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(12) # EUROPEAN PATENT SPECIFICATION

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DE-A-2 645 052
DE-B-2 621 803
US-A-3 067 438

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Description

This invention relates to support systems for mattresses or cushions in beds, chairs, sofas, settees, stretchers and other body support appliances. Such support systems will be referred to as systems "of the kind defined".

The invention is particularly applicable to support systems of the kind defined in which a mattress or cushion rests on slats extending between supporting air springs. My European Patent Application publication No. 0.0 38155 disclose mattress support systems of this kind in which the air springs are in the form of long inflatable tubes on which the ends of mattress supporting slats are rested. Such beds have been successful but one problem has been the tendency for the slats to move on the tubes and the consequent need to provide some holding means which will not interfere with the flexure of the springs or the slats and which is not unduly complex and expensive. The present invention enables economical manufacture of air springs fitted with appropriate slat restraining means.

DE—B—2621803 (Eggenweiler) discloses a bed having spaced, longitudinally extending rigid members each accommodating a closed elongate resilient tube which is filled with a medium capable of flowing and pressurised to meet the requirements of the person using the bed. The upper surface of each tube has a plurality of spaced pockets vulcanised thereto with the pockets of one tube all facing towards the pockets of the other tube. The body support surface of the bed is formed by a plurality of transversely extending, laminated slats arranged parallel to each other with their ends fixedly mounted in the tube pockets.

This prior art arrangement is complicated and costly due to the vulcanising of the pockets to the tubes which, in addition, increases the possibilty of failure at the seams of each pocket.

According to the invention there is provided a support system for mattresses in beds or the like, comprising spaced elongate air springs formed by inflatable tubular bladders each provided with a series of longitudinal spaced pockets having open mouths, a purality of transversely extending slats having their respective ends accommodated in the pockets of said air springs characterised in that stabiliser means are provided interconnecting said air springs to provide lateral stability of the support system, the stabiliser means comprising a transversely-extending member accommodating, without clearance, the air springs.

Preferably the pockets are formed in a tangential flap connected to the tubular bladder along a longitudinal connection line at the surface of the tubular bladder such that the open mouths of the pockets are spaced along a longitudinal edge of the flap.

The invention also provides a method of making an air spring, comprising forming two tubes of heat weldable sheet plastics material with a longitudinal heat welded seam and so as to leave a longitudinal strip of said sheet material projecting beyond the seam exteriorly of the tube, and folding and welding said strip of material to form a tangential flap with longitudinally spaced pockets having open mouths spaced along a longitudinal edge of the flap, so as to form two air springs, interconnecting the two air springs by means of a plurality of transversely-extending slats having their respective ends accommodated in the pockets, and providing stabiliser means interconnecting said air springs to provide lateral stability of the support system, the stabiliser means comprising a transversely-extending member accommodating, without clearance, the air springs.

In order that the invention may be more fully explained some particular embodiments and methods of manufacture will be described with reference to the accompanying drawings in which:-

Figure 1 is a perspective view of part of a bed comprised of mattress support slats extending between a pair of air springs;

Figure 2 is an enlarged scrap view taken in the region 2 in Figure 1;

Figure 3 is a transverse cross-section through an upper part of one of the air springs;

Figure 4 is a side view of the upper part of the air spring in the direction of arrow 4 in Figure 3;

Figure 5 is a perspective view of a heat welding apparatus used in the form of the air spring illustrated in Figures 1 to 4 and shows a partly formed spring in the process of manufacture;

Figure 6 illustrates a specially shaped heat welding bar which is fitted to the apparatus during a later stage of the forming process;

Figure 7 is a vertical cross-section through the apparatus of the partly formed tube at the stage of the forming process illustrated in Figure 5;

Figure 8 is a vertical cross-section through the apparatus at a later stage of the forming process;

Figures 9 to 11 diagrammatically illustrate alternative types of air spring constructed in accordance with the invention;

Figure 12 is a perspective view of part of an air spring of the general kind shown in Figure 2;

Figure 13 is a perspective view of an air spring of the general kind shown in Figure 10;

Figure 14 is a perspective view of a stabiliser for use with a bed according to the present invention;

Figure 15 is a perspective view of part of the bed shown in Fgure 1 including the stabiliser shown in Fgure 14 mounted thereon, and

Figure 16 is a cross-section taken on the line X—X of Figure 15.

Figure 1 illustrates a mattress support system for a bed comprising a series of parallel wooden slates 11 extending between a pair of elongate inflatable air springs 12. The air springs 12 can be mounted in any convenient frame (not shown). Each air spring 12 comprises an elongate tube 13 formed with closed ends 14 and with a tangential flap 15 which is connected to the tube along a longitudinal connection line 16 at the surface of

the tube and has a series of longitudinally spaced pockets 17 with open mouths 18 located along one longitudinal edge of the flap to receive the respective ends of the slats 11.

Each tubular bladder is formed of heat welded sheet plastics material, the tube being closed by a longitudinal welded seam defining the connection line 16, and the flap is formed by a continuation of the sheet material of the bladder which is folded and welded to form the pockets so that the flap is integrally connected with the bladder at the seam. The ends of the tubes are closed by heat welds 19 and one end of each tube is fitted with an inflation valve 21.

As referred to above, in order to maintain lateral stability, the air springs 12 can be mounted in any convenient frame (not shown) which is usually of 'U'-shaped cross-section for at least a portion of its length. However, for certain applications, such as the provision of a portable bed or a design application where lateral stability is required without any constraint at the sides, the support system shown in Figure 1 incorporates a stabiliser arrangement as shown in Figures 14 to 16 and now to be described.

