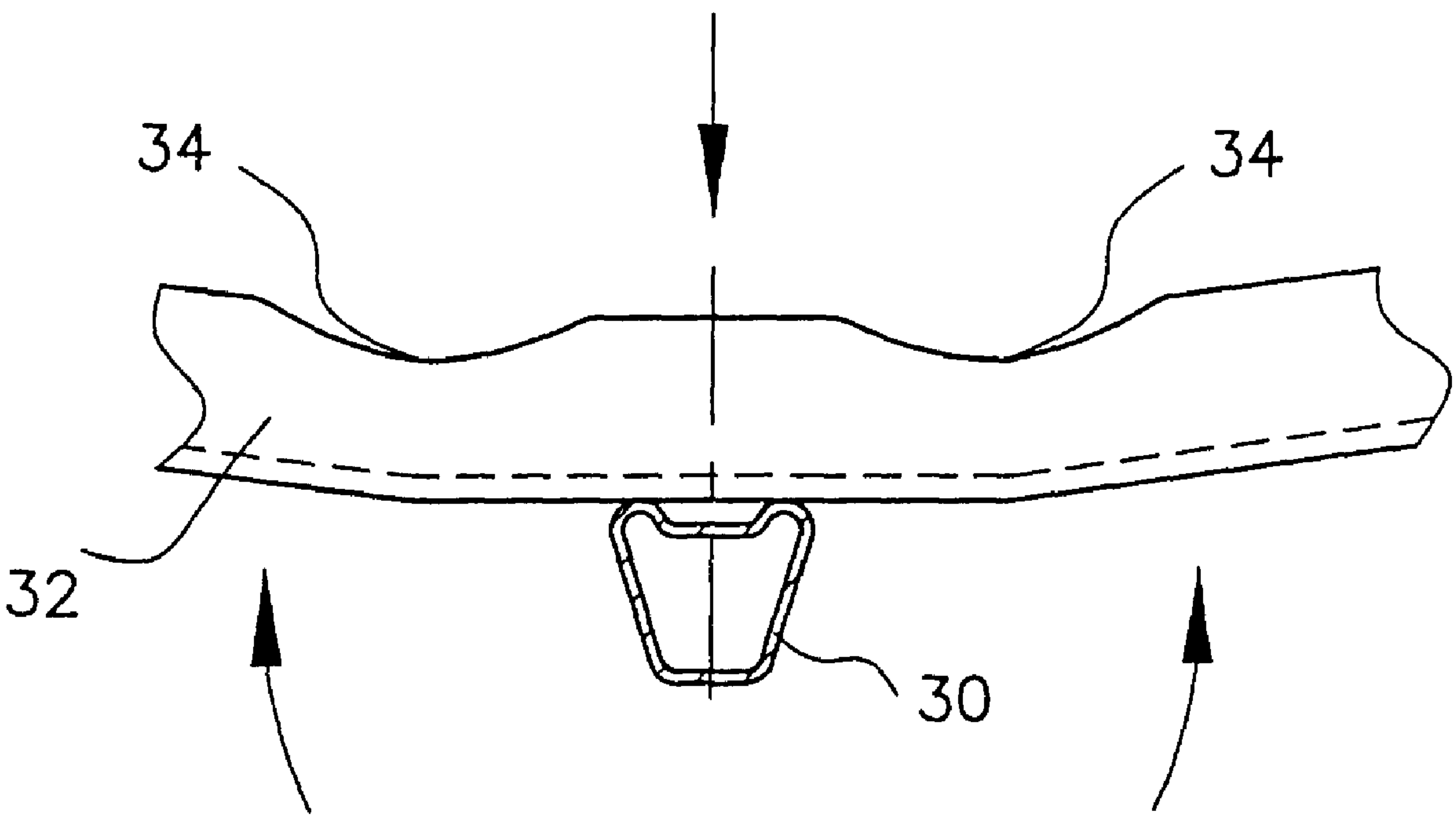

(57) Abrégé/Abstract:
The instant invention relates to a pallet container (10) with a rigid thin-walled inner receptacle (12) from thermoplastic material for storage and transport of fluid or free-flowing loads, with a cage of crossed pipe bars (14) closely surrounding the plastic receptacle (12) as a support jacket and a bottom pallet (16) which supports the receptacle and on which the support jacket is firmly attached, whereby the cage (14) comprises vertical and horizontal pipe bars (30,32) firmly welded to each other. Known pallet containers exhibit considerable flaws (pipe bar fractures due to fatigue) during extended dynamic vibrational stress, as experienced for example through stress due to lengthy transports on bad roads. In accordance with the invention a suitable optimal vibration elasticity with sufficient flexural strength can be realized for improving the cage jacket, by configuring the vertical or/and horizontal pipe bars (30, 32) in their contact plane in the area of an intersection, such that they are free of indentations and each have at least one indentation lateral and at a distance from the intersection (36), respectively the welding point (34).

ABSTRACT

The instant invention relates to a pallet container (10) with a rigid thin-walled inner receptacle (12) from thermoplastic material for storage and transport of fluid or free-flowing loads, with a cage of crossed pipe bars (14) closely surrounding the plastic receptacle (12) as a support jacket and a bottom pallet (16) which supports the receptacle and on which the support jacket is firmly attached, whereby the cage (14) comprises vertical and horizontal pipe bars (30,32) firmly welded to each other.

Known pallet containers exhibit considerable flaws (pipe bar fractures due to fatigue) during extended dynamic vibrational stress, as experienced for example through stress due to lengthy transports on bad roads.

In accordance with the invention a suitable optimal vibration elasticity with sufficient flexural strength can be realized for improving the cage jacket, by configuring the vertical or/and horizontal pipe bars (30, 32) in their contact plane in the area of an intersection, such that they are free of indentations and each have at least one indentation lateral and at a distance from the intersection (36), respectively the welding point (34).

(Fig.1)

PALLET CONTAINER

[0001] The invention relates to a pallet container having a thin-walled inner receptacle made from thermoplastic material for the storage and transport of fluid or free-flowing goods, wherein the plastic container is closely surrounded by an outer cage jacket as a supporting casing of crossed pipe bars and a bottom pallet on which the thermoplastic receptacle is supported and which is firmly connected to the supporting casing.

Prior Art

[0002] Such pallet containers that have a welded pipe bar supporting casing are generally known, as for example in EP 0 734 967 A (Sch). The pipe bar supporting casing of the pallet container disclosed there consists of pipe bars having a circular profile, that are highly compressed at the welded intersection points. From EP 07 55 863 (F) another pallet container is known with pipe bars having a square profiled cross section, that are partially slightly (each about 1mm) compressed at four contact points only in the areas of intersections to facilitate a better welding action, while otherwise, along their entire length retaining a cross section without any indentations, respectively any cross section-reducing dents whatsoever. A further pallet container is known for example from the DE 196 42 242 A, with a cage that has an open trapezoid shaped pipe bars. There, straight surfaces laterally flanged outwards are welded together in the area where the bars intersect. The attachment of the cage jacket at the bottom pallet, which may be configured as flat pallet from plastic or wood or as a steel tube frame, is usually realized by attachment means as for example, screws, brackets, clamps or grips that engage with the lower horizontal and circumferentially extending cage bars. These attachment means are either nailed, riveted, screwed or welded to the upper plate or the upper outer edge of the pallet.

[0003] For industrial use or when the pallet containers are utilized in the chemical industry, they have to pass a governmental approval inspection and fulfill various quality controls. For example, the filled pallet containers have to undergo interior pressure tests and drop tests from specific heights. Pallet containers or combination –IBCs (IBC=Intermediate Bulk Container) of the type discussed here –with a filling volume of usually 1000 liters-, are preferably used in the transport of liquids. Particularly when transporting filled combination-IBCs by truck, considerable gushing motions of the fluid container load occur that are due to transport shocks and the movement of the transport vehicle- particularly, on bumpy roads, thereby exerting constantly changing pressure forces on the interior receptacle walls which in turn lead to radial vibrational motion of the cage jacket (dynamic continuous vibrational stress). Depending on the configuration of the cage jacket during long transports over bad roads, stress builds up so that the cage bars fatigue and break. Consequently, such pallet containers are not suitable, for example for export to the USA , or for multiple usage.

[0004] The drawbacks of the embodiment in the afore-described EP 0 734 967 A are such, that the circular pipe profile of the horizontal and vertical cage pipe bars, particularly in the area of the intersections, are prone to considerable deformation, specifically at the side of the welding points and thus exhibits a markedly reduced section modulus as compared to the other areas. The welding of the pipe bars causes material brittleness precisely in the area of the dented pipe bar profile. Additionally, the pipe bar profile is still deeper indented next to the indentations for the welding points and thus, further weakened.

[0005] It is an object of the present invention to obviate the afore-described drawbacks and to propose a pallet container with improved transport strength that provides a cage jacket with improved resistance against transport stress respectively, against the long-term vibrational motion stress. The pallet container should thus be suitable for transporting dangerous fluids or free-flowing loading goods up to the class 6 (= highest standard of admissions quality).

Solution

[0006] In accordance with the invention, this object is attained by providing a pallet container with a cage jacket of vertical and horizontal steel pipe bars wherein the vertical and/or horizontal steel pipe bars lack any indentations, or are only very slightly indented at the contact plane in the area of the intersecting bars (wherein such a slight indentation in one of the bars is equal or less than twice the thickness of the width of the pipe bar, in concrete terms, about 2mm or less), and each of the pipe bars have at least one indentation laterally next to the intersection, respectively the welding point – a wanted bending point - each of which is located at a distance of about one tenth of the pipe bar width (B) from the welding point. When the wanted bending points are transferred to a certain distance away from the critical welding points to accommodate the varying bending stresses, resulting from vibrations of the cage jacket, the continuous bending stresses no longer occur at the brittle and thus critical welding points, but mainly only on the comparatively noncritical bars themselves, that is, at points of considerably higher bending elasticity and not directly at the stiffened intersections. In order to improve the bending elasticity of the vertical or/and horizontal pipe bars, they can be kept indentations-free at the side opposite the contact plane in the area of the intersection, and each of the pipe bars can be provided with at least one indentation laterally next to the intersection, that is, on the other side of the welding points, as a wanted bending point, each of which can also be at a distance of at least one tenth of the pipe bar width (B).

One embodiment of the present invention provides a pallet container, comprising:

a bottom pallet;

a thin-walled rigid thermoplastic receptacle for storage and transport of a liquid or flowable contents; and

a cage jacket closely surrounding the thermoplastic receptacle and securely connected with the bottom pallet; wherein the cage jacket includes horizontal and vertical hollow bars welded together in a contact area at points of intersection, wherein the hollow bars are provided laterally next to each point of intersection with at least one dimple which is spaced from the point of intersection at a distance of about one tenth of a width of the hollow bar, and wherein the at least one dimple is located on a side of the bar opposite a plane of the contact area.

[0007] An excellent bending elasticity of the cage jacket is realized, when the vertical or horizontal pipe bars between two intersections, at the side of the welding points, respectively at the contact plane or/and at the side opposite the contact plane, are provided with at least two indentations.

[0008] It is very advantageous to provide each of the vertical or/and horizontal pipe bars at the side of the welding points between two intersections, at their contact plane and the side opposite the side of the contact plane, with at least one indentation, such that the indentations are located precisely opposite each other and wherein the indentations are located at a distance from the intersection of at least one tenth of the pipe bar widths (B). Thereby, the neutral phase of the bending stress is located well in the middle of the pipe bar.

[0009] According to one feature of the invention, the depth (T) of one indentation for reducing the height of the profile (H) is kept possibly small, that is, between about 15% and 50%, preferably about 33% of the height of the profile (H). The longitudinal extension of an indentation - in longitudinal direction – should be in the range of one and one half times to three times of the profile width (B), preferably about twice the profile width (B). As a compromise, while least weakening the flexural strength, a sufficiently high bending elasticity in the wanted bending points, respectively the indentations, is thereby realized.

[0010] Since the intensity of the vibrational stress which occurs in the cage jacket of a pallet container filled with fluid varies, the indentations in each of the horizontal or/and vertical pipe bars can be formed with varying depth in dependence of the intensity of the occurring vibrational stress in the various areas of the cage jacket or/and in the horizontal and vertical pipe bars.

[0011] In a preferred embodiment, the vertical or/and horizontal pipe bars are provided with a very specific pipe profile, that is, a closed profile having a trapezoid shaped cross section with longer and shorter parallel extending side walls and two straight side walls which extend obliquely relative to one another, and which, starting from the longer of the parallel side walls extend obliquely towards each other, connect to the shorter wall, and wherein the two straight side walls that are extending obliquely relative to each other form a crown angle of approximately 20° to 45°, preferably about 36°. The trapezoid shaped closed profile of the pipe bar has a high bending section modulus and a high torsion-section modulus due to the profile sidewalls being positioned relative to each other in a slightly oblique manner. This is realized particularly when the height to width (H/B) ratio of the trapezoid shaped tube profile is in the range of 0.8 to 1.0, preferably about 0.86. In one embodiment of the invention, the longer parallel side wall of the pipe bar with the trapezoid shaped profile, partially in the area the intersection of two pipe bars, is indented inwardly along a length of approximately two width of a pipe profile in such a manner, that at each of the two outer longitudinal edges they form an outward curvature (bulging), so that four points are formed at each intersection of the vertically and horizontally extending cage bars that are firmly joined after welding, whereby in each of the cage bar intersections the (longer) parallel walls facing each other are not in contact with each other even after being welded.

[0012] In a preferred embodiment, the longer of the parallel walls of the cage bar with a trapezoid shaped profile is indented inwardly along its entire length (= continuous longitudinal indenting or profiling), such that the two outer longitudinal edges are formed with an outwardly extending curvature (bulging), wherein at each intersection of the horizontally and vertically extending cage bars four contact point are formed, which are firmly connected after being welded so that the (longer) opposing parallel walls are at a distance from each other even after being welded and without contacting each other. In prototypes, the trapezoid shaped cage bars, which are indented along their entire length have proven especially outstanding in their use.

[0013] In a variation of the embodiment, the longer parallel wall of the trapezoid profiled pipe bar may be inwardly indented only partially in the area of an intersection and the longer parallel wall of the other trapezoid shaped pipe bar inwardly indented along the entire length. This may prove already entirely adequate for the average stress load.

[0014] The depth of the profiling indentation of the longer parallel wall is about twice that of the wall thickness of the profiled pipe bar; in an actual pallet container, the profiled pipe bar wall thickness is 1mm and the depth A of the indentation is also 1mm, so that after welding - whereby the contact points of the crossed cage bars melt into each other by about 1mm – it is assured that at each intersection, the long parallel walls facing each other are spaced apart from each other by about 1mm and are not in contact with each other, even after welding. This is particularly important because oftentimes pallet containers are stored outdoors and are thus exposed to the elements of weather. By providing a distance between the cage bars at the points of welding, accumulating rain water can easily dry off and formation of rust is thereby substantially prevented. If the welding surfaces were in contact, the formation of rust would be unavoidable leading to extensive rusting of the cage bars within a short time.

