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W. T. WAGNER ET AL

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FOLDABLE MATTRESS

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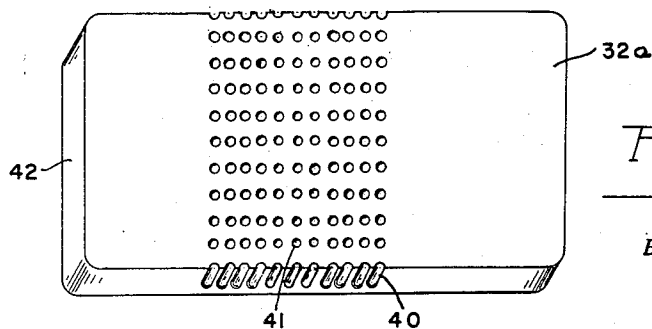
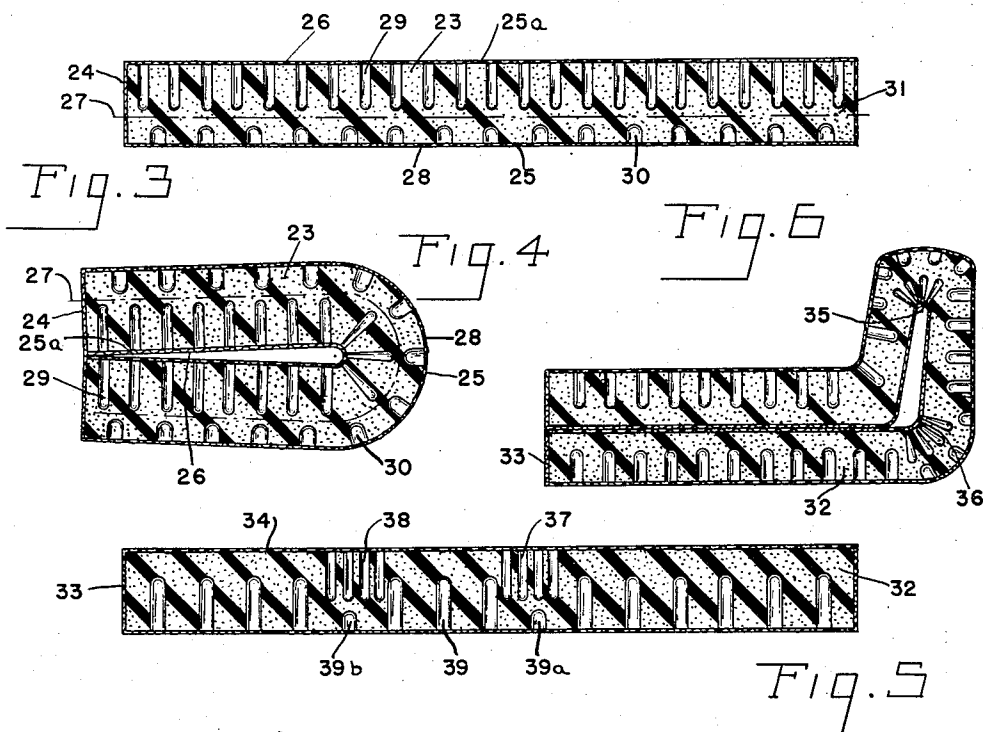
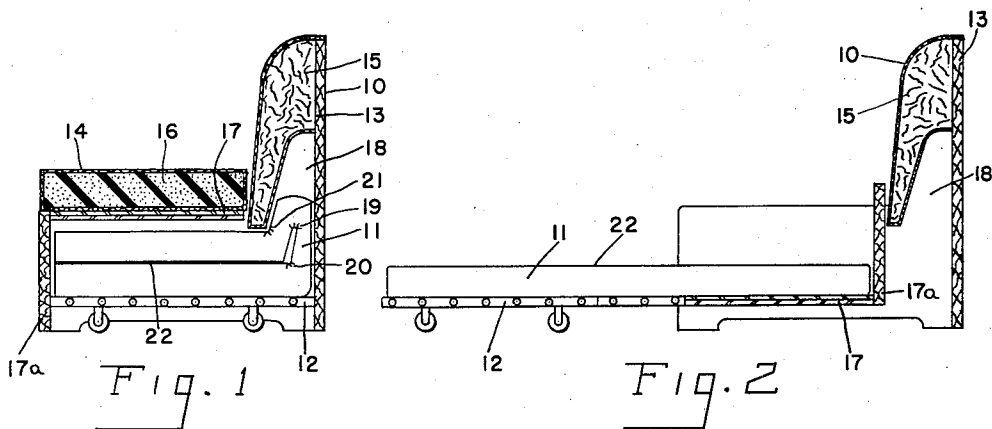