As shown in Figure 14, before fitting on the bed, the stabiliser comprises an open-ended, flattened tubular member 55 of sheet plastics material similar to the tubular bladders 13. The member 55 is of a length slightly greater than the overall width of the bed and is provided with spaced apertures 56 whose axes correspond, respectively, with the axes of the tubular bladders 13. The diameter of the apertures 56 is slightly less than the diameter of the tubes 13 to provide a gripping action when the stabiliser is mounted on the tubes. One edge 58 of the tubular member 55 has a seam 57 formed by heat welding extending parallel to, but spaced slightly from the edge 58 to provide an elongate chamber 59 extending the length of the member.

In use, a predetermined slat 11*a* is removed from the bed and a rod 60 is accommodated in the chamber 59. The stabiliser is then positioned on the bed after removing slats 11 as necessary, by passing the tubular bladders 13, respectively, through the apertures 56 in the tubular member 55 until it reaches the location at which the predetermined slat 11*a* has been removed. The slat 11*a* is then passed into the upper portion of the tubular member 55 (see Figure 14) and its ends, respectively re-inserted into the pockets 17 formed in the tubular bladders 13 so that the cross-section of the stabiliser adopts a triangular configuration (see Figure 16).

Any desired number of stabilisers may be used but, in general, from one to five are sufficent to provide lateral stability of the bed depending on the use and manufacturing design.

It will be readily appreciated the stabilisers may take other forms. For example, the lower rod 60 may be replaced by a slat 11 similar to the slat forming the support surface. In this arrangement, when positioned on the tubular bladders 13, the stabiliser cross-section is of rectangular configuration.

Alternatively, the upper slat 11 may be replaced by a rod similar to the lower rod 60. In this arrangement the stabiliser is positioned between adjacent slat 11. In a further embodiment, the stabiliser comprises a single membrane of plastics material having rod-accommodating chambers formed along its upper and lower edges.

The method of manufacturing the air springs, and the heat welding apparatus employed, will now be described with particular reference to Figures 5 to 8.

Figure 5 shows a heat welding apparatus comprising a sliding table 22 slidable along a bench 23 beneath a vertically movable welding head 24 fitted with an elongate heat welding bar 25. A sheet 26 of heat weldable plastics material is wrapped around a backing bar 27 on table 22 to form a tube and this tube is closed by heat welding a longitudinal seam by bringing the welding head downwardly so that the overlapping layers of material between the welding bar 25 and the backing bar 27 are welded together. This stop in the process is shown in cross-section by Figure 7.

As shown in Figures 5 and 7 a wide strip of the plastics material is allowed to project beyond the heat welded longitudinal seam exteriorly of the tube. This strip is subsequently folded and welded to form the pocketed flap. More specifically, the strip is double folded in the manner which will be apparent from Figure 3. Thus the sheet material extends from the seam to a first longitudinal side edge 31 of the flap where it is folded back at 32 to extend to the second longitudinal side edge 33 of the flap and it is there folded at 34 to extend to a free edge 35 at the first side edge 31. The thus folded strip is then laid flat on the table 22 as illustrated in Figure 8 for welding of the pockets. In order to weld the pockets, the welding bar 25 is replaced by the specially shaped welding bar 36 illustrated in Figure 6. This bar is formed with U-shaped projections 37 at intervals along its length and when the welding head is brought downwards, these projection weld the three layers of the sheet material between the longitudinal seam and the side edge 31 of the flap together to define the pockets. More particularly, the sliding bar produces U-shaped heat welds having limbs 38 sealing the edge of the flap between the pocket mouths and legs 39 extending from one another. The pockets are not completely sealed form one another since the welds do not extend across the full width of the flap but they do serve effectively as individual pockets to hold the slats apart. The flap can move about the longitudinal seam and can flex so as to permit free flexure of the slats while the pockets provide the necessary restraints against shifting of slats.

After formation of the tube with the pocketed flap from a single sheet of plastics material in the manner described above the ends of the tube can be closed by simple heat welding and inflation valves also heat welded in place to complete the air spring.

Figures 9 and 12 illustrate an alterative construction in which a pocketed flap is formed by a single

fold and welding operation rather than by double folding as described above. In this case the tube is again formed by producing a longitudinal seam with a strip of the plastics material projecting beyond the seam. The strip is folded with a single fold at 41 so as to form a flap having only two layers of material and extending only to one side of the longitudinal seam. In this case the U-shaped welds 42 defining pockets may be produced by gripping the material to be welded between the welding bar 36 and the backing bar 27.

Figures 10 and 13 illustrate the manner in which a flap may be formed so as to have pockets along both of its longitudinal edges. An air spring with such a double pocketed flap may be used to support the ends of two adjacent sets of mattress support slats, either as a central support spring in a double bed or, in some cases, as an additional central support in a single bed. In this case the flap 43 is initially formed in the same manner as the flap 15 of the construction illustrated in Figures 1 to 4 and the flap thus has a series of pockets 44 along one edge corresponding to the pockets 17 of the previous construction. However, an additional series of pockets 45 is formed along the other side of the flap by trimming off the folded edge of the flap at the line 46 and applying additional 'U'-shaped welds 47.

Figure 11 shows an alternative manner of producing a flap with pockets along both sides. In this case a separate sheet strip 51 of weldable material is laid over the folded strip 52 and the two welded together at the seam line and around the pockets.

The illustrated constructions are exemplary only and they can be modified or varied considerably. For example, the pockets could be formed by welding a strip of material to the surface of the tubular bladder so that the pockets are formed directly at the exterior surface of the tube. The pocket forming strip could be connected integrally with the tube and be folded back against the tube after the longitudinal seam has been welded or it could be a separate strip welded to the tube. The pockets are formed in a tangential flap to avoid direct contact between the slats and the wall of the inflatable tube and the welding of the pockets directly to the tube wall entails the risk of pinholes and localized thinning of the tube wall which could give rise to blowouts. However, the alternatives are feasible.