[0015] It is a special feature of the invention, that the pipe bar profile-as compared to the known pipe bar profiles- is not partially indented at the welding points, but is provided with corresponding dents, respectively indentations at a certain distance next to the welding points at the same side or/and at the opposite side of the profile, in order to realize a reduced bending section modulus relative to the intersecting points, and to relieve the welding points of the cage bars of static and/or dynamic stress. The preferred trapezoid profile is configured such that it can be indented easily and without extensive material displacement. Only specific regions of the cage pipe bars (= indentation, respectively denting, as desired formation of "vibration elements") are indented, whereby relief against vibrational stress and the fluctuating flexural tension peaks on the welded intersection or the four welding points is realized. When welding one pipe bar together with a second pipe bar, stiffening of the pipe with an attending material brittleness results at that location making the pipe bar particularly sensitive to vibrational stress at that point. Considerable vibrational stress, which is present, for example, during transport by truck can lead in the shortest time to breaking of the welding points or the pipe bar itself at the welding points.

[0016] In accordance with the invention, the desired "wanted vibration points" in the cage jacket-support casing are not provided precisely at the intersecting points or in the proximate zone thereof, but at least a short distance from the welding points of the intersection. The wanted vibration points, which are provided by forming the indentations, are in any event less than 50% of the cross section of the pipe bar. They are arranged in the range of 10 % to 45% of the height of the pipe bar cross section, preferably about 1/3 (33%). The flexural strength of the indented pipe bars is thereby somewhat reduced, but the proneness to fractures due to fatigue is considerably reduced.

[0017] The invention is explained and described in greater detail hereinafter with reference to embodiments, which are illustrated in the drawings. It is shown in:

[0018] FIG. 1 a front view of a pallet container according to the invention;

[0019] FIG. 2 a side view of a testing-pallet container;

[0020] FIG. 3 an sectional illustration on an enlarged scale of the trapezoid shaped pipe bar profile according to the invention at a pipe bar intersecting point;

[0021] FIG. 4 a further sectional illustration on an enlarged scale of a preferred trapezoid shaped pipe profile at a pipe bar intersecting point;

[0022] FIG. 5 a schematic sectional illustration of a hydro-dynamic pressure effect of a fluid load on the container side- wall;

[0023] FIG. 6 a horizontal partial sectional illustration of a point of greatest outward deflection of the cage;

[0024] FIG. 7 an enlarged illustration of an intersection of pipe bars with indentations;

[0025] FIG. 8 a trapezoid shaped cross section of a pipe bar according to view D of FIG. 7;

[0026] FIG. 9a an indentation of a trapezoid shaped cross section of a pipe bar (narrow side) C-C;

[0027] FIG. 9b an indentation of a trapezoid shaped cross section of a pipe bar (broad side) C-C;

[0028] FIG. 10 a square shaped profile of a cross section of a pipe bar – unstressed;

[0029] FIG. 11 the square shaped profile of a cross section of a pipe bar according to FIG. 10- stressed-overstressed;

[0030] FIG. 12 a profile of a pipe bar according to the invention – unstressed;

[0031] FIG. 13 the profile of a pipe bar according to the invention according to FIG. 12 – stressed;

[0032] FIG. 14 another pipe bar profile according to the invention with two indentations;

[0033] FIG. 15 a further pipe bar profile according to the invention with four indentations;

[0034] FIG. 16 a partial top view of a corner arc of the pipe profile according to the invention;

[0035] FIG. 17 a square shaped pipe bar profile with two indentations;

[0036] FIG. 18 another square shaped pipe bar profile with two-four indentations;

[0037] FIG. 19 a circular cross section of a pipe bar with two indentations;

[0038] FIG. 20 an open trapezoid shaped pipe bar profile with two indentations; and

[0039] FIG. 21 a further circular cross section of a pipe bar with two indentations.

[0040] In Figure 1 referenced with numeral 10, is a pallet container according to the invention which shows a thin-walled blow-molded rigid inner receptacle 12 made of thermoplastic material (HD-PE) with an upper input opening and a cage of intersected pipe bars 14 closely enveloping the inner receptacle, and which is firmly but detachably or interchangeably connected to the bottom pallet 16. The front view as depicted exhibits the narrow side of the pallet container 10 with an exit valve disposed at the plastic receptacle 12 near the bottom. The lower front edge of bottom pallet 16, here shown in configuration as a wooden pallet (US Runner), with the exit valve situated above, represents the most vunerable point of the pallet container, which is exposed to the greatest stress during approval testing, especially during the diagonal drop test. The special configuration of the cage bars with indentations (cf. Fig. 7) are shown in the circles.

[0041] Prior to the development of the pallet container according to the invention, five different pallet containers known and available on the market were submitted to the precise comparative stress tests (interior pressure test, drop tests, vibration tests, test for pressure capacity upset, respectively testing stacking capacity). In serial vibration tests during simulation of long haul truck transport on bad roads, certain particularly frequently occurring weak points in various cage jackets could be isolated.

[0042] The test pallet container 10 (here shown without the elasticity promoting indentations) shown in Figure 2, which for testing purposes was also deliberately submitted to continuous overload testing, is shown with circles drawn to illustrate those points marked at the horizontal and vertical cage bars, which fail and begin to break first according to the comparative testing results during dynamic vibration stress, (cf. FIG. 10, 11).

[0043] Figure 3 shows an area of intersection of a closed pipe bar profile 18 having a trapezoid shaped cross section in accordance with the invention, a longer wall and a shorter wall extending parallel to each other 20, 22 and the two straight walls 24 extending obliquely relative to each other, and beginning from the longer parallel wall 22 they extend obliquely and connect to the shorter wall 20, whereby the two straight side walls of profile 18 which extend obliquely relative to each other form a crown angle 26 in the range of 20° to 45°, preferably about 36°. The ratio of height to width of the trapezoid shaped profile of the pipe bar is in the range from 0.8 to 1.0, – preferably about 0.86. Due to the relatively great height of the trapezoid shaped profile (without dents in the oblique side walls) a correspondingly high flexural stiffness is realized, and due to the closed and compact configuration of the trapezoid shaped profile, the pipe bars exhibit an improved torsional stiffness as compared to pipe bar profiles that are configured with a circular profile or those having an open profile. The distance of the intersection of the extended horizontal axis of the walls 24 extending obliquely relative to each other at crown angle 26 is about the height H of the profile or, measured beginning from the longer parallel wall 20 is about 2H. The distance can be in the range of 0.75 and 2.5 H.

[0044] The trapezoid shaped profile 18, preferably utilized is depicted in Figure 4. In a simple embodiment, the longer parallel wall 22 is only partially inwardly dented in the area of the intersection of two pipe bars in such a manner that at each of the two outer longitudinal edges a curvature 28 (bulge) is formed that bulges outwardly, so that at each intersection of the horizontally and vertically extending pipe bars, four contact points are formed, which after being welded, are firmly connected to each other, whereby the longer parallel walls 22 in each pipe bar intersection are still spaced apart from each other without any contact even after welding.

[0045] In an especially preferred embodiment, the longer parallel wall 22 is dented inwardly along the entire length of the pipe bars, wherein the two outer longitudinal edges are provided with an outwardly bulging curvature 28. The pipe bar having the indented trapezoid shaped profile 18 has proven outstanding and is being manufactured from a circular pipe template having a diameter of 18mm (56. 55mm in circumference). The depth of indentation of the longitudinal profile should be about once or twice that of the wall thickness of the pipe bar (about 1mm to 2mm); in a fully formed pallet container the wall thickness of the pipe bar is 1mm and the depth of the indentation 1 mm. The welding at each of the four contact points at each intersection of the pipe bars is carried out by means of electrical resistance pressure welding. When carrying out the four-point welding, the crossing cage bars are being pressed together about 1mm, so that the opposing parallel walls 22 in each intersection are still distanced from each other by about 0.5 mm to 2mm, preferably, about 1mm and are not in contact with each other even after being welded. (distance A= 1mm). This is a particularly important aspect, since pallet containers oftentimes are stored outdoors and are exposed to the weather. By distancing the cage bars from each other at the welding points, rain water which might accumulate there dries off by exposure to air and thus, rusting is substantially prevented. Welding surfaces that are abutting each other are inevitably prone to formation of rust, which can lead to heavy rusting of the entire cage in the shortest time. Illustration of the cross section also clearly shows that the width of the (longer) parallel wall 22 that remains between the outwardly bulging edges 28 is approximately the same as the width B1 of the opposite (shorter) parallel wall 20.

[0046] In Figure 5, the schematic representation of the changing deforming deflection of the cage jacket due to dynamic vibrational stress is illustrated. The hydrostatic interior pressure of the fluid goods load - illustrated in the right hand side, causes the maximal cage deflection D_a, D_i occurring approximately at the level of the center of gravity S of the loaded goods, which means at about 33% of the cage height, and at that level the vibration amplitude toward the outside is approximately two times that of the inside, which is the reason the greatest danger of crack formation in the cage pipe bars during vibrational stress is in the area of the lower half of the cage.

[0047] The schematic representation of a partial sectional view in Figure. 6 illustrates the horizontal cross section at the location of the maximal deformation effect D_a and D_i. There is no interference of vibrational deflection directed towards the outside, while inside the fluid column encounters the opposite side wall. The lower circumferential horizontal cage bars 30 are thus submitted to great bending stresses particularly in the vicinity of the corner bends 38.

[0048] Figure 7 shows – in an interior view of the cage - the intersection 36 of a horizontal pipe bar 30 with that of a vertical pipe bar 32. In the intersection 36, the four welding points are indicated. The trapezoid shaped pipe profile of horizontal bar 30 and that of the vertical bar 32 is provided each with one indentation 34 at each side exactly next to the intersection 36, respectively the four welding points, wherein the indentations 34 are distanced to the point of intersection 36 by at least one tenth of the pipe bar width B. View D of the non-deformed trapezoid shaped profile 18 is shown in Figure 8 and a sectional illustration of the indentation 34 along the line C-C is shown in Figure 9b. The indentations 34 in the pipe bar can be made on the side of the ("longer") parallel wall 22 (Fig. 9b) or/and on the side of the opposing ("shorter") parallel wall 20 according to Figure 9a. Numerous variations may thereby be realized, so that between two cage bar intersections at least two indentations may be provided at the outer side of the trapezoid shaped profile or/and two indentations may also be provided at the inner side. It is however significant that the pipe bars in these embodiments are not indented or deformed directly at the point of intersection or respectively at the welding points, but only next to them.

[0049] When reducing the height H of the profile, the depth T of one indentation 34 should be kept low if possible, i. e. in the range of 15% and 50%; in a preferred embodiment, the depth T of the indentation is about 33% of the height H of the profile. The longitudinal extension of indentation 34 along the bar should be in the range of about one and one half to three times the width B of the profile, and in a preferred embodiment, the longitudinal extension of an indentation 34 is about twice that of the profile width B.

[0050] Figure 10 shows an unstressed pipe profile of the known type having a square shaped profile along the entire length of the bar. Already after a relatively short period of dynamic vibrational stress, formation of a crack is seen on the horizontal bar 30' directly at the intersection, respectively at the welding points, as is illustrated in FIG. 11.

[0051] The formation of cracks or respectively, the tearing of the cage bars always occurs in the area of highest pull tensions, or at the location where the greatest bulging of the cage jacket occurs. The vertical pipe bars are arranged at the inside of the cage jacket and the horizontal pipe bars are arranged at the outside. Cracks and fracture points always occur in the area of the intersection directly next to the welding points (cf. circled views in FIG. 2). Cracks start forming at the vertical pipe bars – and relative to the jacket always travel from the outside to the inside and always start on the inside of the horizontal bars travelling to the outside. In comparative tests, it has been found that the cage jackets made from cage bars with an open profile and provided with flat outwardly angled edges exhibit good stacking capacity because the welding points are relatively far part from each other within the intersection, but they react most unfavorable to vibrational stress.

[0052] As compared to the square shaped pipe profile, in Figure 12, a closed trapezoid shaped pipe profile 18 in accordance with the invention, is shown with two indentations 34 in a horizontal bar 30. As illustrated in exaggerated manner in Figure 13, crack formation does not occur even after prolonged exposure to vibrational stress. On the one hand, this is due to the intersecting area at the welding points lacking weakness-inducing indentations and therefore is very stable, while on the other hand, the indentations 34 reduce the bending section modulus and function as a kind of "bending hinge" when located at least at a small distance from the intersection thereby acting to prevent the peak tensions impacting upon the sensitive welding points and deflecting them towards more distant flexible areas.

[0053] An indentation, which acts as a wanted bending point represents a reduction in the height of the pipe bar profile H and serves as a stress reduction against the occurring vibrational stress at the sensitive welding points at critical stress peaks during changing bending stresses. Thus, during occurrence of the dynamic vibrational stress, the critical tension peaks are shifted away from the welding points to adjacent areas at a distance thereto. By means of this special configuration, a substantial reduction in static or dynamic stress on the welding connections is realized by means of the indentations on the pipe bars, which are provided laterally next to the welding points and which reduce the peak-stress, so that the welding points are provided not in a deformation zone, thus retaining their high flexural strength.

[0054] The special problems in constructing a particular embodiment of a cage jacket is that the vertical and horizontal cage bars should be as stable and rigid as possible in order to prevent excessive bulging of the pallet container which is, for example, exerted by interior pressure; and on the other hand, a high bending section modulus should be provided to counteract constant dynamic vibrational stress, wherein the two afore-mentioned criteria operate in opposite directions. While considering favorable, i.e. low production costs, an optimal solution must be found. Thus, known pallet containers having cage bars with an even profile along the length of bar, as for example according to DE 297 19 830 U1, according to latest trends in the present invention, are not suitable as containers for carrying dangerous fluid loads submitted to dynamic vibrational stress; but may be suitable as storage containers, not as a transport container undergoing dynamic vibration stresses. The afore-cited patent publication is based on the prior art insofar as the known pallet container has a cage jacket made from pipes with a circular cross section that are provided with indentations at least at the welded pipe intersections. A statement on page 2 of that patent disclosure which states "....by using a profiled pipe (there) according the invention (without any localized indentations) local tension accumulation is avoided...." does not correctly state the latest trends in the present invention and simply shows that the effect of the opposite connection between flexural strength and vibration elasticity have not been taken into account when such cage jackets of pallet containers are submitted to transport stress.

[0055] The depth T of the indentations 34 in the trapezoid shaped profile according to the invention are approximately 25% and 50%, preferably approximately 33% of the height H of the pipe bar profile. An indentation by 5mm (=33%) is generally sufficient for a pipe having a height of 15mm, whereby the vibrational stress at the welding points is either kept low or is eliminated while retaining a sufficiently high rigidity in the pipe. This rigidity is important in order to keep the vibration amplitude of the lateral bulging of the vibrating cage at a low level.

