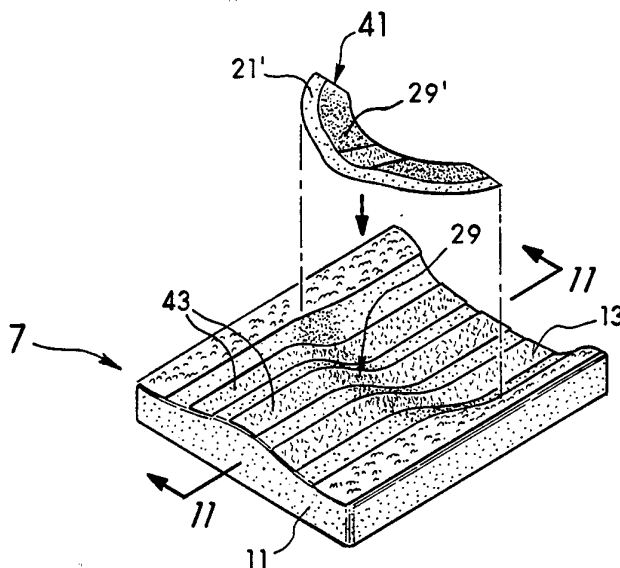




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(54) Title: SEATING AND BACK SYSTEMS FOR A WHEELCHAIR



## (57) Abstract

An anti-thrust seating system (1) and low profile, adjustable back system (2) primarily intended for use in a wheelchair (3). The anti-thrust seating system includes a base seating member (7) with a forward section (15) to support the user's thighs and a rearward section (17) to support the user's buttocks including the ischial tuberosities. The upper surfaces of the forward and rearward sections meet to form an edge (33) extending across the base seating member (7). The upper surface of the rearward section has two portions which form a first step face or anti-thrust barrier (29) to the user's ischial tuberosities. The seating further includes at least one separate step means (41) that can be removably positioned adjacent and rearwardly of the first step face (29) wherein the separate step means has a second step face (29') which serves to effectively extend the thigh supporting surface or shelf rearwardly. The adjustable back system has first and second relatively rigid shell members (6, 8) with a back cushion (10) removably attached to the second or forward shell member (8).

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**SEATING AND BACK SYSTEMS FOR A WHEELCHAIR****BACKGROUND OF THE INVENTION****1. Field Of The Invention**

5 This invention relates to the field of seating and back systems and more particularly, to the field of seating and back systems for wheelchairs for growing children as well as adults whose bodies are changing as for example, due to weight gain or loss.

**2. Discussion Of The Background**

10 Growing children present a unique problem to seating and backing systems for wheelchairs in that the fitting requirements of the child are continually changing sometimes even on a month-to-month basis. Consequently, a seating and back system that may properly position and support the growing child one month may not do so the next month or months. Such growth takes place in both the seat and back areas of the child; but, the primary fitting problem is presented in adjusting or modifying the seating portion of the system and in particular, the pre-  
15 ischial shelf area.  
20

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More specifically, a properly fitting seating system typically has a base seating member or cushion. The base member has a thigh supporting surface or shelf near its front and a step down to a depressed, seating well toward the rear which supports the child's buttocks including his or her ischial tuberosities. The child is preferably positioned with his or her ischial tuberosities (and the flesh immediately forward of them) immediately adjacent the face of the step. Ideally, the back of the child's knees are immediately adjacent the front surface of the seating member in roughly a 90 degree position with the child's feet on the footrests and the child's back is supported roughly in a 95 degree or so position. This aids in achieving maximum support under the thighs to reduce pressure under the ischial tuberosities and in achieving proper leg, pelvic, and spine positioning. However, with time, the child's thigh or femur bones will grow and lengthen often dramatically (e.g., 2 to 3 inches in 2 to 3 years). Although such growth is gradual, it manifests itself in the seating system in a number of ways. In particular, the previously proper fit of the child with the backs of his or her knees against the front of the seating member and his or her ischial tuberosities against the step face now finds the ischial tuberosities spaced rearwardly from the step face due to the femur growth. The end result is that the child often thrusts or scoots his buttocks forward until his or her ischial tuberosities again are immediately adjacent the step face. This can be due to a number of reasons including the fact that a child often lacks the discipline to sit up straight or may have involuntary extensor tone.