Fig. 7

INVENTOR.
W. T. WAGNER
B. ADINOFF

BY

John Wolk
ATT'Y.

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FOLDABLE MATTRESS

William T. Wagner and Bernard Adinoff, Dayton, Ohio,
assignors to The Dayton Rubber Company, a corpora-
tion of Ohio

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10 Claims. (Cl. 5—351)

The present invention relates to the art of body support-
ing furniture such as sofa beds and the like and in particu-
lar to an improved foldable mattress construction for use
in such furniture.

In furniture pieces which may be converted from a
couch or sofa accommodating the seated body of a person
to a bed upon which one may recline, it has long been
desired to incorporate a foldable mattress composed of
foam rubber or like material. In addition to the in-
creased comfort to be enjoyed from the use of such a
mattress, its incorporation in sofa bed combinations has
been recognized as additionally desirable in that such a
mattress may be folded with greater ease and so arranged
as to occupy a minimum of space when the furniture item
of which it is a part is in the form of a sofa.

One particularly undesirable feature resulting from the
use of foam rubber mattresses in sofa beds however, has
been the fact that, where the mattress is bent and folded
for a considerable length of time, the creases which have
been formed in the mattress upon such folding become
more or less permanently fixed. Since most users of sofa
bed combinations allow the furniture piece to stand for
long periods of time in the form of a sofa, using it as a bed
only intermittently, this permanent setting of the fold line
is a real and almost universal problem. The creases thus
fixed in the mattress surface, in addition to being un-
attractive from the standpoint of the wrinkled effect which
they impart, have been found to hasten cracking and de-
terioration of the mattress.

It is accordingly an object of the present invention to
provide a foldable foam rubber mattress for use in sofa
beds and the like.

A further object of the present invention is to provide
such a foldable foam rubberlike mattress which may re-
main in folded position for extended periods of time with-
out causing the fold lines to become permanently set upon
the surfaces thereof.

It is yet a further object of the present invention to pro-
vide such a foldable mattress which is encased in an in-
extensible sheath such as a fabric cover and which may
be folded for long periods of time without presenting a
wrinkled appearance when it is opened to form a bed.

To achieve these and other obvious objects and advan-
tages to be apparent from a reading of the following dis-
closure, it is provided herein that the flex characteristics
of the foamed cellular rubberlike mattress bun or filler be
made to conform within certain defined limits to the flex
characteristics and properties of the entire mattress; i. e.,
the combination of the cellular rubber-like bun and the
inextensible cover surrounding the same. The present
invention is based upon the discovery that severe buckling
and creasing may be avoided where the foam rubber bun
is so constructed, particularly at points of the contem-
plated folds, that its neutral axis of flexure per se corre-
sponds to or is positioned relatively near the neutral axis
of flexure of the combined bun and inextensible cover
taken as a whole when this whole is flexed in a given di-
rection. The present invention is further based upon the

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discovery that the relatively inextensible fabric casing it-
self becomes the neutral axis of the bun and cover com-
bination when it is flexed in any direction, because the
surface properties of the foam rubber bun are such that
the bun is not allowed to slide along the fabric as is its
tendency when the mattress is bent.

Various modifications and preferred embodiments of
the principles of this invention thus propounded are set
forth in greater detail in the following description in con-
nection with which reference may be had to the accom-
panying drawings.