Claims

1. A support system for mattresses in beds or the like, comprising spaced elongate air springs (12) formed by inflatable tubular bladders (13) each provided with a series of longitudinal spaced pockets (17, 44) having open mouths (18), a plurality of transversely-extending slats (11) having their respective ends accommodated in the pockets (17, 44) of said air springs (12), characterised in that stabiliser means (55) are provided interconnecting said air springs (12) to provide lateral stability of the support system, the stabiliser means comprising a transversely-extending member (55) accommodating, without clearance, the air springs (12).

2. A support system as claimed in claim 1, characterised in that said member (55) is tubular and has one of said slats (11*a*) extending lengthwise along its upper portion and a rod (60) extending lengthwise along its lower portion so that the cross-section of the stabiliser, in use, is of triangular configuration.

3. A support system as claimed in claim 1, characterised in that said member (55) is tubular and has one of said slats (11) extending lengthwise along its upper portion and a further slat (11), not forming part of the support surface, extending lengthwise along its lower portion so that the cross-section of the stabiliser, in use, is of rectangular configuration.

4. A support system as claimed in claim 1, characterised in that said member (55) has spaced rods (60) extending lengthwise, respectively, along its upper and lower portions, said member (55) being positioned between adjacent slats.

5. A support system as claimed in claim 2, characterised in that said member (55) comprises a single membrane having rod-accommodating chambers formed along its upper and lower edges.

6. A support system as claimed in any of the preceding claims, characterised in that the pockets (17) are formed in a tangential flap (15, 43) connected to the tubular bladder (13) along a longitudinal connection line (16) at the surface of the tubular bladder (13) such that the open mouths (18) of the pockets (17) are spaced along a longitudinal edge of the flap (15).

7. A support system as claimed in claim 6, characterised in that said bladder (13) and the flap (15) are formed of heat welded sheet plastics material.

8. A support system as claimed in claim 7, characterised in that the bladder (13) has a longitudinal welded seam and the flap (15) is formed by a continuation of the sheet material of the bladder beyond the seam which is folded and heat welded to form the pockets (17) so that the flap (15) is integrally connected with the bladder (13) at said seam.

9. A support system as claimed in any one of claims 6 to 8, characteried in that the flap (43) has an additional series of longitudinally spaced pockets (45) with open mouths spaced along the other longitudinal edge of the flap.

10. A method of making a support system as claimed in any of claims 6 to 9, comprising forming two tubes (13) of heat weldable sheet plastics material with a longitudinal heat welded seam (16) and so as to leave a longitudinal strip of said sheet material projecting beyond the seam (16) exteriorly of the tube (13), and folding and welding said strip of material to form a tangential flap (15, 43) with longitudinally spaced pockets (17) having open mouths (18) spaced along a longitudinal edge of the flap (15, 43) so as to form

two air springs (12), interconnecting the two air springs (12) by means of a plurality of transversely-extending slats (11) having their respective ends accommodated in the pockets (17), and providing stabiliser means interconnecting said air springs (12) to provide lateral stability of the support system, the stabiliser means comprising a transversely-extending member (55) accommodating, without clearance, the air springs (12).

Patentansprüche

1. Traganordnung, für Matratzen in Betten oder dergleichen, mit beabstandeten, von aufblasbaren, rohrförmigen Bälgen (13) gebildeten, längserstreckten Luftfedern (12), die jeweils mit einer Anzahl von in Längsrichtung beabstandeten Taschen (17,44) mit offenen Mündungen (18) versehen sind, und mit einer Anzahl von sich in Querrichtung erstreckenden Leisten (11), deren jeweilige Enden in den Taschen (7, 44) der Luftfedern (12) angeordnet sind, gekennzeichnet durch eine die Luftfedern (12) zur Querstabilisierung der Traganordnung verbindende Stabilisatoranordnung (55), welche ein Querelement (55) aufweist, das abstandslos die Luftfedern (12) aufnimmt.

2. Traganordnung nach Anspruch 1, dadurch gekennzeichnet, daß das Querelement (55) röhrenförmig ist und eine der Leisten (11a) sich längs seines oberen Bereichs und eine Stange (60) sich längs seines unteren Bereiches erstreckt, sodaß der Querschnitt der Stabilisatoranordnung in Verwendung von dreieckförmiger Konfiguration ist.

3. Traganordnung nach Anspruch 1, dadurch gekennzeichnet, daß das Querelement (55) röhrenförmig ist und eine der Leisten (11) sich längs seines oberen Bereiches und eine weitere, nicht Teil der Tragfläche bildende Leiste (11) sich längs seines unteren Bereiches erstreckt, sodaß der Querschnitt der Stabilisatoranordnung in Verwendung von rechteckförmiger Konfiguration ist.

4. Traganordnung nach Anspruch 1, dadurch gekennzeichnet, daß das Querelement (55) beabstandete Stangen (60) aufweist, welche sich jeweils längs seiner oberen und unteren Bereiche erstrecken, und daß das Querelement (55) zwischen benachbarten Leisten angeordnet ist.

5. Traganordnung nach Anspruch 2, dadurch gekennzeichnet, daß das Querelement (55) eine Einfachmembran aufweist, die mit entlang ihrer oberen und unteren Kanten ausgebildeten Stangen-Aufnahmekammern versehen ist.

6. Traganordnung nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Taschen (17) in einer mit dem rohrförmigen Balg (13) entlang einer longitudinalen verbindungslinie (16) auf der Oberfläche des rohrförmigen Balgs (13) verbundenen tangentialen Klappe (15, 43) so ausgebildet sind, daß die offenen Mündungen (18) der Taschen (17) entlang einer Längskante der Klappe (15) beabstandet sind.

7. Traganordnug nach Anspruch 6, dadurch gekennzeichnet, daß der Balg (13) und die Klappe (15) aus heißverschweißtem Plastikfolienmaterial gebildet sind.