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Such thrusting or scooting then misaligns the child's knees and legs which can lead to lower extremity deformities including abduction (legs permanently apart), adduction (legs permanently together), windsweeping (both legs permanently off to one side), or subluxation (dislocation) of the femur from the hip joint. Furthermore, such misalignments can lead directly to serious back problems, including permanent deformities, the most common of which is kyphosis or front-to-back curvature of the spine. Other back deformities include lordosis (excessive lumbar curve), and scoliosis (side-to-side curvature of the spine). These problems are further accentuated by the excessive muscle tone frequently found in people with spastic cerebral palsy. If such individuals are not properly positioned in their wheelchairs at every step of their growth process, the development of permanent deformity is frequent.

In the past, such fitting needs of a growing child were simply met by replacing the entire seating member with a larger one every 6 to 12 months. Such a process is obviously expensive. Further, in making such replacements in 6 to 12 month stages, the immediate fitting needs of the child at each stage were often not even met as the tendency was to compromise at each stage and to provide a larger than needed seating cushion in order to allow for some growth. Toward the end of any such stage, the fitting needs of the growing child were also usually not met as the tendency was to wait until the child had clearly overgrown the seating system before replacing it. In the meantime, seat belts, shoulder harnesses, and other restraints were often needed to maintain the child in the seating system not to mention the

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continuing discomfort and potential damage of such an ill-fitting seating system.

Another approach has been to use "linear" seating systems, consisting of plywood padded with foam. With these systems, the changing contours of the body did not significantly affect the fit of the seating, as substantial body contact was never achieved. Body contoured seating has been successfully developed for adults in wheelchairs (see, for example, applicant's U.S. Patent Nos. 4,588,229, 4,726,624; and 5,018,790). These contoured systems have provided increased body contact, with a resulting increase in stability and positioning capability. This additional stability and contact have also been extremely effective in reducing the spasticity and tone that has pulled the child's bones into deformity. Such generic contours, particularly in a cushion, have been recognized to be of great value to children, but have been in limited use because as the child grew, the child invariably began sitting on the anti-thrusting shelf built into the contoured cushion. As a result, contoured seating has been used only minimally with children, with the effect that the individuals who most needed positioning were the ones least likely to receive it. In this regard, the reason children need positioning more than adults is that their bones are soft and are very susceptible to being pulled into permanent deformities, particularly during growth spurts.

With the above in mind, the seating and back systems of the present invention were developed. With them, a pre-ischial shelf extender or separate step means is provided wherein the seating cushion in the area of the ischial tuberosities can be selectively and progressively modified to accommodate the changing

needs of the growing child. The basic, overall seating system of the present invention can then be used for a number of years in contrast to current seating systems that often need full replacements every few months. Additionally, the needs of a fully grown adult can also be met with the seating system of the present invention wherein an off-the-shelf or standard sized seating member can be easily and quickly modified and customized to specifically fit the adult. Adults whose bodies are changing (e.g., by weight gain or loss) or whose diagnoses are changing can also be accommodated. Other modifications and additions have also been made in the seating system of the present invention including a specially designed fluid pad. An adjustable back system was also specially developed for use with the seating system of the present invention; however, it can be used with other seating systems if desired. The adjustable back system permits the position of the back to be varied about multiple axes to meet the special needs of the child or adult user. The adjustable back system further includes unique features that provide a very desirable, low profile yet permit significant modes of adjustment.

SUMMARY OF THE INVENTION

This invention involves an anti-thrust seating system and low profile, adjustable back system primarily intended for use in a wheelchair.