[0056] Figure 14 illustrates an embodiment having two indentations 34 at the side of the pipe bar profile facing away from the welding points with the short parallel wall 20, and which - as is shown in Figure 15 - illustrates a modified and particularly useful variation of that embodiment. The trapezoid shaped pipe profile 18 is provided with indentations 34, each at the side of the shorter parallel wall 20 and on the side of the longer parallel wall 22 laterally next to an intersection 36, so that the indentations are exactly opposite each other. The indentations are spaced here at a distance of approximately one tenth of the width B of the pipe bar profile from the intersecting point 36. Placing the indentations 34 in each of the parallel extending side walls 20, 22, particularly enhances the "hinge effect" or the elasticity of the pipe profile.

[0057] According to the technical teaching of the present invention, the configuration of the indentations 34 in the horizontal and vertical pipe bars 30, 32 can be of different depth depending on the intensity of the dynamic stress expected to bear on the cage jacket 14. Thus, in accordance with a specific demand or need, while retaining sufficient flexural strength, the optimal vibrational elasticity in the horizontal and vertical pipe bars can be controlled in various areas of the cage jacket, for example in the longer side walls, or the shorter front and rear walls of the pallet container.

[0058] Figure 16 illustrates a further important embodiment for reducing the bad effects of the dynamic vibrational stress of the horizontal pipe bars. In the region of the corner areas, bent 90° and parallel to the vertical, the horizontal pipe bars 30 of the cage jacket 14 are flattened, such that they also act as a hinge-type "bending joint". In the corner areas, the horizontal pipes need not possess a high bending resistance, of greater importance here is a higher elasticity. Particularly favorable test results were realized with pallet containers that have horizontal pipe bars 30 which are flattened in the corner areas 38 of support jacket 14 from the inside and/or from the outside by at least one fourth of the height H of the diameter of the profile 18. In one of the embodiments actually built, the horizontal pipes in the lower region of the cage jacket are flattened from the inside by about 20 % and form the outer corner arch by about 35%, while of flattenings in the upper region of the cage jacket are configured so they are incrementally reduced.

[0059] In Figure 17 an intersection of two pipe bars with a special square shaped profile 42 is depicted. There, the pipe walls are slightly indented along the entire length if the bar, so that at the intersection of the pipe bars a four-point contact is realized, by which the pipe bars are welded to each other. In section along plane C-C an indentation is shown. Figure 18 shows a similar pipe bar profile 44 with a square shaped cross section of the vertical and horizontal pipe bars, wherein here, a partial indentation of one of the pipe walls was only formed in the area of the intersection such, that a four-point contact by which the two crossing pipe bars are welded to each other was likewise realized. Section along plane B-B also shows an indentations 34.

[0060] The vertical or/and horizontal pipe bars can have a closed profile with a round, respectively circular cross section. Such a circular profile 46 with an indentation 34 along section line A-A is shown in Figure 19. In another embodiment, the vertical and horizontal pipe bars can have an open profile with a trapezoid shaped cross section. Figure 20 illustrates such an open trapezoid shaped profile 48 with an indentation 34 along section line D – D.

[0061] Finally, in Figure 21, a further circular pipe profile 50 is shown, wherein the crossing pipe bars are only partially indented in the area of the intersection 52, so that a preferred four point contact is realized by which the two pipe bars are welded to each other. Here, the wanted bending points, respectively the indentations 34 are provided at the side opposite the welding point.

[0062] It is understood that the variations as shown can be combined in various ways and that other combinations are also within the ambit of the invention.

[0063] The above-presented possible variations, particularly the lower region of the cage jacket can be provided with different means for realizing sufficient flexural strength with an optimal suitable pipe bar elasticity.

REFERENCE NUMERAL LIST

10	pallet container
12	inner receptacle HD-PE
14	cage jacket
16	bottom pallet
18	trapezoid profile
20	short parallel wall
22	long parallel wall
24	straight slanted wall
26	crown angle
28	convexity (bulging)
30	horizontal bar
32	vertical bar
34	indentation (30, 32)
36	intersection (30, 32)
38	corner arc (30)
40	flattening (38)
42.	square profile I
44.	square profile II
46	circular profile I
48	open trapezoid profile
50	circular pipe bar profile II
52	intersection (50)

A	distance (22-22)
B	width pipe profile
B_1	reduced width (22)
H	height pipe profile
S	load-point of gravity
T	depth indentation (34)
D_a	outer deformation
D_i	inner deformation

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A pallet container, comprising:
a bottom pallet;
a thin-walled rigid thermoplastic receptacle for storage and transport of a liquid or flowable contents; and
a cage jacket closely surrounding the thermoplastic receptacle and securely connected with the bottom pallet; wherein the cage jacket includes horizontal and vertical hollow bars welded together in a contact area at points of intersection, wherein the hollow bars are provided laterally next to each point of intersection with at least one dimple which is spaced from the point of intersection at a distance of about one tenth of a width of the hollow bar, and wherein the at least one dimple is located on a side of the bar opposite a plane of the contact area.

2. The pallet container according to claim 1, wherein the hollow bars are characterized in the contact area by an absence of dimples.

3. The pallet container according to claim 1, wherein the at least one dimple has a depth of about 2 mm.

4. The pallet container according to claim 1, wherein at least one of the vertical hollow bars and horizontal hollow bars is provided between two points of intersections on the contact area with said at least one dimple or on the opposite side of the contact area with said at least one dimple, wherein the dimple on one side and the dimple on the other side are disposed in a precise confronting relationship at a distance to the points of intersection of about one tenth of the width of the hollow bar.

5. The pallet container according to any one of claims 1 to 4, wherein the hollow bars have a cross section defined by a height, and a depth of each of the dimples being between about 15% and 50% of the height.

6. The pallet container according to claim 5, wherein the depth of each of the dimples is about 33% of the height.

7. The pallet container according to any one of claims 1 to 4, wherein the hollow bars have a cross section defined by a width, wherein each of the dimples has a length which, as viewed in a longitudinal direction of the bars, is approximately between one and one half to three times the width of the cross section.

8. The pallet container according to claim 7, wherein the length is about twice the width of the hollow bar.

9. The pallet container according to any one of claims 1 to 5, 7 and 8, wherein the dimples in the hollow bars are configured with varying depths in dependence on an intensity of dynamic vibrational stress encountered in various sections of the cage jacket or in the horizontal and vertical hollow bars.

10. The pallet container according to any one of claims 1 to 6, wherein the vertical or horizontal hollow bars, or both, have a closed profile of a trapezoid cross section, thereby defining a longer wall and a shorter wall in parallel relationship, and two straight walls extending obliquely relative to each other toward one another from the longer wall toward the shorter wall at an angle between 20° and 45°.

11. The pallet container according to claim 10, wherein the angle is about 36°.

12. The pallet container according to claim 10 or 11, wherein the trapezoid cross section is defined by a height and a width, wherein the ratio between height and width is in the range between 0.8 and 1.0.

13. The pallet container according to claim 12, wherein the ratio is about 0.86.

14. The pallet container according to any one of claims 10 to 13, wherein the longer wall of the trapezoid-shaped profile of the hollow bar is inwardly indented along an entire length of the hollow bar to define two outer longitudinal edges which are each formed with an outwardly projecting bulge so as to provide at each point of intersection of vertical and horizontal hollow bars four contact points which are firmly connected to each other after welding, wherein at each point of intersection of the hollow bars confronting ones of said longer wall are still spaced from each other and without being in contact.

15. The pallet container according to claim 10, wherein the longer wall of one of the hollow bars is spaced from a longer wall of another one of the hollow bars at a point of intersection by a distance of about 0.5 mm to 2 mm after the welding.

16. The pallet container according to claim 15, wherein the distance is about 1 mm.

17. The pallet container claim according to claim 14, wherein a remaining portion of the longer wall between the bulged outer longitudinal edges has a same width as a width of the opposite shorter wall, as viewed in cross section of the trapezoid-shaped profile.

18. The pallet container claim according to claim 14, wherein a remaining portion of the longer wall between the bulged outer longitudinal edges has a same width as a width of the opposite shorter wall, as viewed in cross section of the trapezoid-shaped profile.

19. The pallet container according to any one of claims 1 to 4, wherein the hollow bars have an open profile with a cross section which has a trapezoid or substantially trapezoid configuration.

20. The pallet container according to any one of claims 1 to 4, wherein the hollow bars have a closed profile with a rectangular cross section, a square cross section, a round cross section or a circular cross section.

21. The pallet container according to claim 1, wherein the hollow bar is slightly inwardly indented by about no more than 2 mm along an entire length of the hollow bar to define two outer longitudinal edges which are each formed with an outwardly projecting bulge so as to provide at each point of intersection of vertical and horizontal hollow bars four contact points which are firmly connected to each other after welding, wherein at each point of intersection of hollow bars confronting ones of said longer wall are still spaced from each other and without being in contact.