8. Traganordnung nach Anspruch 7, dadurch gekennzeichnet, daß der Balg (13) eine längsgeschweißte Naht aufweist und die Klappe (15) von einem Fortsatz des Folienmaterials des Balgs über die Naht hinaus gebildet ist, und daß der Fortsatz zur Bildung der Taschen (17) gefaltet und hitzeverschweißt ist, sodaß die Klappe (15) an de Naht einstückig mit dem Balg (13) verbunden ist.

9. Traganordnung nach einem der Ansprüche 6 bis 8, dadurch gekennzeichnet, daß die Klappe (43) eine Anzahl zusätzlicher, in Längsrichtung beabstandeter Taschen (45) mit entlang der anderen Längskante der Klappe beabstandeten offenen Mündungen aufweist.

10. Verfahren zur Herstellung einer Traganordnung nach einem der Ansprüche 6 bis 10, wobei zwei Röhren (13) aus hitzeverschweißbarem Plastikfolienmaterial mit einer hitzeverschweißten Längs-Naht (16) gebildet werden wobei ein Längsstreifen dieses Folienmaterials über die Naht (16) außerhalb der Röhre (13) vorstehen gelassen wird, wobei dieser Materialstreifen zur Bildung einer tangentialen Klappe (15, 43) mit in Längsrichtung beabstandeten Taschen (17) mit entlang einer Längskante der Klappe (15, 43) beabstandeten offenen Mündungen (18) gefaltet und zur Bildung von zwei Luftfedern (12) verschweißt wird, wobei weiters die beiden Luftfedern (12) mittels einer Anzahl von sich quer erstreckenden Leisten (11), deren jeweilige Enden in den Taschen (17) aufgenommen sind, verbunden werden, und wobei schließlich ein Stabilisatoranordnung zur Querstabilisierung der Traganordnung vorgesehen wird, welche die Luftfedern (12) verbindet une ein Querelement (55) aufweist, das die Luftfedern (12) ohne Zwischenraum aufnimmt.

Revendications

1. Système de support pour des matelas dans des lits ou similaires, comprenant des ressorts pneumatiques espacés de forme allongée (12), constitués par des boudins tubulaires gonflables (13) dont chacun est muni d'une série de poches espacées longitudinalement (17, 44) présentant des ouvertures béantes (18), une multiplicité de lattes (11) qui s'étendent transversalement et dont les extrémités sont respectivement logées dans les poches (17, 44) des ressorts pneumatiques (12), caractérisé en ce que des moyens stabilisateurs (55) sont prévus, reliant entre eux les ressorts pneumatiques (12) de manière à assurer la stabilité latérale du système de support, ces moyens stabilisateurs comprenant une pièce (55) qui s'étend transversalement et qui est adaptée sans jeu sur les ressorts pneumatiques (12).

2. Système de support selon la revendication 1, caractérisé en ce que ladite pièce (55) est tubulaire et comporte l'une desdites lattes (11a)

s'étendant longitudinalement le long de sa partie supérieure et une baguette (60) s'étendant longitudinalement le long de sa partie inférieure, de telle manière qu'en service, la section transversale du stabilisateur a une forme triangulaire.

3. Système de support selon la revendication 1, caractérisé en ce que ladite pièce (55) est tubulaire et comporte l'une desdites lattes (11) s'étendant longitudinalement le long de sa partie supérieure et une autre latte (11), ne faisant pas partie de la surface de support, s'étendant longitudinalement le long de sa partie inférieure, de telle manière qu'en service, la section transversale du stabilisateur a une forme rectangulaire.

4. Système de support selon la revendication 1, caractérisé en ce que ladite pièce (55) comporte des baguettes espacées (60) s'étendant longitudinalement le long de ses parties supérieure et inférieure respectivement, cette pièce (55) étant placée entre des lattes voisines.

5. Système de support selon la revendication 2, caractérisé en ce que ladite pièce (55) est constituée par une simple membrane comportant des chambres de logement des baguettes, formées le long de ses bords supérieur et inférieur.

6. Système de support selon l'une quelconque des revendicatons 1 à 5, caractérisé en ce que les poches (17) sont formées dans un volet tangentiel (15, 43) raccordé au boudin tubulaire (13) le long d'une ligne d'assemblage longitudinale (16) à la surface du boudin tubulaire (13), de telle manière que les ouvertures béantes (18) des poches (17) soient espacées le long d'un bord longitudinal du volet (15).

7. Système de support selon la revendication 6, caractérisé en ce que le boudin (13) et le volet (15) sont formées a partir de matière plastique en feuille thermosoudée.

8. Système de support selon la revendication 7, caractérisé en ce que le boudin (13) comporte un cordon de soudure longitudinal et en ce que le volet (15) est forme par un prolongement de la matière en feuille du boudin au-delà du cordon, prolongement qui est replie et thermosoudé de manière à former les poches (17), ce qui fait que le volet (15) est raccordé d'un seul tenant au boudin (13) au niveau dudit cordon.

9. Système de support selon l'une quelconque des revendications 6 à 8, caractérisé en ce que le volet (43) présente une série supplémentaire de poches espacées longitudinalement (45) dont les ouvertures béantes sont espacées le long de l'autre bord longitudinal du volet.

10. Procédé de fabrication d'un système de support selon l'une quelconque des revendications 2 à 9, comprenant les opérations consistant à former deux tubes (13) de matière plastique en feuille thermosoudable par un cordon de thermosoudure longitudinal (16) et de manière à conserver, au-delà de ce cordon (16), une bande longitudinale de la matière en feuille qui fait saillie à l'extérieur du tube (13), et à replier et souder cette bande de matière de façon à former un volet tangentiel (15, 43) comportant des poches espacées longitudinalement (17) dont les ouvertures béantes (18) sont espacées le long d'un bord longitudinal du volet (15, 43), de manière à former deux ressorts pneumatiques (12), à relier entre eux les deux ressorts pneumatiques (12) au moyen d'une multiplicité de lattes (11) qui s'étendent transversalement et dont les extrémités sont logées respectivement dans les poches (17), et à mettre en place des moyens stabilisateurs qui relient entre eux les ressorts pneumatiques (12) de manière à assurer la stabilité latérale du système de support, ces moyens stabilisateurs comprenant une pièce (55) qui s'étend transversalement et s'adapte sans jeu sur les ressorts pneumatiques (12).