5           The anti-thrust seating system includes a base seating member with forward and rearward sections. The forward section has an upper surface to receive and support the user's thighs and the rearward section has a depressed, seating well to receive and support  
10       the user's buttocks including the user's ischial tuberosities. The upper surfaces of the forward and rearward sections meet to form an edge extending across the base seating member. The upper surface of the rearward section has two portions with the first  
15       portion extending downwardly and rearwardly of the edge to form a first step face or anti-thrust barrier to the user's ischial tuberosities. The seating system further includes at least one separate step means that can be removably positioned adjacent and  
20       rearwardly of the first step face wherein the separate step means has a second step face.

          In use, the separate step means with its second step face serves to effectively extend the first step face rearwardly. For example, if the first step face  
25       is too far forward and does not properly position the user, the separate step means can then be added to properly fit and support the user's ischial tuberosities positioned near or immediately adjacent the second step face. This is true whether the user  
30       being fitted is a growing child or fully grown adult. The separate step means also has an upper surface and in use, the upper surface aligns with the upper surface of the forward thigh supporting section of the

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base seating member. In doing so, it serves to effectively extend the thigh supporting surface or shelf rearwardly. In this manner, the separate step means forms a pre-ischial shelf extender to better fit the user and in particular, a growing child whose seating requirements are constantly changing. In one embodiment, this shelf extender is taller or higher than the shelf of the forward section. This produces a fulcrum which can be very effective in reducing ischial pressure during sitting as the weight of the legs actually leverages the person's weight off the ischial tuberosities.

The base seating member and pre-ischial shelf extender can be used with or without a covering fluid pad. However, if it is used with a fluid pad, the pad is preferably designed and dimensioned so as to avoid having any lateral seams in the step area. The seating system also includes an extra or separate base member or cushion. The separate cushion can be positioned both above the upper surface of the forward section of the base seating member and the upper surface of the separate step member to further raise the thigh supporting surfaces in relation to the footrests and seating well area under the ischial tuberosities. This provides more resistance to the user's thrusting and reduces pressures on the ischial tuberosities and coccyx. In other embodiments, the separate cushion can be used with the base seating member without the pre-ischial shelf extender and with or without the fluid pad.

The adjustable back system of the present invention is designed to be used with the seating system but can be used separately if desired. The back system has first and second relatively rigid

shell members with a back cushion removably attached to the second or forward shell member. The first or rearward shell member is removably attached to the back posts of the wheelchair and has a first portion that extends substantially between and along the posts. The forward shell member is then mounted to the first portion of the rearward shell member and can be moved relative to it and the back posts to a number of positions to properly fit and support the user.

10           The first and second shell members of the back system nest in their retracted position to present a desirable, low profile. In this retracted position, portions of both the first and second shell members extend between and along the back posts of the wheelchair and very little of the back extends forward of the back posts. Additionally, the cushion nests with the forward shell member to further minimize the back's profile. The means for moving the shells relative to each other in the preferred embodiment includes a plurality of screw arrangements. Each screw arrangement has a front end portion that projects through the front shell member and into specially provided depressions in the back surface of the cushion. In this manner, the projecting end portions of the screw arrangements when the shells are fully retracted are received in the cushion depressions to further minimize the overall profile depth of the back system. In use, the back system can be selectively operated to place the forward shell member and the cushion in a variety of positions about multiple axes to meet the positioning needs of the child or adult user. The adjustable back also enables the user to place the seating cushion in a typical position (i.e., wherein the cushion does not protrude

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rearwardly beyond the back posts on the wheelchair) rather than having to move the cushion too far rearwardly for a proper fit. This is particularly advantageous since most wheelchair footrests and frame depths are essentially non-adjustable and to a certain extent dictate where the seating cushion must be positioned on the wheelchair for a proper fit.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a side elevational view of a wheelchair with the anti-thrust seating system and the adjustable back system of the present invention.