In the drawings:

Figure 1 is an elevation in partial cross-section of an
end of a typical sofa bed combination utilizing a mattress
of the type considered herein.

Figure 2 is a similar elevation in partial cross-section of
the same sofa bed combination as it appears when the
mattress is extended and the combination is in the form
of a bed.

Figure 3 is a longitudinal cross-section through one pre-
ferred foldable mattress according to the present inven-
tion.

Figure 4 is a similar longitudinal cross-section of the
mattress of Figure 3 as it appears when it is folded.

Figure 5 is a longitudinal cross-section through a mod-
ified mattress embodying the features of this invention.

Figure 6 is a cross-section through the mattress of
Figure 5 as it is folded in a typical sofa.

Figure 7 is a perspective view of still another modifica-
tion of a mattress according to this invention.

Referring now to Figures 1 and 2 there is shown a typi-
cal sofa bed combination 10, first as it appears when in
the form of a sofa and second as it appears when the
mattress 11 and support 12 are unfolded and extended
such that the device is in the form of a bed to accommo-
date the recumbent body of a person. This sofa bed com-
bination comprises the conventional back 13 and cushion
14, both of which may be designed and constructed in a
manner well-known to furniture art and composed of such
common upholstery materials as fibers 15 supporting the
back 13 or foam rubber 16 forming the seat cushion 14.
The support 17 underlying the cushion may be affixed to
a front piece 17a which becomes a head board when the
combination is in the form shown in Figure 2. The mat-
tress 11 is of course designed to lie in a substantially hori-
zontal plane such as shown in Figure 2 to accommodate
the body of a sleeping person. When the sofa bed com-
bination is in the form of a sofa as shown in Figure 1,
however, it is necessary that this mattress 11 be com-
pacted. This is shown in Figure 1 to involve a folding
pattern in which the principal portion of the mattress 11
is folded over upon itself such that two thicknesses of the
mattress underlie the seat cushion 14 and the supporting
structure 17 therefor; while a lesser portion of the mat-
tress, and, in this instance, that portion along which the
primary fold is made, is designed to fit into a recess or
cavity 18 in the back member 13. The folded position
which the mattress is thus forced to assume is a result of
a primary fold 19, which initially breaks the mattress into
two substantially equal overlapping portions, and a bend-
ing of the mattress thus folded to form the folds or creases
20 and 21. When the mattress is unfolded by operation
of a conventional sofa bed mechanism, the details of
which have been omitted for clarity, the broadside surface
22 which is that surface of the mattress upon which the
primary fold is made opens up to become the top sur-
face or "sleep side" of the mattress. By a comparison of
Figures 1 and 2 it can be seen that the folds 19 and 20
are on that surface of the mattress which is subsequently
opened to become the upper mattress surface 22, and
which not only directly underlies the body of a person
sleeping thereon but also is readily apparent to one

viewing the sofa bed combination. Thus, when the sofa bed combination has been allowed to stand for a long period of time in its form as a sofa and the folds of the mattress take a permanent set upon such a surface, the resulting wrinkles in this top surface 22 detract considerably not only from the eye appeal but also from the comfort and wearing qualities of the mattress.

To prevent these wrinkles resulting from a buckling of the foam rubber bun or filler, the present invention provides for so controlling the flexing properties of this foam rubber portion that the buckling action will be alleviated or removed, even though the mattress as a whole is still subjected to the same severe bending forces. In Figures 3 and 4 a typical mattress embodying the features of this invention and accomplishing the purposes thereof is shown in extended and in folded position respectively. As previously stated, it has been discovered that the foam rubber bun or filler 23 has surface characteristics such that, when it is surrounded with an inextensible cover such as fabric cover 24 and is then folded in any given direction, the bun 23 will not slip against the cover 24, but rather will be held in its fixed position thereagainst with the result that the surface 25 of this foam rubber bun away from the direction of the fold will not be free to stretch as it would normally if it were unrestrained.