FIG. 1.

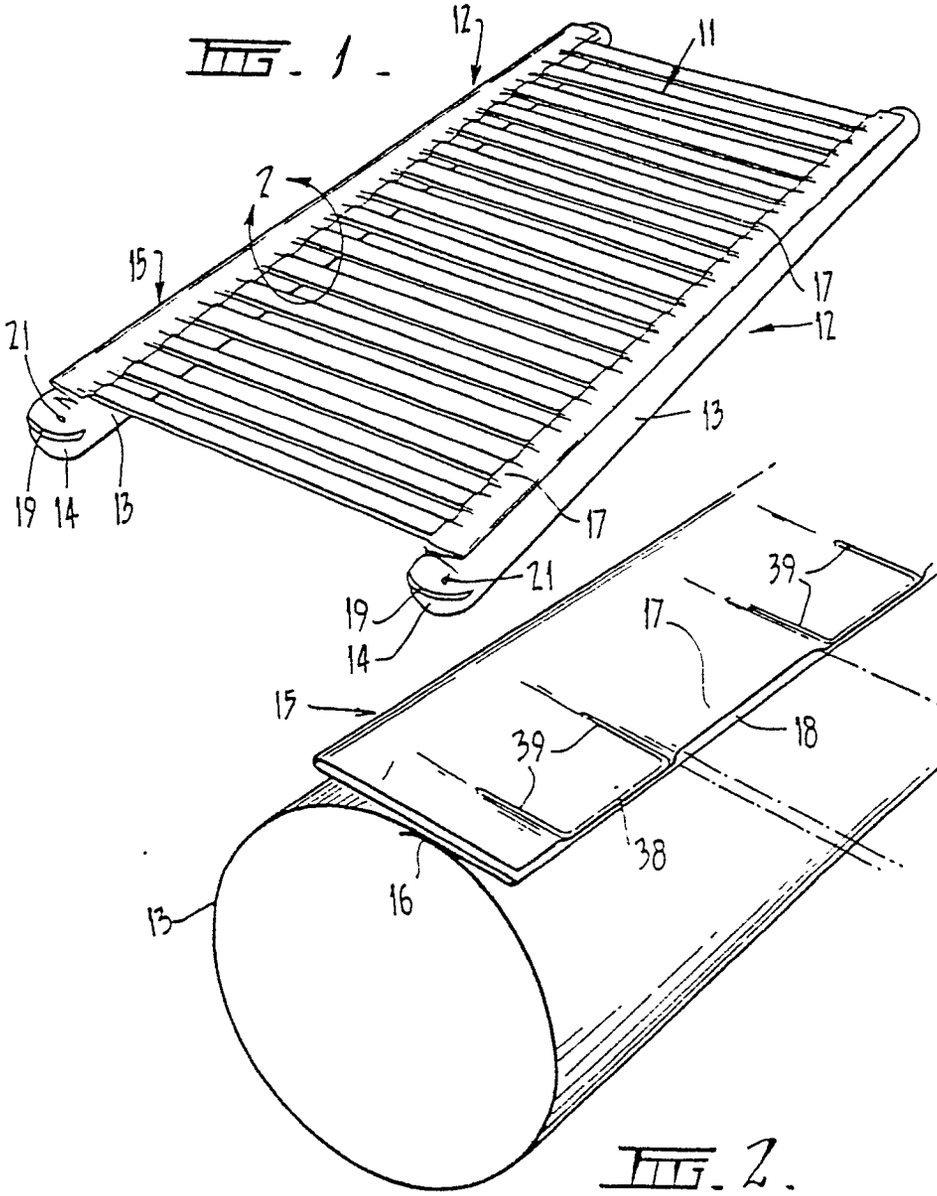


FIG. 2.

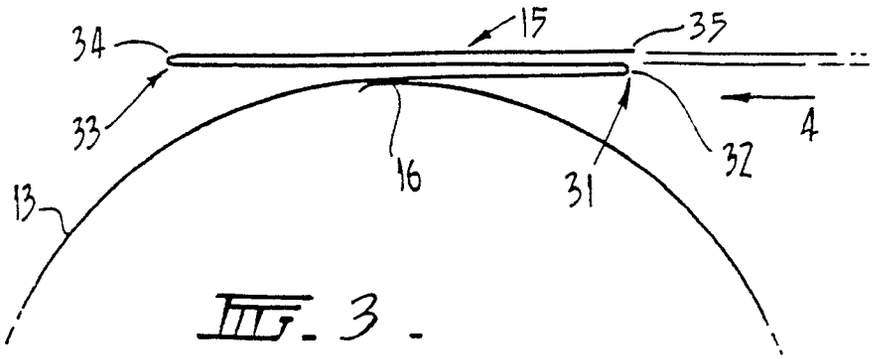
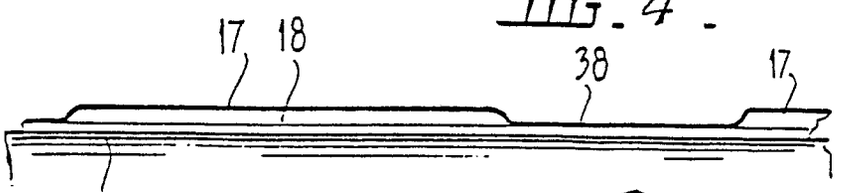


FIG. 3.

FIG. 4.