5           Figure 2 is a view of the anti-thrust seating system of the present invention removed from the wheelchair.

          Figure 3 is a view of the anti-thrust seating system of Figure 2 with the cover removed to show the  
10       base seating member and the fluid pad positioned on it.

          Figure 4 is an exploded view of the base seating member and fluid pad.

          Figure 5 is a cross-sectioned view taken along  
15       lines 5-5 of Figures 4 and 6.

          Figure 6 is a top plan view of the base seating member of Figure 5.

          Figure 7 is a cross-sectioned view showing a  
20       person properly positioned and fitted in a seating system.

          Figure 8 is a view similar to Figure 7 showing a person either who has grown from the size of Figure 7 or who is otherwise improperly positioned and fitted in a seating system.

25       Figure 9 illustrates the tendency of a person improperly fitted as in Figure 8 to thrust or scoot forward into an undesirable position.

          Figure 10 illustrates a pre-ischial shelf extender or separate step means according to the  
30       present invention.

          Figure 11 is a view taken along line 11-11 of Figure 10.

Figure 12 is a top plan view of the pre-ischial shelf extender or separate step means of the present invention in place on the base seating member.

5 Figure 13 is a view similar to Figures 8 and 9 showing the pre-ischial shelf extender or separate step means in place to properly position and fit the person of Figures 8 and 9 in the seating system.

Figure 14 is a view similar to Figure 7 showing a fluid pad on the base seating member.

10 Figure 15 is a top plan view of the fluid pad.

Figure 16 is a cross-sectional view similar to Figure 13 showing the fluid pad positioned over the base seating member and pre-ischial shelf extender or separate step means.

15 Figure 17 is a view similar to Figure 16 showing the use of two, pre-ischial shelf extenders.

Figure 18 is a perspective view of an additional thigh supporting member or cushion.

20 Figure 19 illustrates the additional thigh supporting member in use with a pre-ischial shelf extender or separate step means of the present invention and a fluid pad.

25 Figure 20 is a view similar to Figure 17 but showing the use of a modified pre-ischial shelf extender that includes a raised bump portion.

Figure 21 is a view similar to Figure 20 showing the versatility of placing the shelf extender with the raised bump portion ahead of a shelf extender with a relatively flat top to position the bump as desired.

30 Figure 22 is a view similar to Figures 20 and 21 showing the use of a single shelf extender with a raised bump portion.

Figure 23 is a perspective view of the adjustable, low profile back system of the present

invention positioned on the back posts of the wheelchair.

Figure 24 is a view of the adjustable back system of Figure 23 with the cover removed and showing the back system in its forward or extended position.

Figure 25 is an exploded view of the back system of Figure 24.

Figure 26 is a rear view of the back system taken along line 26-26 of Figure 1.

Figure 27 is a simplified view taken along line 27-27 of Figure 26 showing the relatively rigid shell members of the back system in their low profile, retracted position.

Figure 28 is a view similar to Figure 27 showing the shell members in an extended position.

Figure 29 is a view taken along line 29-29 of Figure 27 showing one of the screw arrangements for moving the shell members in its retracted position.

Figure 30 is a view taken along line 30-30 of Figure 28 showing the screw arrangement of Figure 29 in its extended position.

Figures 31-35 show various positions to which the front shell member and cushion can be adjusted to meet the needs of the user.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

As illustrated in Figure 1, the anti-thrust seating system 1 and adjustable back system 2 of the present invention are primarily intended to be used in a wheelchair 3. In this preferred arrangement, the seating and back systems are used together to properly position and support the user; however, they can be used separately if desired. They can also be used in other conveyance means such as a baby stroller.

10

**Seating System**

The seating system 1 as best seen in Figures 2-4 includes an outer cover 5 (see Figure 2) positioned over a base seating member 7 (see Figure 3) and fluid pad 9. The base seating member 7 is preferably a foam cushion but can be a relatively rigid tray. It can also be used in the present invention with or without the fluid pad 9 and even independently of the wheelchair 3.