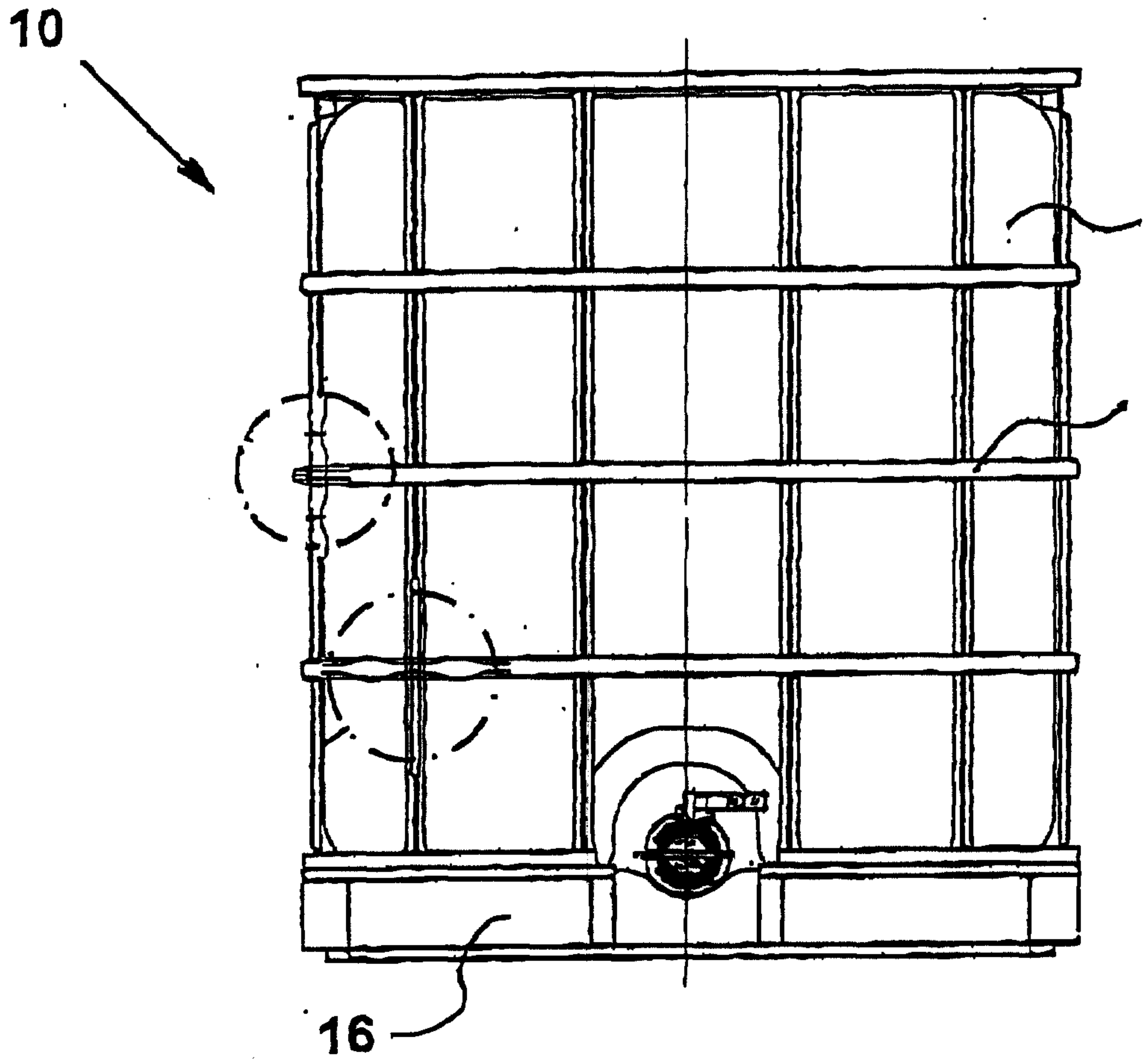

Fig. 1

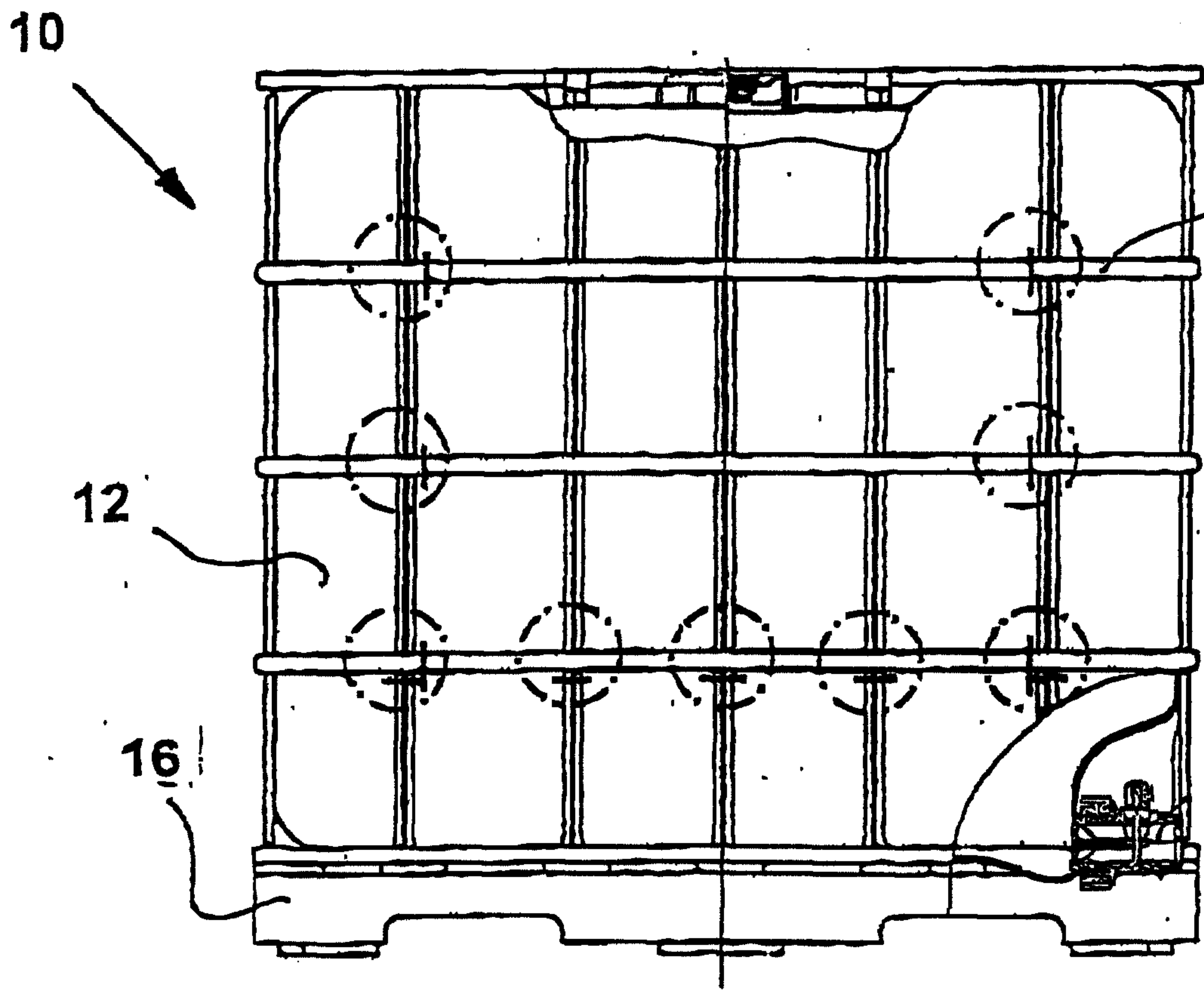

Fig. 2

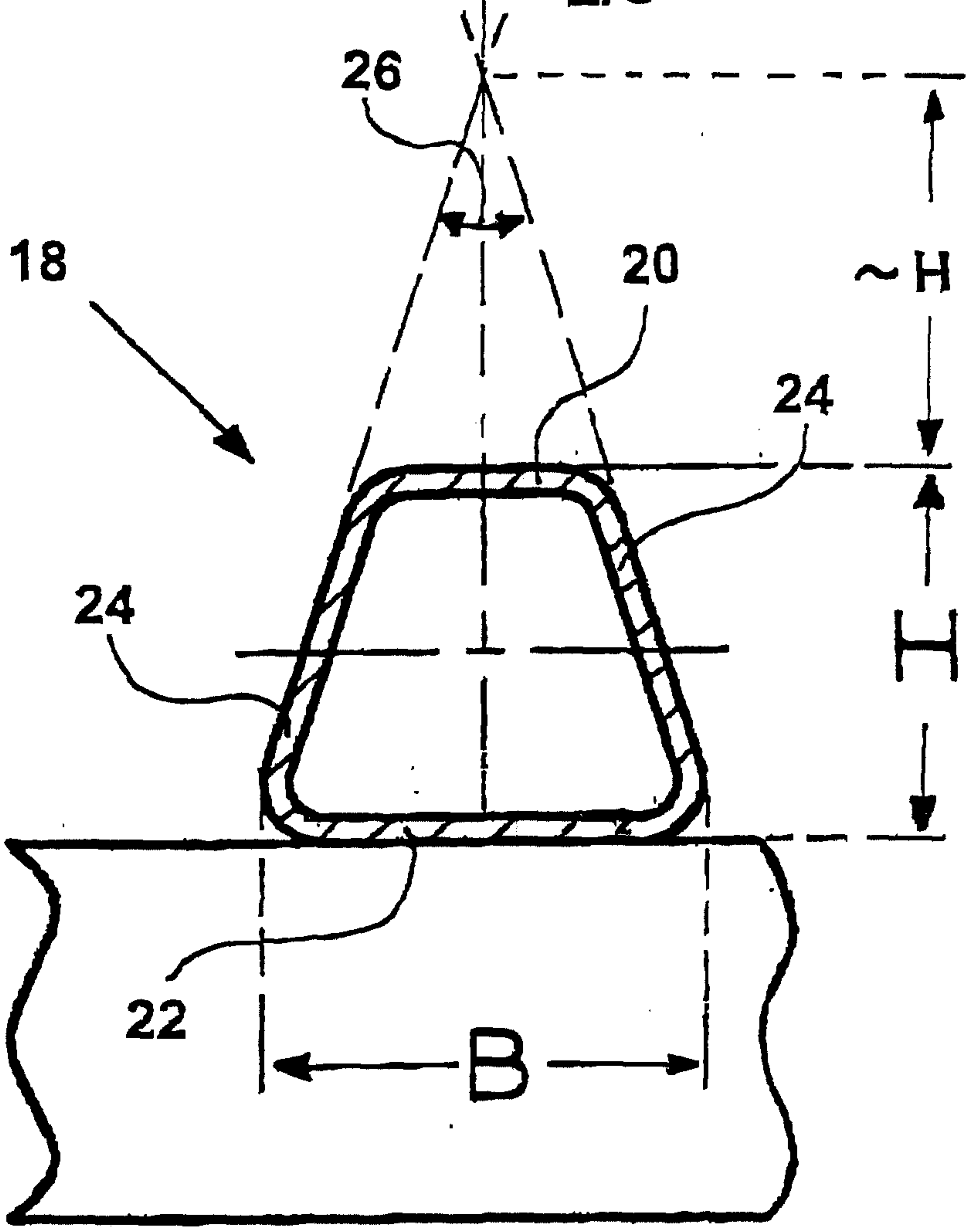

Fig. 3

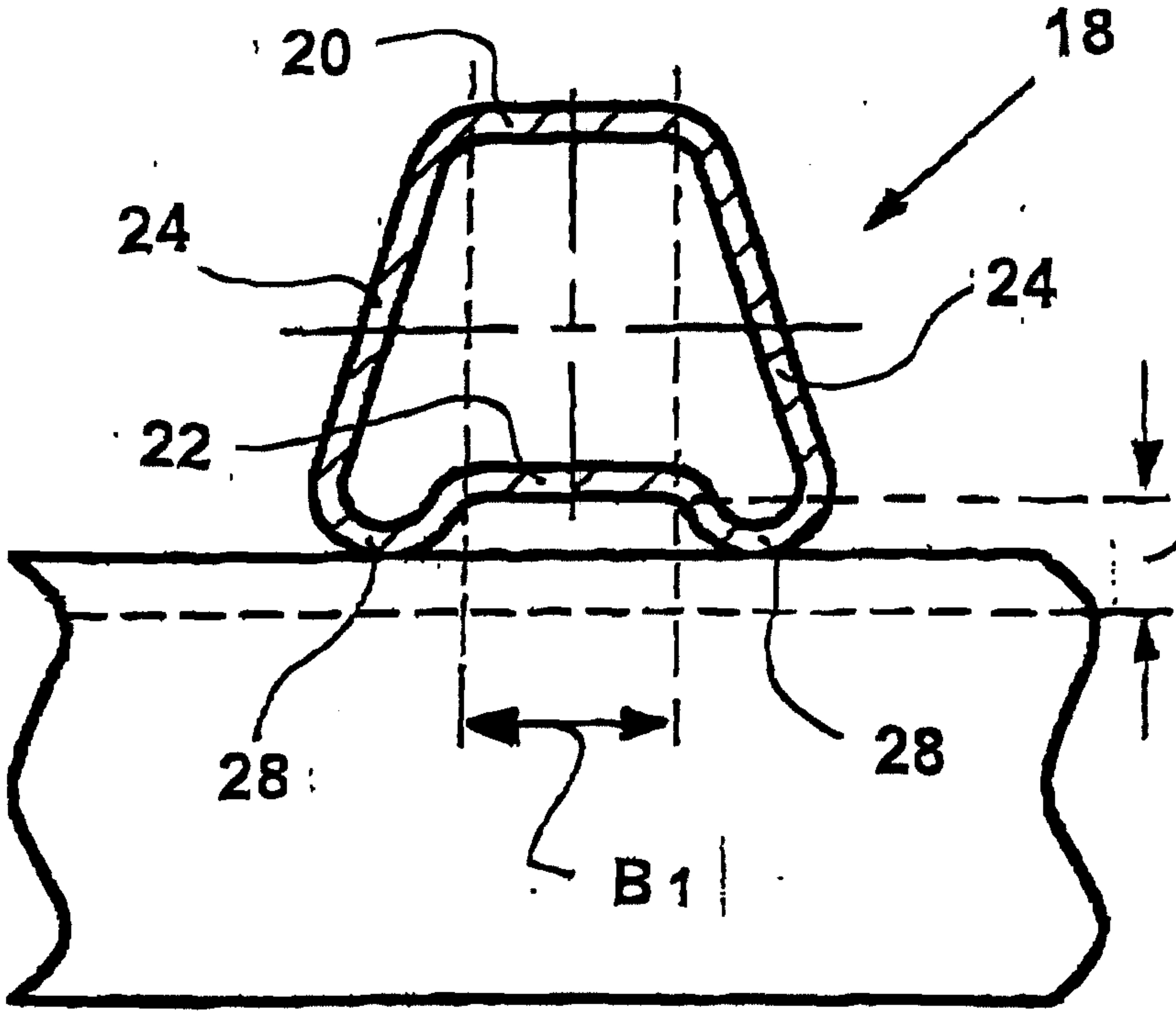

Fig. 4

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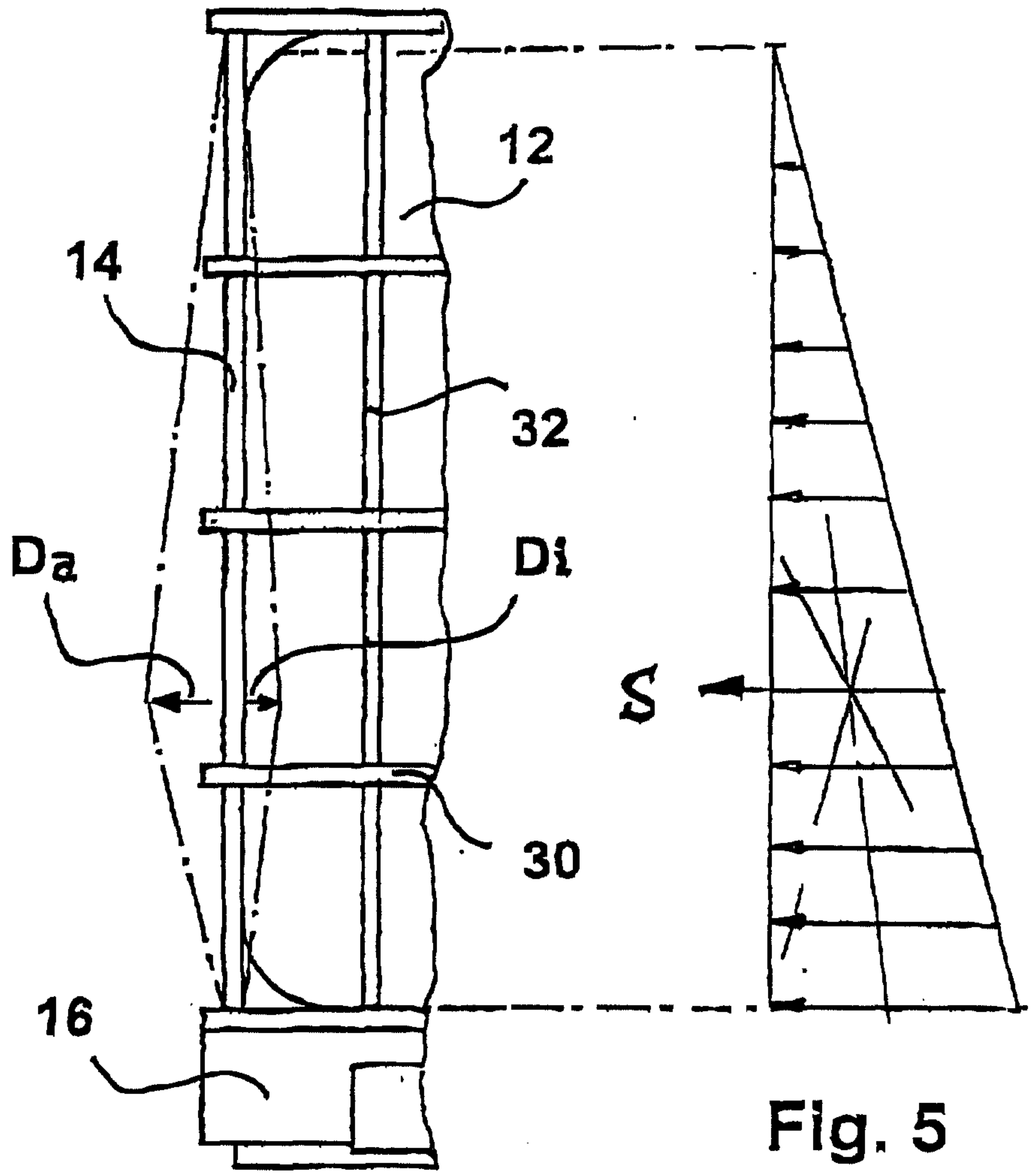