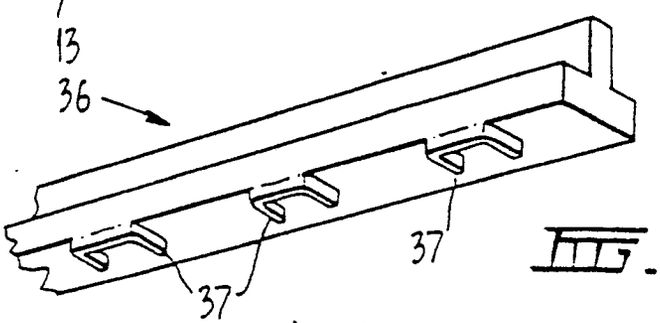


FIG. 6.

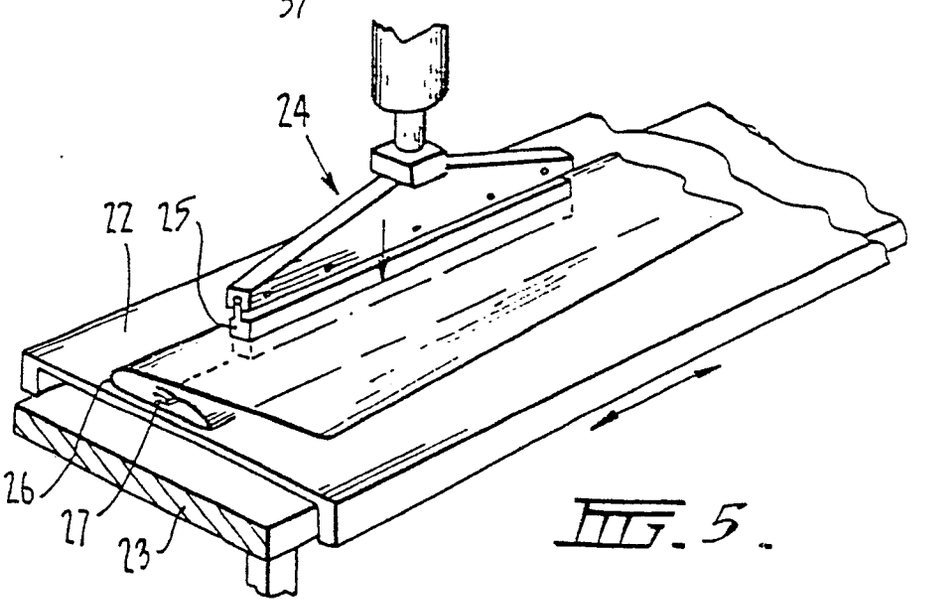
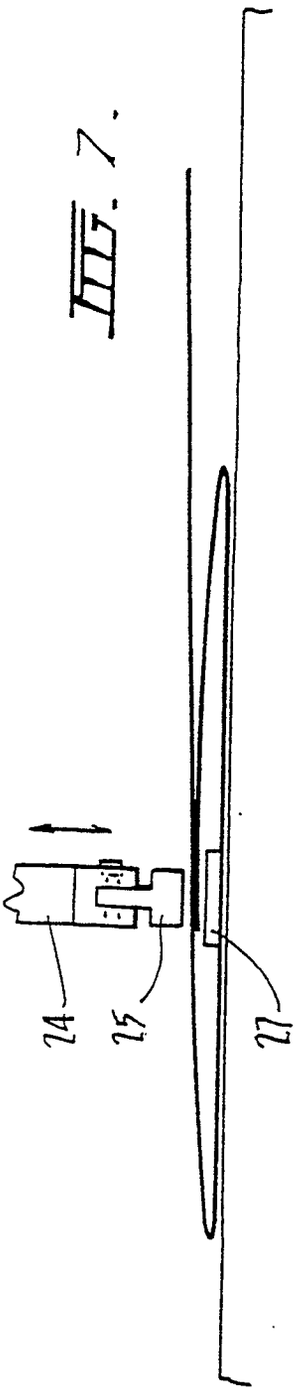
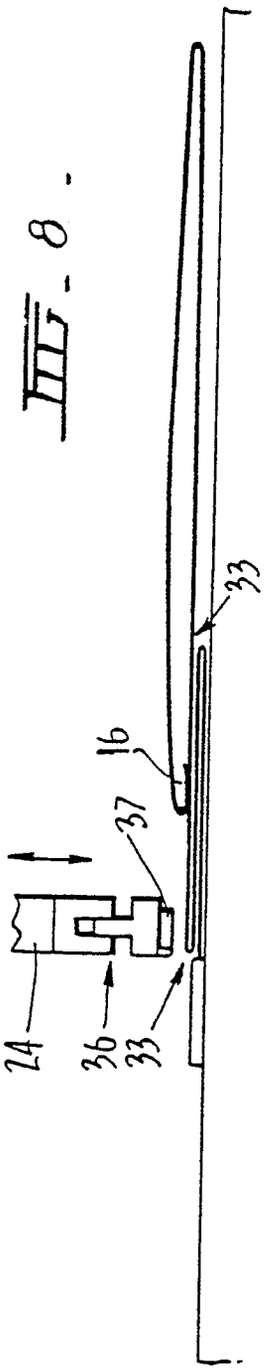


FIG. 5.

Фиг. 7.



Фиг. 8.



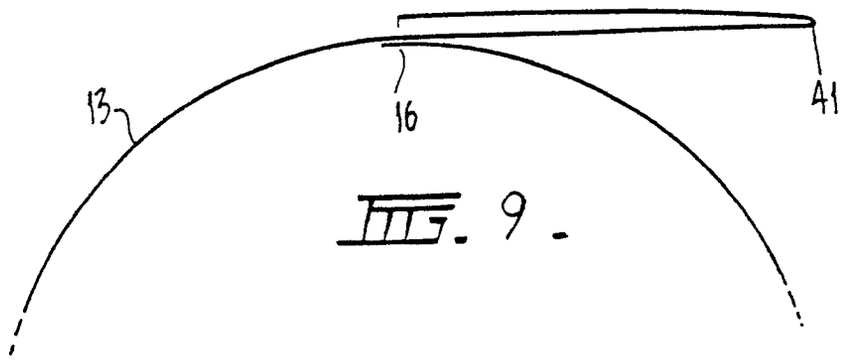


FIG. 9.