This natural tendency for a flexed body to stretch along that surface away from the fold is part of the established theory of flexure which recognizes that a flexed body tends to bend about a neutral axis which itself undergoes no change in length during the bending of the article. The material of such body toward the direction of the fold from such neutral axis, however, is caused to be compressed and to be reduced in length, while the material of the flexed body outwardly of such neutral axis is placed under tension and is caused to stretch or increase in length. While, in a homogeneous body of rectangular cross-section, the neutral flexural axis would fall or be positioned centrally of such body, the shape and composition of the article may be so varied that the neutral axis line will vary upwardly or downwardly. It has been discovered that if the neutral axis of flexure of the bun or filler per se is varied from its medial position to a position farther away from the direction of the fold, and more nearly contiguous with the neutral axis of the entire mattress, the stresses within the article tending to permanently set the creases formed upon the fold are so reduced as to substantially alleviate this permanent setting.

Thus in the mattress of Figures 3 and 4, where it is contemplated to fold the same upon its upper or sleeping surface 26, the flexural neutral axis of the bun or filler per se designated at 27 is made to lie as near as possible to the bottom surface 28 of the cover 24 which is also that surface of the cover away from the direction of the fold and establishes the actual neutral flexural axis of the mattress and cover combination. By thus bringing the neutral axis 27 into closer conformity with the flexural neutral axis of the combined mattress and cover which is along the outer surface 28 of the inextensible cover the portion of the bun which would normally tend to remain of constant length during flexure is made to lie nearer to that portion of the bun which is forced to maintain a constant length, with the result that excessive buckling along the inner surface of the mattress is avoided.

While several expedients may be employed for thus bringing the natural neutral axis 27 into closer conformity with the neutral axis of the overall covered mattress, this effect is accomplished in the mattress of Figures 3 and 4 by the removal of the foam rubber material at predetermined places along that portion of the bun which lies in the direction of the anticipated fold. In molded foam rubber items such as the mattresses herein considered, it is convenient to remove the material from such surface of the bun during the molding operation by the use of core pins such as are already customarily employed in the foam rubber molding art.

If the foam rubber mattress is to have no other core pin depressions, it is apparent that such depressions of any depth placed upon the fold or sleep side of the bun will cause the flexural neutral axis of the mattress to move away from that surface upon which these depressions are formed. It is likewise apparent that if the bottom side of the foam rubber bun or filler is to have core depression openings thereon as is the case in the presently known mattresses, it is necessary that the core pin depressions opening on the top side of the bun be of a depth greater than those opening on the bottom such that the neutral axis will be made to lie nearer this bottom surface. While any such manipulation of core depression depths, causing the flexural neutral axis of the bun or filler to move even slightly away from its normally medial position in a direction away from the surface upon which the folds are to be made, results in some degree of improvement of the type herein considered, it has been found that greatly improved anti-wrinkling properties may be achieved when the flexural neutral axis of the bun is located substantially $\frac{3}{4}$ of the thickness of the filler away from that surface upon which the folds are to be made. In a mattress filler having no other cored depressions, this positioning of the flexural neutral axis could be achieved by providing upon the sleep side surface thereof core depressions extending substantially one-half the thickness of the bun. On the other hand, where both broadside surfaces of the bun or filler are to be characterized by core depressions opening thereon, it is preferred that those depressions opening upon the top or sleep side surface be of sufficient depth, as compared with the opposing core pin openings, to cause the foam rubber layer separating the bottoms of these respective sets of depressions to have its bisecting plane substantially at a point $\frac{3}{4}$ of the thickness of the mattress away from the sleep side thereof.

Thus in the mattress shown in Figures 3 and 4, those core pin depressions 29 opening upon the top surface 25a of the filler may be $2\frac{7}{8}$ " in depth whereas the core depressions 30 opening upon the bottom surface 25 of the filler extend into the same only to a depth of $\frac{3}{4}$ ". If, as is the usual case, the filler has an overall thickness of 4" it can be seen that a continuous band 31 separating the bottoms of these respective sets of core pins and measuring $\frac{3}{8}$ " in thickness will be provided. It has been found that, for all practical purposes, the flexural neutral axis 27 of the filler 23 will lie at substantially the midpoint of the continuous band 31 such that it may be considered as lying approximately 3" from the top surface 25a of the filler. It thus develops in this one preferred example that the neutral axis 27 which is the free and normal neutral axis of the bun or filler 23 taken by itself lies only 1" or approximately 25% of the thickness of the filler away from the bottom surface 25 which is contiguous with the fabric portion 28 which forms the actual neutral axis of the mattress and filler combination.