Fig. 5

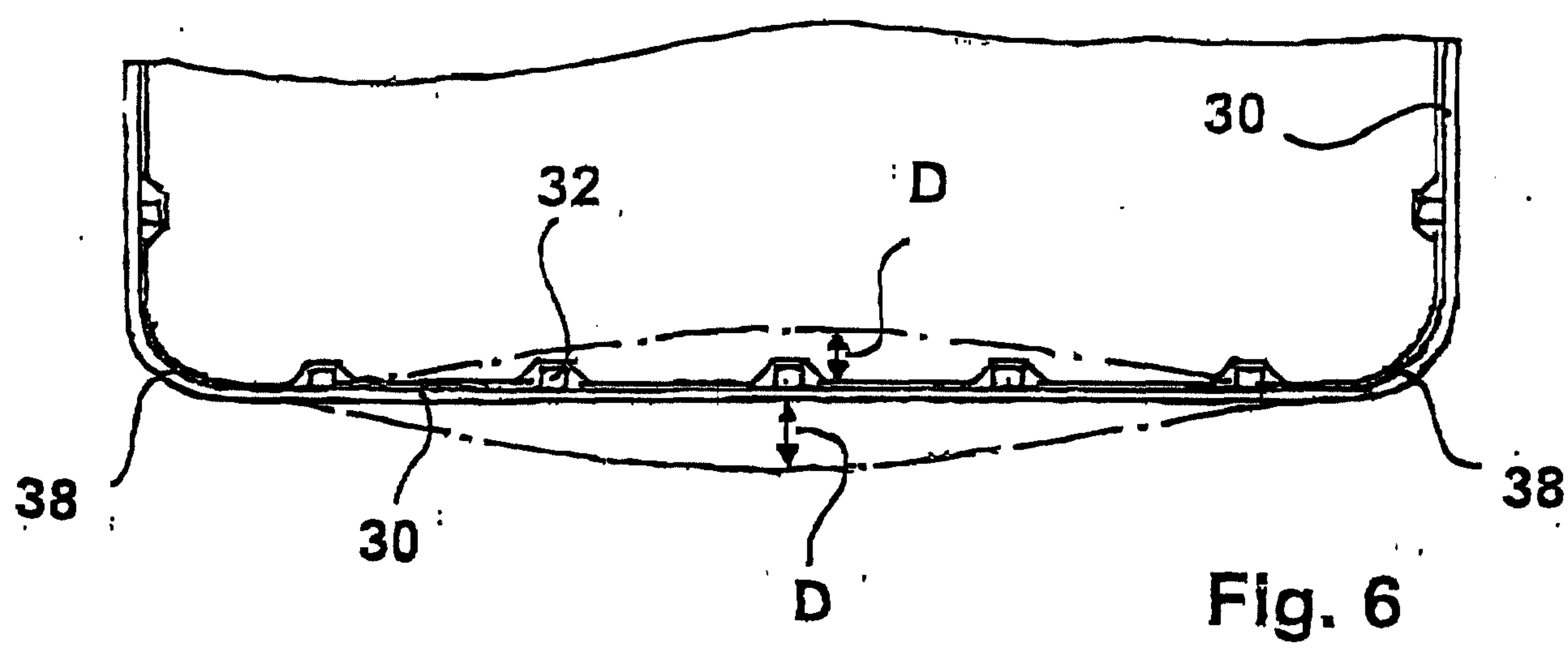

Fig. 6

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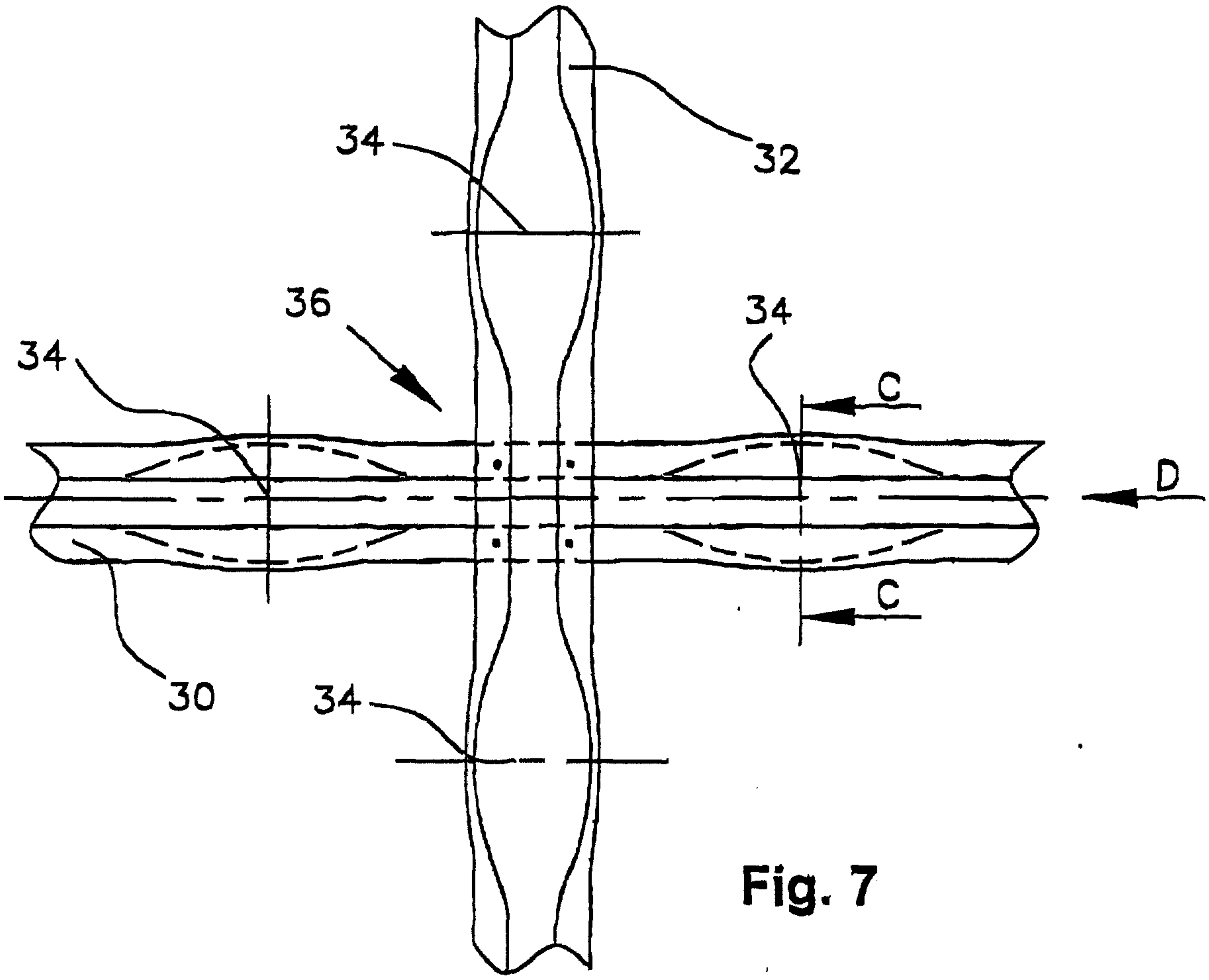