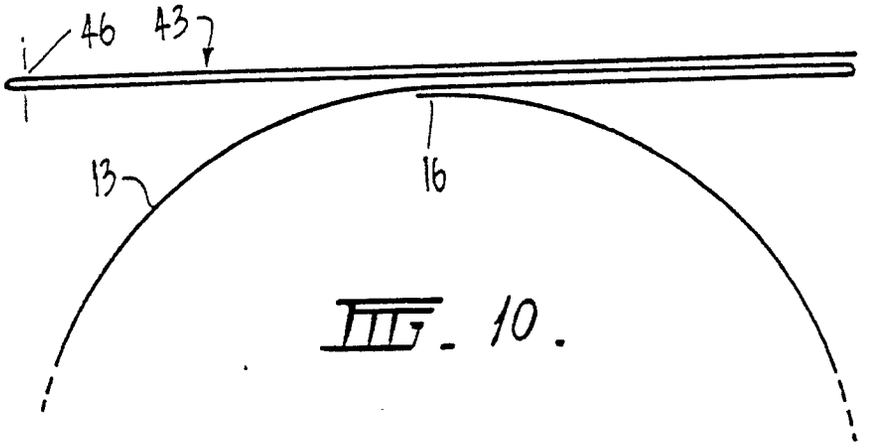


FIG. 10.

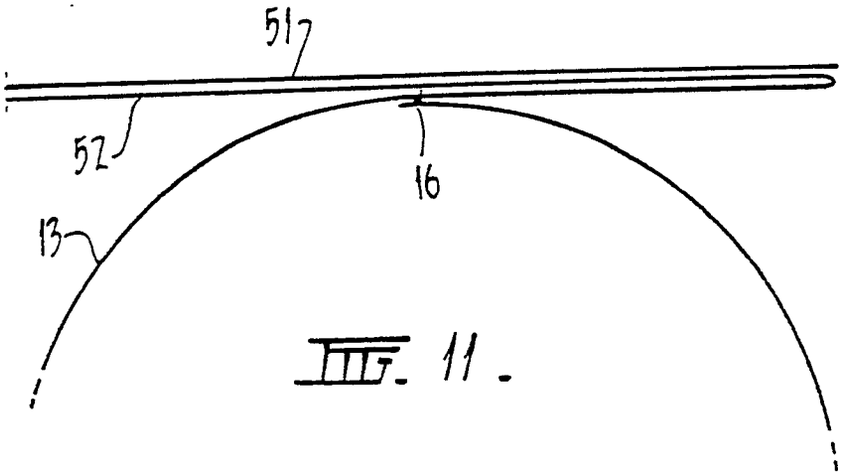


FIG. 11.

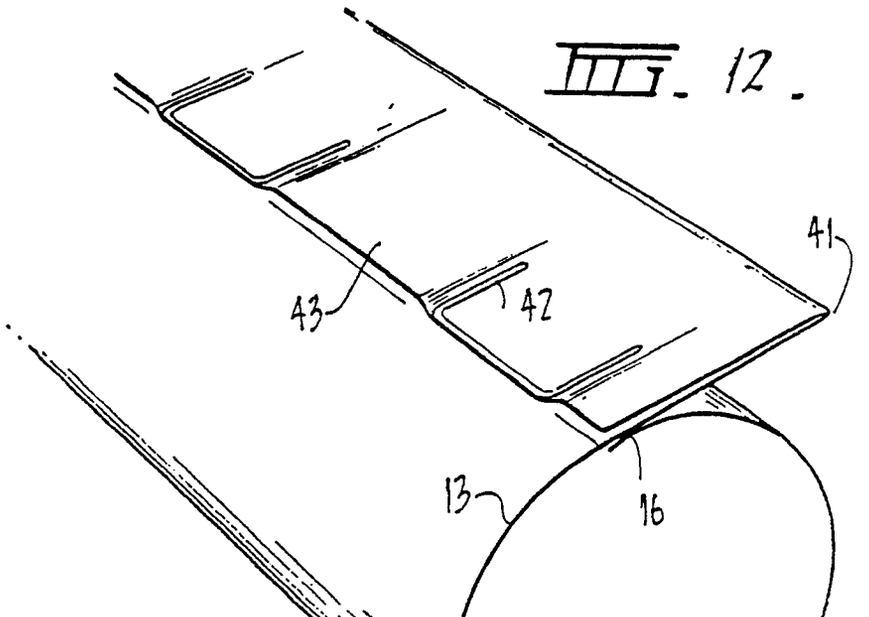


FIG. 12.