The base seating member 7 as shown in Figures 5 and 6 has front and rear surfaces 11 and 13. The base seating member 7 is then essentially divided into forward and rearward sections 15 and 17 which extend adjacent one another substantially from the front surface 11 to the rear surface 13 along the central axis 19. The forward section 15 has an upper surface 21 which forms a shelf to receive and support the user's thighs (see Figure 7). This surface 21 as best seen in Figure 6 extends substantially along and across the central axis 19. The rearward section 17, in turn, has an upper surface 23 forming a depressed, seating well to receive and support the user's

5 buttocks including his or her ischial tuberosities 25  
(see again Figure 7). The upper surface 21 is  
typically at an elevation above the upper surface 23  
to produce increased support under the user's thighs  
and thus reduce that portion of the user's weight  
supported by the buttocks. The skin and tissue  
interface pressures are thereby reduced at the  
sensitive bony prominences on the buttocks (i.e.,  
ischial tuberosities, coccyx, and trochanters) and  
10 redistributed to underneath the thighs which generally  
can sustain higher tissue interface pressures.

The upper surfaces 21 and 23 of the forward and  
rearward sections 15 and 17 (see Figures 5 and 6) meet  
to form an upper edge 27. The upper edge 27 extends  
15 substantially across the central axis 19 on each side  
of the base seating member 7. The upper surface or  
seating well 23 of the rearward section 17 has two  
portions 29 and 31. The first portion 29 as best seen  
in Figure 5 extends or slopes downwardly and  
20 rearwardly at about 45 degrees from the upper edge 27.  
As shown, this is in an area immediately adjacent and  
rearward of the edge 27 wherein the first portion 29  
serves to form a step face. The second portion 31 of  
the seating well 23 extends rearwardly of the first  
25 portion 29 from the lower edge 33 that is formed by  
the meeting of the first and second portions 29 and 31  
of the rearward surface 23.

In a proper fitting as shown in Figure 7, the  
step face 29 and surface 21 under the user's thighs  
30 form a shelf-step arrangement. This arrangement is  
positioned in front of the user's ischial tuberosities  
25 wherein the step face 29 serves as a barrier (e.g.,  
1-4 inches high) to prevent undesirable forward thrust  
or movement of the user's ischial tuberosities 25.

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That is and referring to Figure 8, if the user is a growing child for example, his or her thigh or femur bones 35 will grow significantly from the position of Figure 7 to the position of Figure 8. In doing so, the growing child unintentionally and undesirably alters and actually destroys the proper fit of Figure 7. In the proper fit position of Figure 7, the backs of the child's knees are adjacent and preferably touching the front surface 11 of the base seating member 7. His or her ischial tuberosities 25 are then positioned near or immediately adjacent the step face 29 of the pre-ischial shelf formed by step face 29 and upper surface 21 with the flesh immediately ahead of the ischial tuberosities 25 preferably pressed against the step face 29. In an effort to properly fit the growing child with the back of his or her knees against the front surface 11 of the base seating member 7, the back 37 of the wheelchair in Figure 8 is commonly moved rearwardly from its substantially vertical position of Figure 7. Alternately, the base seating member 7 is simply moved forwardly in the wheelchair. However, in either case, the end result particularly with children is that the child thrusts or scoots forward (see Figure 9) until the flesh immediately ahead of his or hers ischial tuberosities 25 presses against the step face 29. This thrusting misaligns not only the child's knees and legs but also his or her back and places undue pressure on the ischial tuberosities. If neither the seat nor back is adjusted, the growing child will end up with his or her ischial tuberosities 25 very undesirably riding up and even over the step face 29. Unless corrected, these situations can lead to serious and undesirable problems.