Fig. 7

View D

Plane C–C

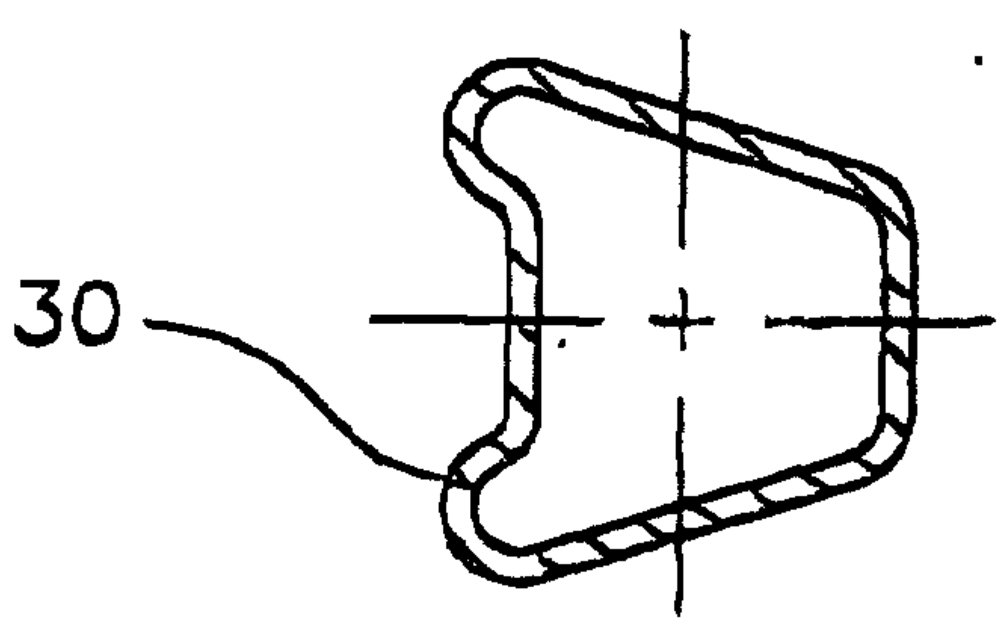

Fig. 8

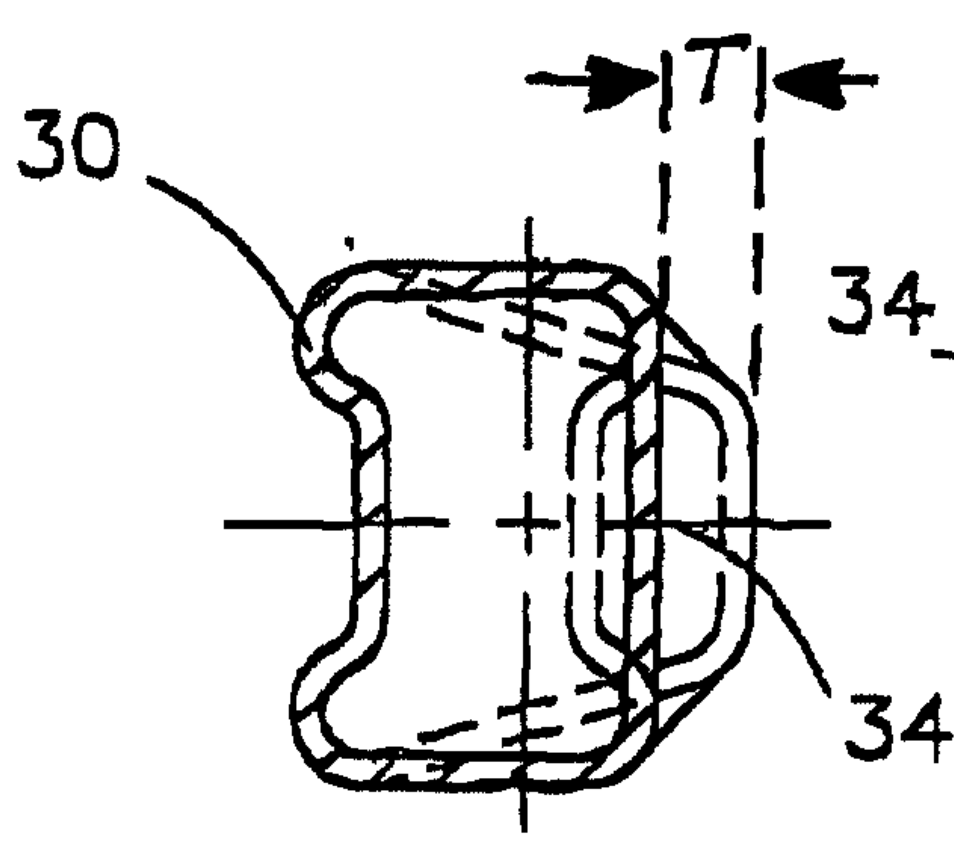

Fig. 9a

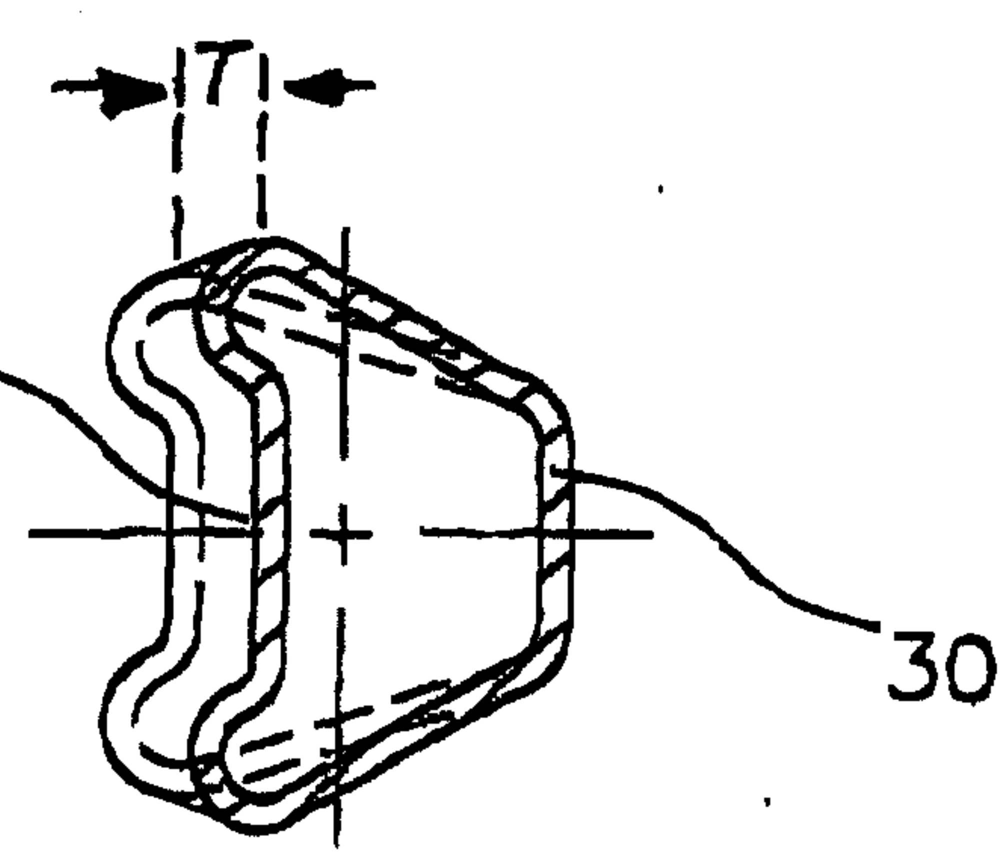

Fig. 9b

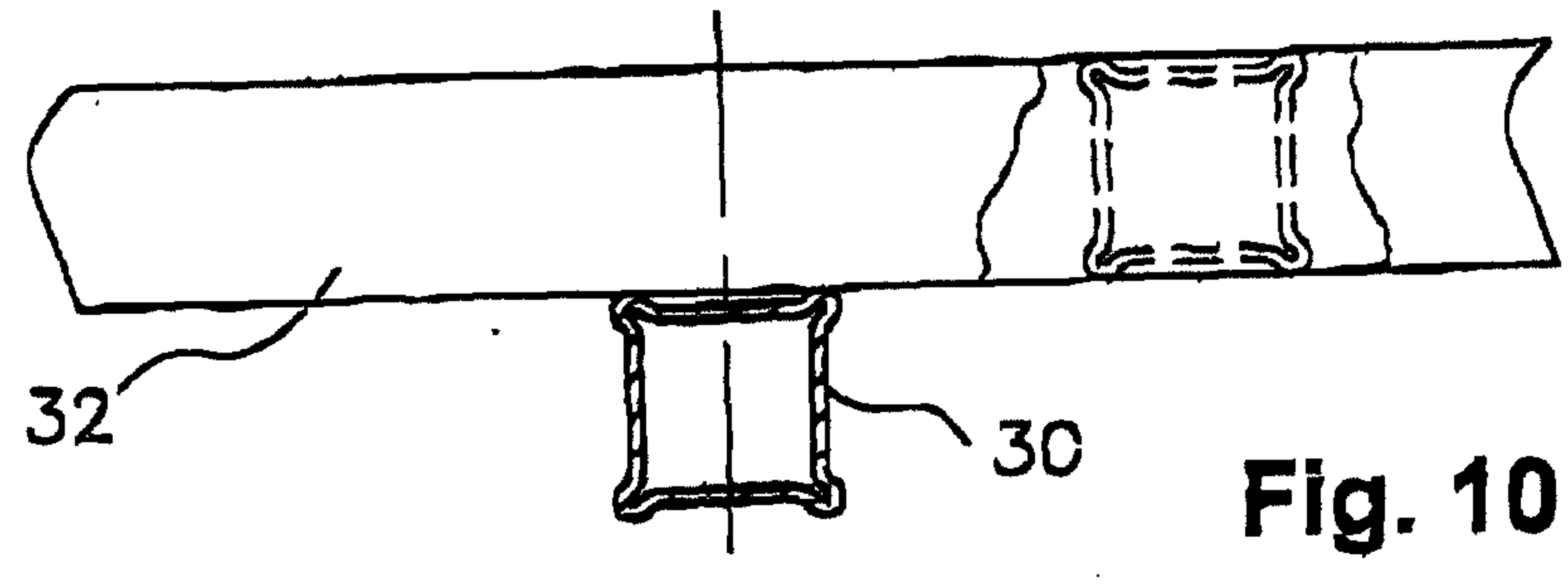

Fig. 10

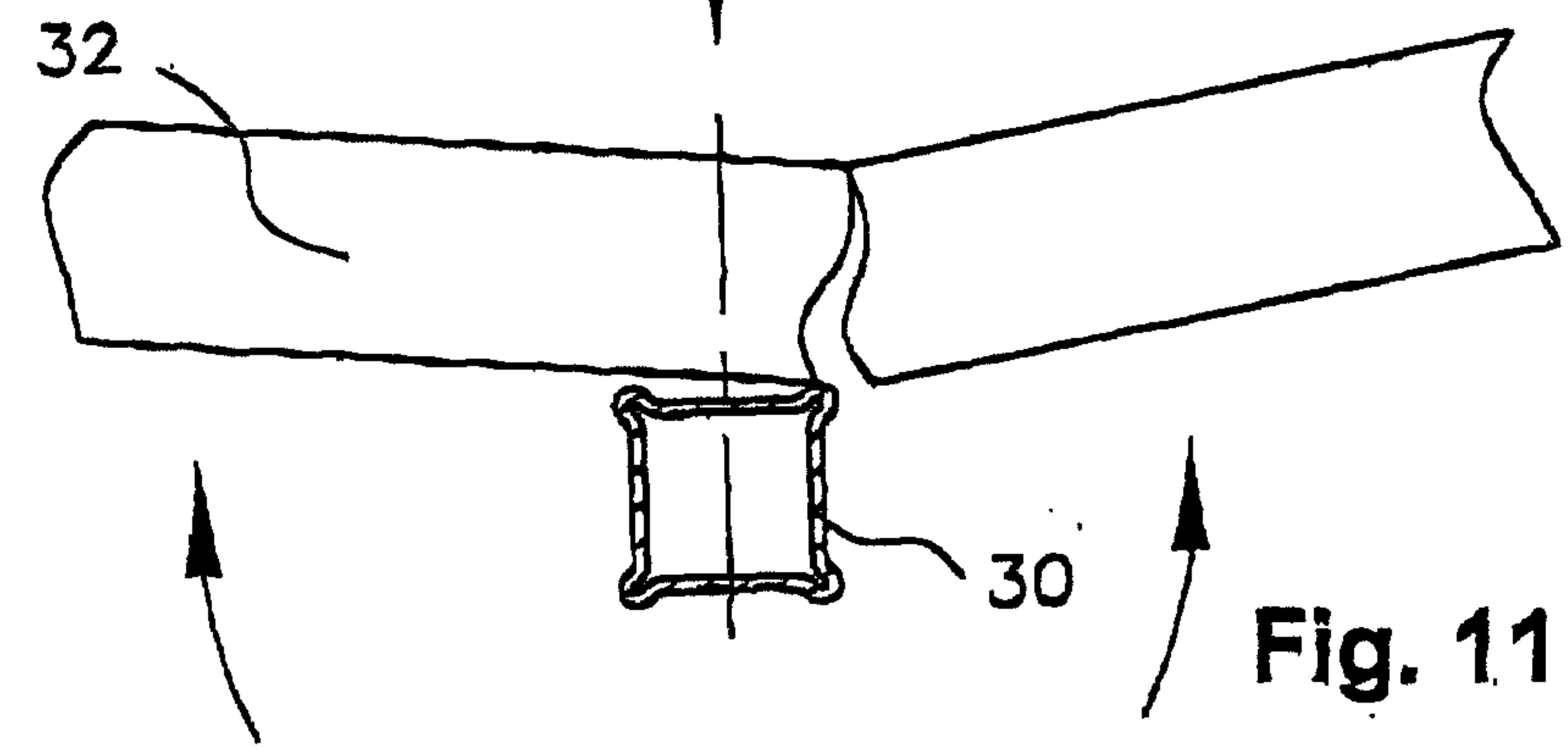

Fig. 11

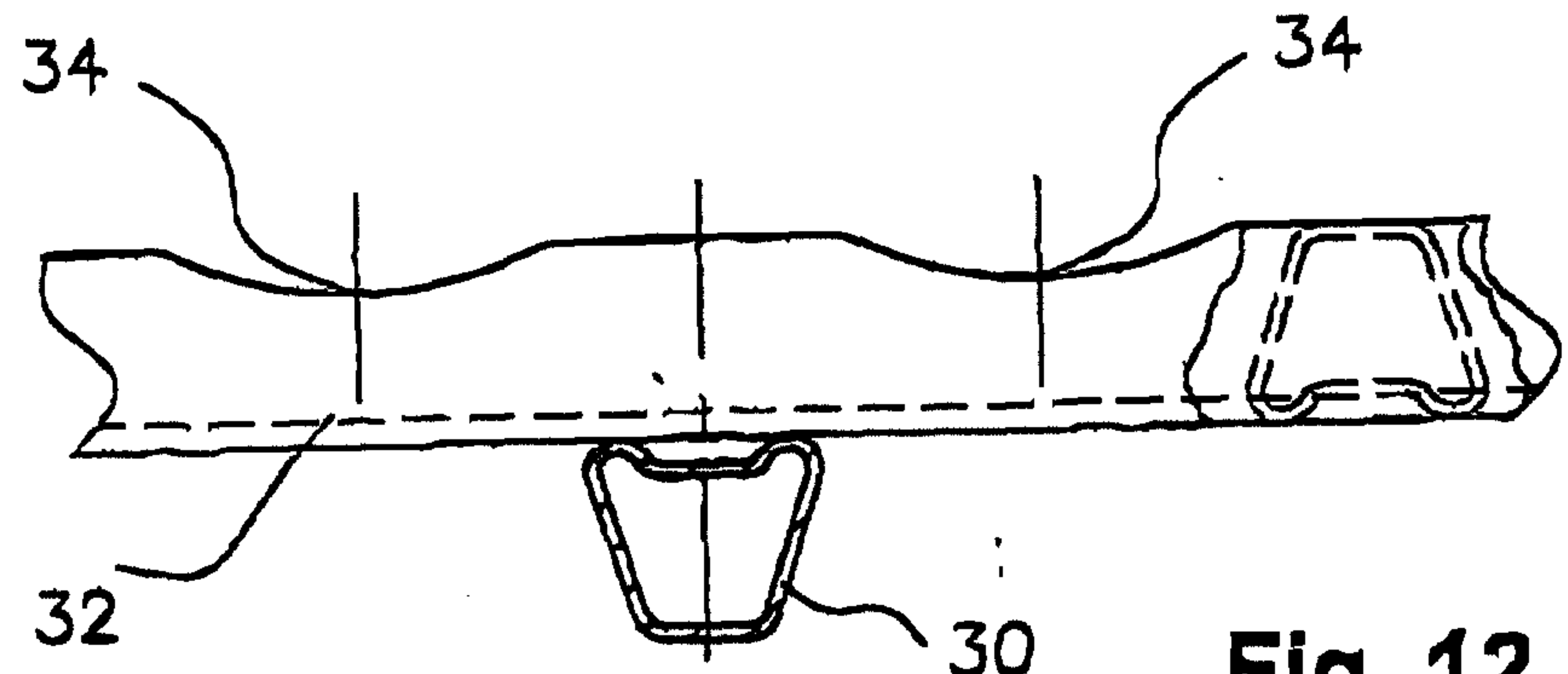