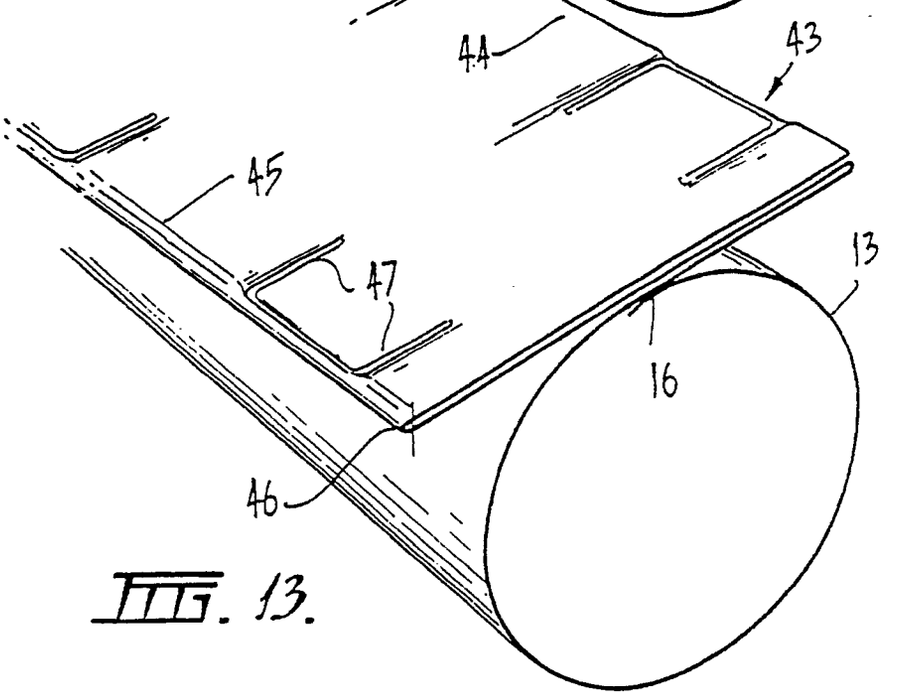


FIG. 13.

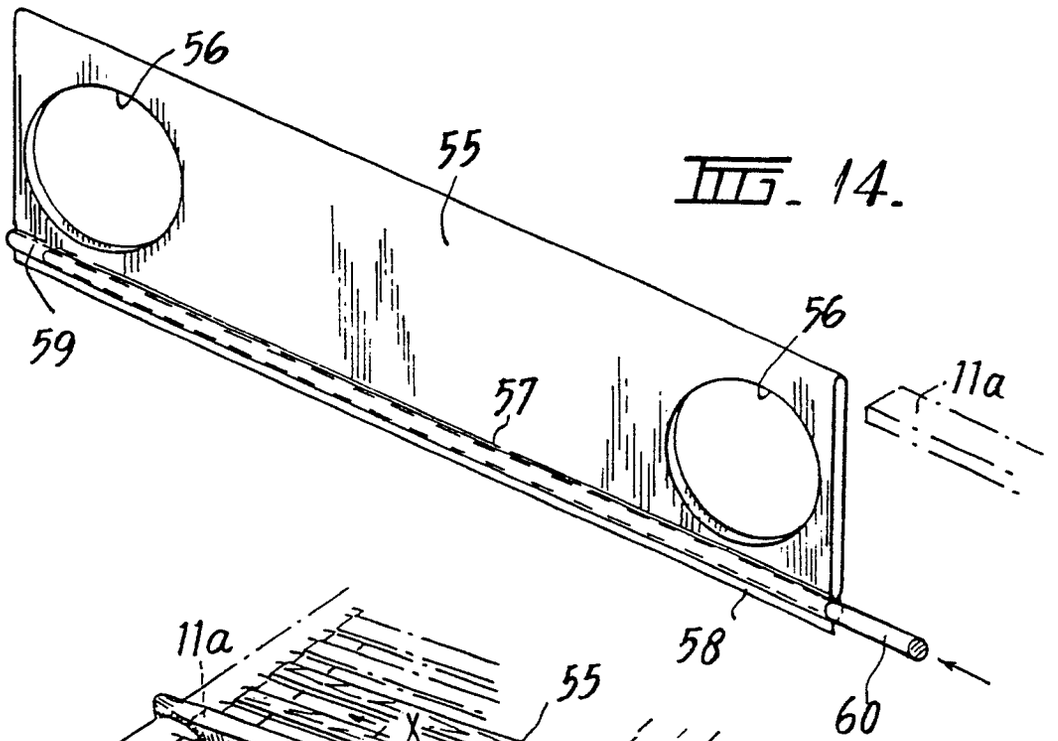


Fig. 14.

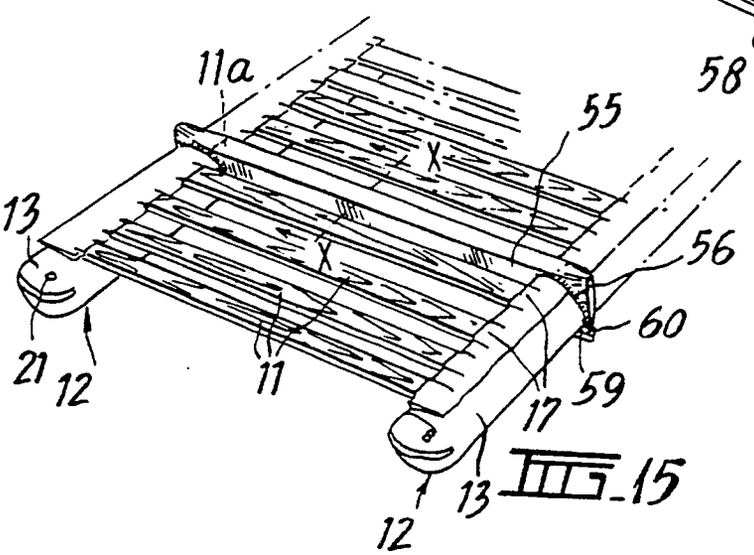


Fig. 15

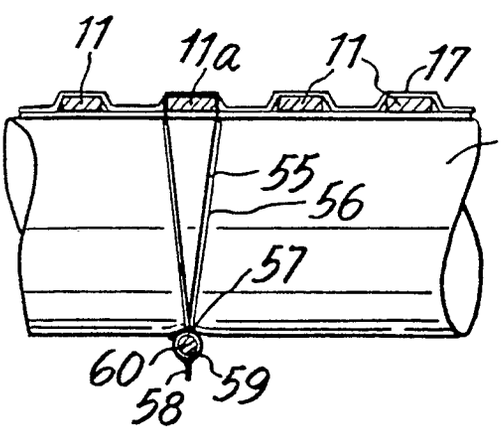


Fig. 16.