A correlation of the mattress shown in Figures 3 and 4 with the application shown in Figures 1 and 2 will demonstrate that the surface 25a of the filler 23 is that surface upon which the folds are to be made and upon which the body of a user will recline. It follows therefore that alterations made in the foam rubber bun along this surface must keep in mind the comfort and satisfaction of the ultimate user. In this regard, it has been discovered that, particularly where the necessary removal or deletion of foam rubber material in the bun may be achieved by the provision of core pin depressions such as 30 opening upon the side of the bun away from the direction of the fold, those core pin depressions 29 which are provided along that surface upon which the folds are contemplated, may be of a considerably reduced diameter ranging from $\frac{1}{2}$ " to $1\frac{1}{4}$ " as compared with the usual 1" to 2" diameter depressions heretofore employed in the foam rubber molding art.

In lieu of the uniform distribution of core pin depressions about both surfaces of the mattress as shown in

Figures 3 and 4, those depressions opening on the fold or sleep side of the filler may be located only at selected areas thereof, when the fold pattern to which the mattress will be subjected is known in advance and will remain constant throughout the life of the article. Such a construction is shown in Figures 5 and 6, this mattress being designed to accommodate a folding pattern such as that which would be involved in the sofa bed illustrated in Figures 1 and 2. This mattress is similar to that previously described in that it comprises a cellular rubber bun or filler 32 and an inextensible fabric cover or sheath 33. As best shown in Figure 6, such a mattress must first be folded along a transverse line substantially at its mid-section to form two overlapping portions; and the overlapping portions thus formed must then be bent at an angle approximately 90° so that the portion including the initial fold will be able to be inserted into the back recess such as 18 of the sofa bed of Figure 1. It can be seen that upon the upper surface 34, folds 35 and 36 similar to 19 and of Figure 1 will be formed when the mattress is forced into the sofa arrangement. To accommodate this folding in a manner which will alleviate the permanent setting of the wrinkles caused thereby, without unduly complicating the molding and core pin arrangements, the neutral axis of the foam rubber bun 32 may be altered or shifted solely at the points where these folds are contemplated. Accordingly, the sleeping surface core pin depressions 37 may be provided in selected areas and arranged in strips which follow generally the lines of the anticipated folds. Such strips of core pin depressions are shown in Figures 5 and 6, those depressions at 37 being intended to accommodate the fold 35 and those depressions at 38 being designed to accommodate the fold 36.

Once again the sleep side core pin depressions 37 and 38 of the mattress set forth in Figures 5 and 6 should be of a reduced diameter not exceeding 1" whereas those core pin depressions 39 opening upon the bottom surface of the mattress away from the body of the user may be of the conventional diameter of from 1" to 2". These bottom core hole depressions 39 may be formed in the conventional manner, and it is preferred that they be so arranged as to preserve a substantially uniform cross-sectional density throughout the entire length of the mattress notwithstanding the presence at the certain desired locations as set forth above of the core depressions 37 and 38. As in the case of the mattress illustrated in Figures 3 and 4, the depressions 37 and 38 should be of such a depth as compared with the opposite depressions such as 39a and 39b that the central portion of the continuous strip separating the bottom of the core depressions will be approximately $\frac{3}{4}$ of the thickness of the mattress away from the side thereof upon which the folds are contemplated.

Another feature of the present invention involves the incorporation in the rubber-like bun or filler 32a of Figure 7 of the edge core depressions 40 which, in addition to being exposed at their ends to the folding surface of the mattress, are also exposed to and open upon its edge portion. This provision of edge-opening core pins is contrary to previously used molding practices and adds to the improvement provided by the present invention in that the undesirable buckling of the mattress is prevented even at the edges thereof. While this buckling at the edges has never appeared to be more excessive than that across the body of the mattress, it has been found that the alleviation of this edge buckling plays an unexpected and important part in the prevention of the wrinkle formation throughout the entire mattress, which is an object sought by this invention.