Fig. 12

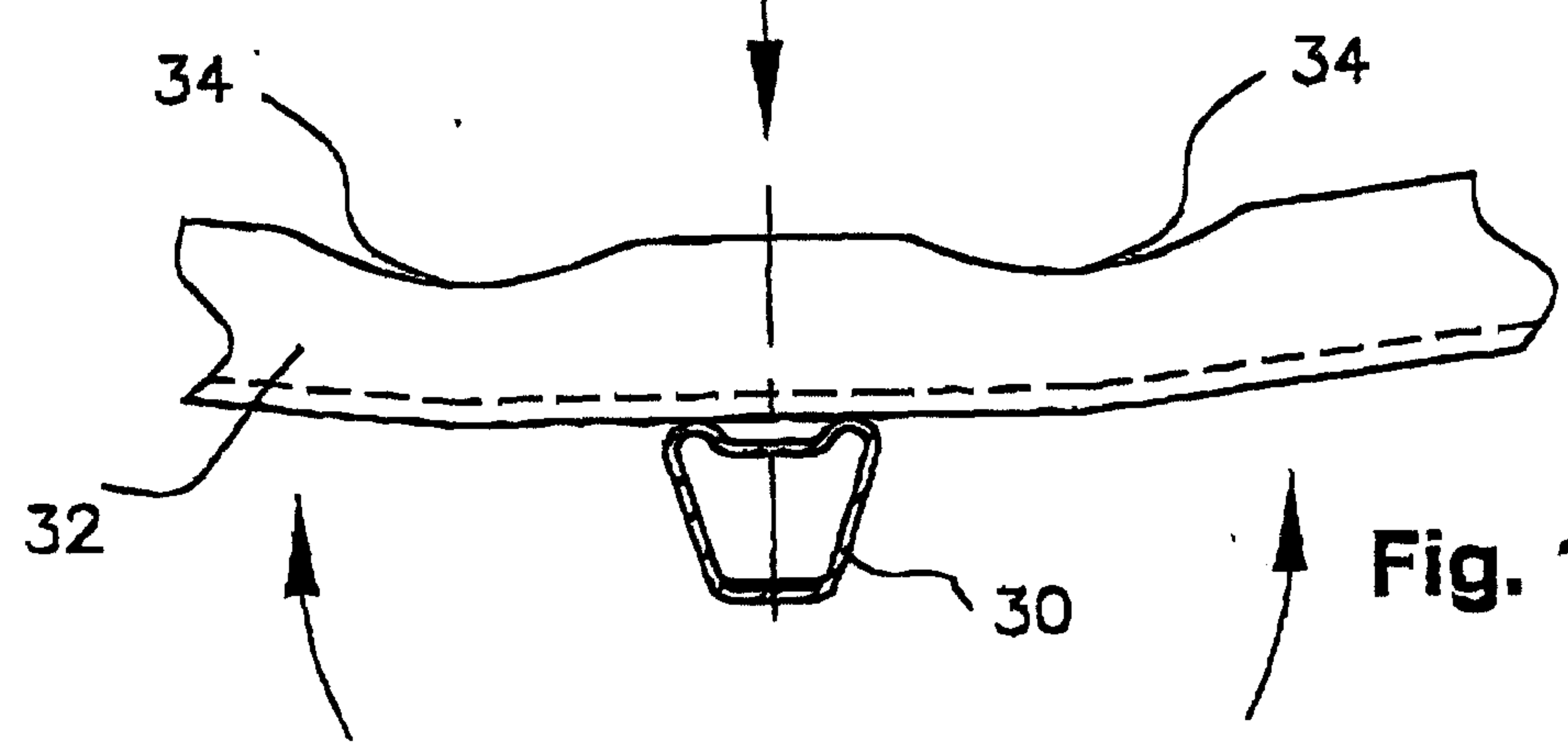

Fig. 13

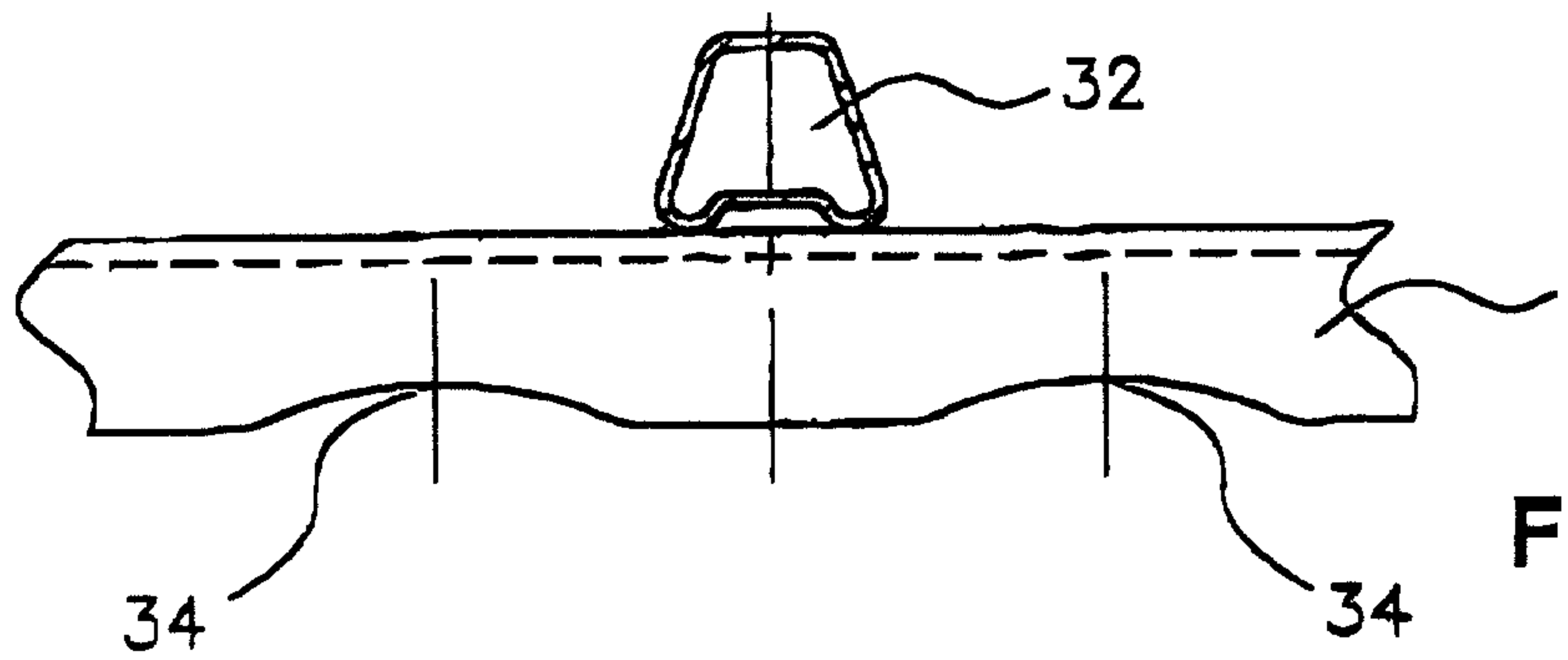

Fig. 14

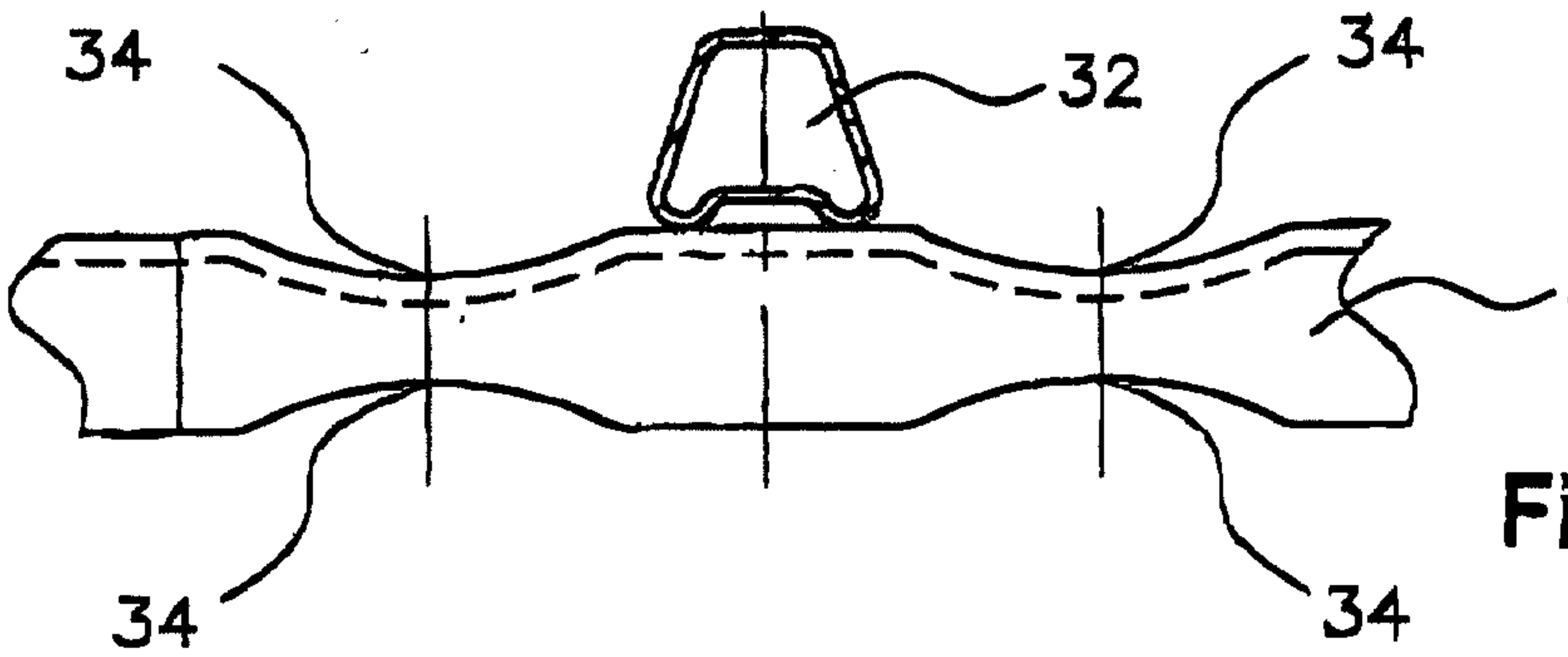

Fig. 15

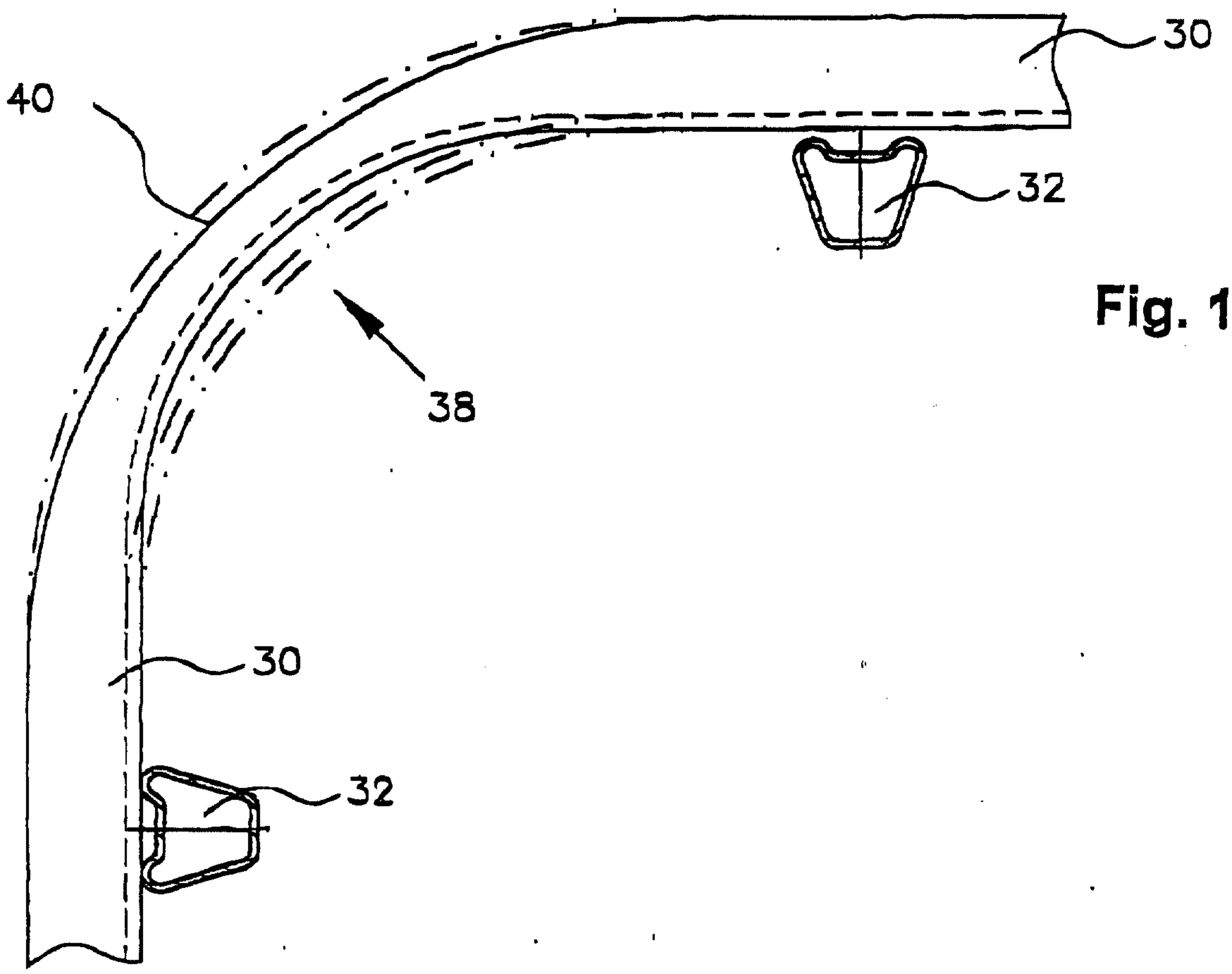

Fig. 16

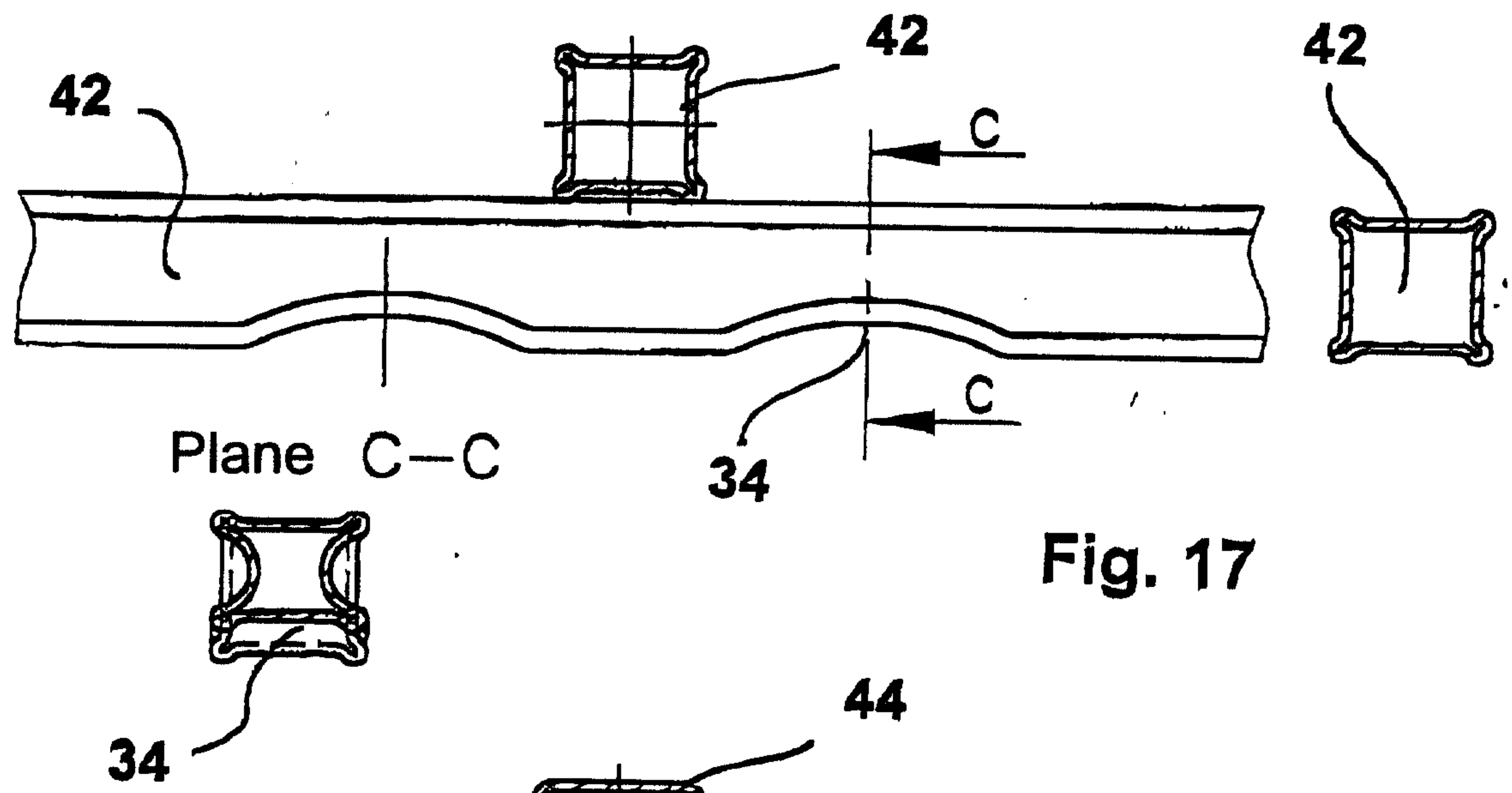

Fig. 17

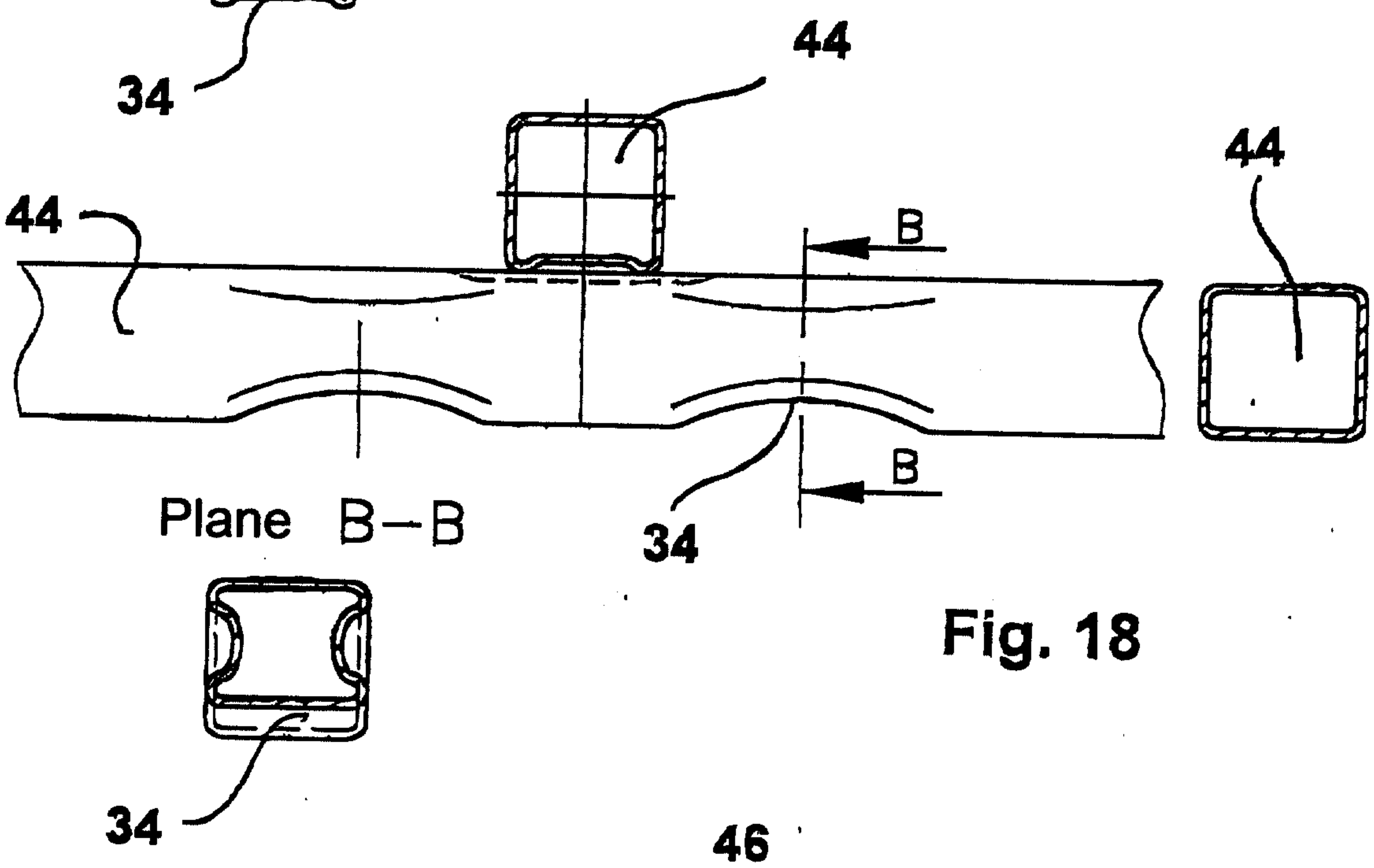

Fig. 18

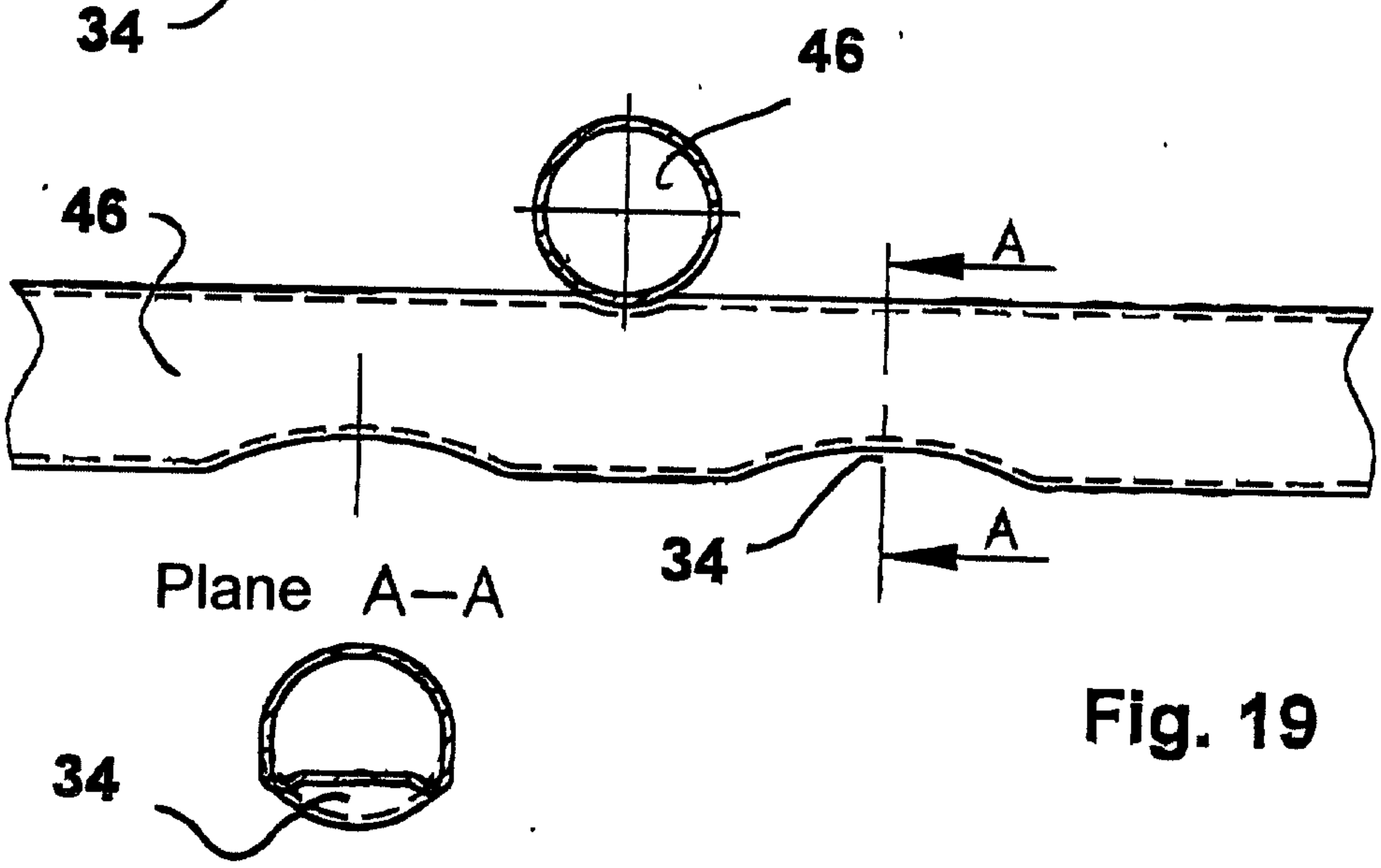

Fig. 19

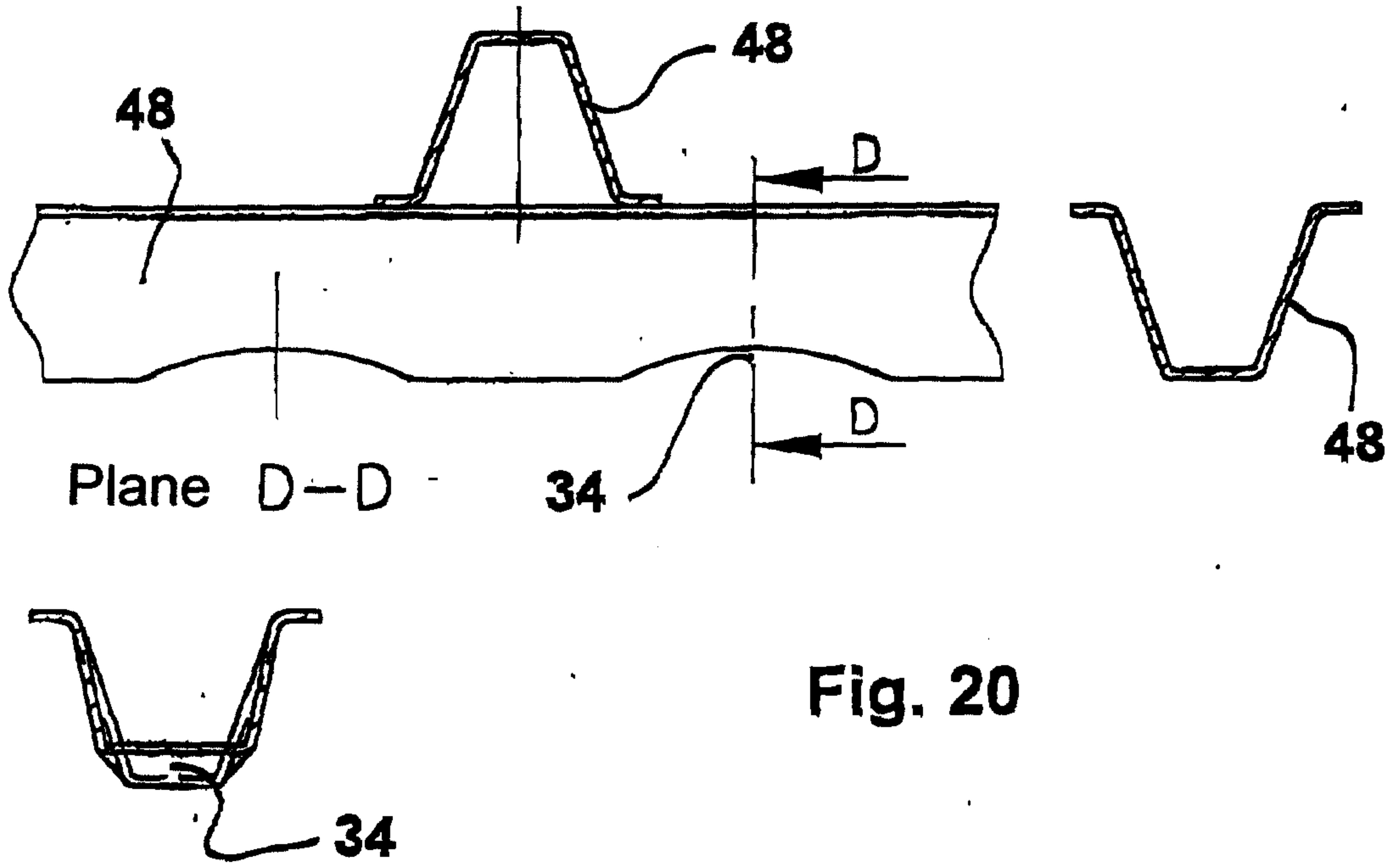

Fig. 20

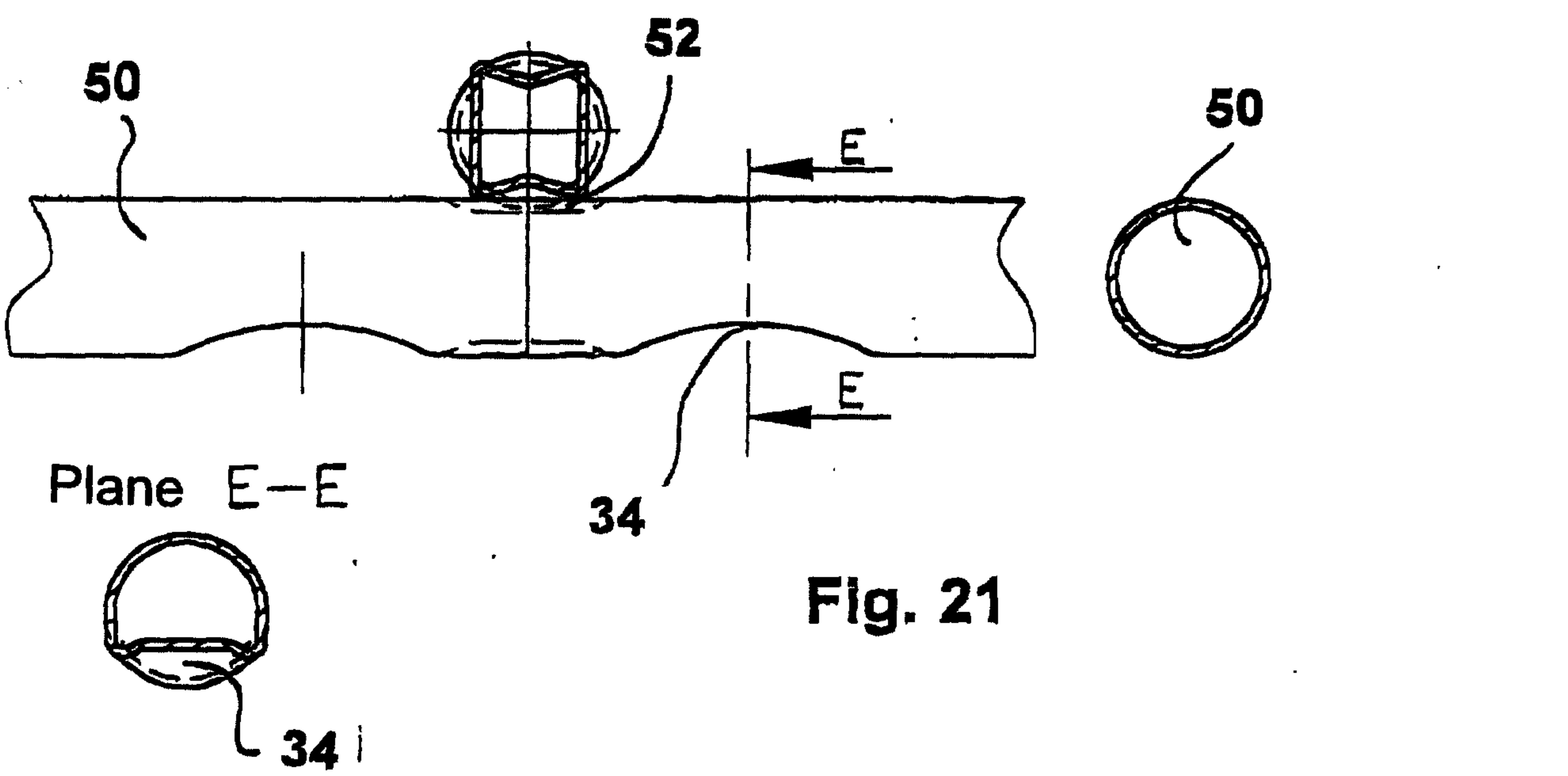

Fig. 21

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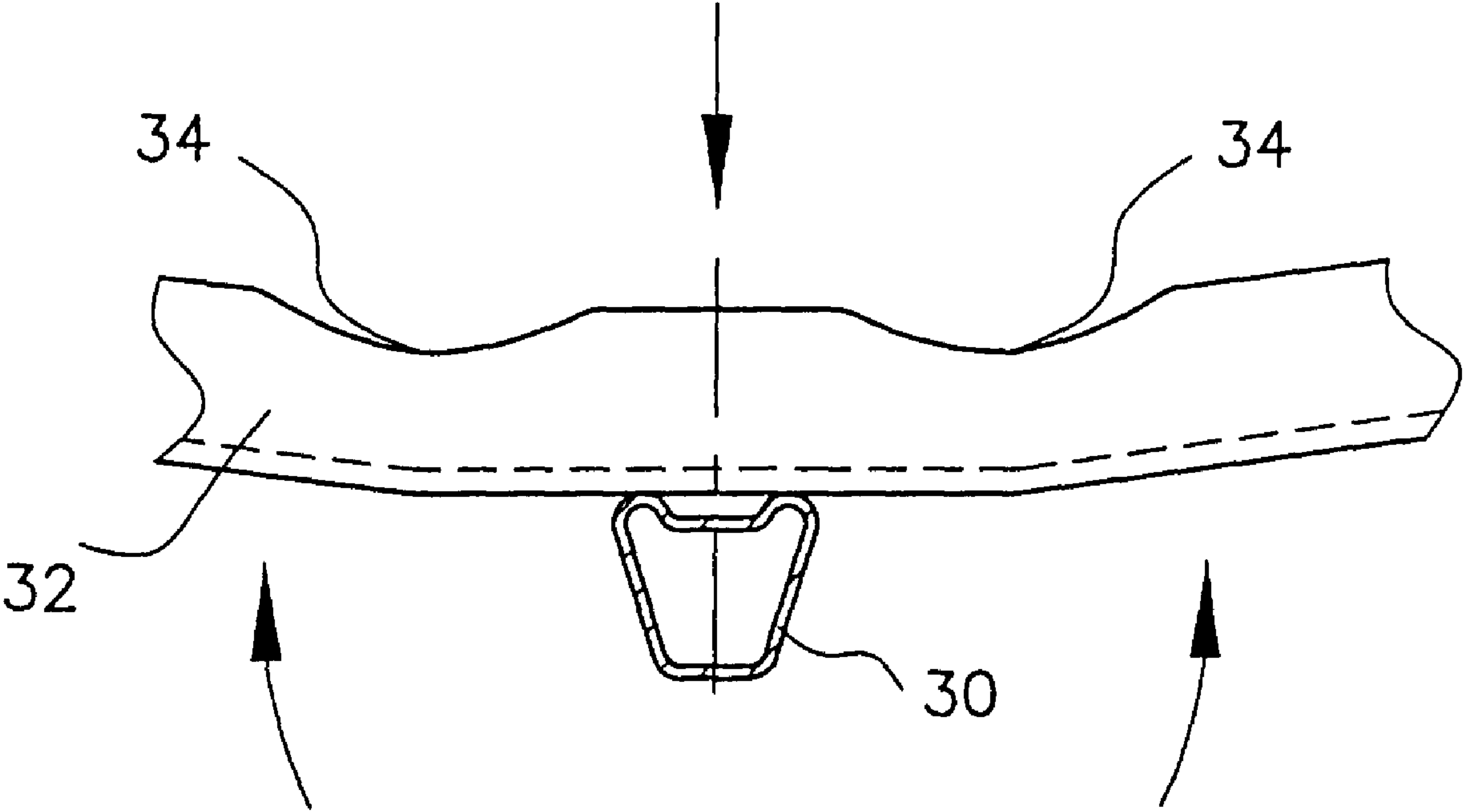
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