The bun 32a of Figure 7 like 32 of Figures 5 and 6 is intended to accommodate the particular fold pattern of the mattress in Figures 1 and 2. In this modification, however, only one wide band of sleep side core holes 41 is provided transversely of the mattress. The selected

area occupied by said band is of sufficient width, in this instance $27\frac{1}{2}$ ", to include the lines of both of the folds 19 and 20. The band begins at a distance of $19\frac{1}{2}$ " from the foot or lower edge 42.

While the present invention has been described in considerable detail in connection with certain preferred embodiments thereof, it is to be understood that the foregoing particularization is for purposes of illustration only and does not limit the scope of the present invention as particularly defined in the subjoined claims. For example, specific reference to cellular rubber, rubbery or rubber-like material has been by way of exemplary description of the physical properties encountered in the instant art and should not be taken to exclude other foamed or cellular resilient materials such as foamed polyvinyl chloride as well as other expanded or cellular resilient plastics having flexibility and resilience characteristics similar to those of rubber such that they are equally adaptable to furniture construction or the like. In general, foam rubber products such as described herein may be prepared by the methods described in Talalay Patent No. 2,432,353 or Patent No. 1,852,447 to Chapman et al.

We claim:

1. In a convertible piece of furniture having a folded mattress associated therewith adapted to be opened to horizontal sleeping position, said mattress being formed of cellular resilient material and being folded transversely of its length, said mattress being provided with a plurality of cored depressions opening along and adjacent to the line of said fold in the inwardly folded surface of said mattress whereby stresses along said fold line are relieved during storage of said mattress in said folded condition.

2. In an article of furniture according to claim 1 wherein the inwardly folded surface contains a plurality of cored depressions opening thereon and arranged in a relatively narrow strip following the line of the fold.

3. In an article of furniture according to claim 1 wherein the core pin depressions opening upon that surface are also formed adjacent to the edge portions of the mattress at the folded position and are exposed at said edge portions.

4. An article of furniture according to claim 1 wherein the cored depressions have a depth at least equal to one-half the thickness of the mattress.

5. In a convertible piece of furniture according to claim 1 wherein both broadside surfaces of said mattress have a plurality of cored depressions formed therein and wherein those depressions on the inwardly folded surface of the mattress are of a greater depth than those in the opposite surface.

6. In an article of furniture according to claim 5 wherein the cored depressions opening on the inwardly folded side of the mattress are of a smaller diameter than the depressions opening on the opposite surface of the mattress.

7. An article of furniture according to claim 6 wherein the depressions on the inwardly folded surface thereof are separated from those on the opposite surface by a continuous strip of foam rubber lying at a distance of substantially $\frac{3}{4}$ of the thickness of the mattress measured from the folded surface.

8. In a sofa bed combination adapted for use as a seating means or as a bed having a mattress for sleeping purposes stored therein in folded condition while the combination is in use as a sofa, said mattress being formed of cellular resilient material and being folded transversely of its length along a first fold and thereafter folded in a second fold along the line parallel to the first fold line so as to underlie the seat and part of the back support of the combination, said mattress comprising a plurality of cored depressions opening upon the upper surface thereof in selected areas wherein such selected areas substantially conform to the lines of the folds and the cored depressions opening upon said upper

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surface penetrate the mattress to a substantial proportion of its thickness.

9. A folded mattress adapted for incorporation into an article of furniture for use either for seating purposes or as a bed, said mattress being folded inwardly along a line transverse to its longitudinal axis and having a flexural neutral axis located more than one-half the thickness of said mattress away from said inwardly folded surface.

10. A folded mattress according to claim 9 having a plurality of cored holes opening upon the inwardly folded surface of the mattress and a plurality of cored holes opening upon the opposite surface of said mattress, the holes opening from said folded surface being of greater depth than the holes opening from said opposite surface.

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