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To compensate for the growth problems of Figures 7-9 (or if the user is a fully grown adult, to compensate for the simple misfitting of Figures 8 and 9), a separate step member 41 is provided as shown in Figures 10-13. The separate step means or member 41 as illustrated has a second step face 29'. In use, the separate step member 41 can be removably positioned (e.g., by hook and loop fasteners 43) immediately adjacent and rearwardly of the first step face 29. In doing so, it effectively serves to extend the first step face 29 rearwardly to the position of step face 29' in Figure 13. In this manner, the first anti-thrust barrier formed by the first step face 29 is also effectively moved rearwardly to form a second anti-thrust barrier. As a result, the user of Figures 8 and 9 can then be properly fitted and supported in the desired position of Figure 13.

The separate step member or means 41 is preferably dimensioned to conform to the step face 29 and to extend laterally across the central axis 19 of the base seating member 7 for a distance at least equal to the distance between the user's ischial tuberosities 25 (e.g., about 3 to 8 inches). The second step face 29' then slopes downwardly and rearwardly at about the same angle as the first step face 29 (e.g., about 45 degrees). Additionally, the separate step member 41 has an upper surface 21' (see Figure 13) substantially aligning in use with the upper surface 21 of the forward section 15. In this manner, the surface 21' serves to effectively extend rearwardly the thigh supporting surface or shelf 21. The separate step member 41 and in particular, its upper surface 21' thus serves to form a pre-ischial shelf extender to better fit the user. Similarly, the

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conforming separate step member 41 serves to effectively extend rearwardly the original upper edge 27 to the new position of 27' in Figure 13. It also effectively extends rearwardly the lower edge 33 to the new position of 33' in Figure 13. In all such cases, the user's ischial tuberosities 25 are preferably positioned immediately adjacent and rearward of the lower edge 33 so as to be close to but not in front of the lower edge 33 (in the configuration of Figure 7) and of the lower edge 33' (in the configuration of Figure 13). In this manner, the ischial tuberosities 25 preferably are near or immediately adjacent the step face or anti-thrust barrier 29 in Figure 7 and the second face step or anti-thrust barrier 29' in Figure 13 for proper fits with the flesh immediately ahead of the ischial tuberosities 25 preferably pressed against the respective step face 29 or 29'.

As discussed above, the base seating member 7 and the pre-ischial shelf extender or separate step member 41 can be used with or without an overlying fluid pad 9. However, if a fluid pad 9 is used as shown in Figures 14-17, the fluid pad 9 is preferably designed so that the central pouches 45 (see Figure 15) are always positioned over the base seating member 7 with the front seams 47 of the pouches 45 (see Figure 14) forward of the edge 27. Additionally, the pouches 45 are preferably dimensioned so that their rear seams 49 are rearward of the lower edge 33 as well as rearward of the user's ischial tuberosities 25. Seams in this area and in particular, in the area of the ischial tuberosities 25 are to be avoided to prevent pressure and positioning problems (e.g., an ischial tuberosity loaded on a pouch near a seam will inevitably tend to

migrate to the seam). This forward and rearward seam positioning is preferred regardless of whether the separate step member 41 is used (compare Figures 14 and 16) or even if a second separate step member 41' is used (see Figure 17). This is also true whether or not the extra or separate base seating member 7' of Figures 18 and 19 is used. That is, when the child grows from the size of Figure 7 to that of Figure 8 (or when a fully grown adult is being fitted), it may be necessary to extend the thigh and fluid pad supporting surface or shelf 21 upwardly and rearwardly to the position of 21" in Figure 19. Preferably, this is accomplished by fashioning the cushion 7' of Figure 18 in the general shape of the upper support surface or shelf 21 and the extended shelf surface 21'. The extra cushion 7' can then be placed over both the surfaces 21 and 21' as shown in Figure 19. This effectively raises the edge 27' in Figure 16 to the position of edge 27'" in Figure 19. It also shifts more weight load to the thigh supporting surface 21" particularly if the footrests are left in place. That is, with the addition of the extra cushion 7', the legs will leverage the ischial tuberosities 25 and coccyx up higher in the seating well 23 and will reduce the pressure on these bony prominences. For the same reason, the extra cushion 7' is desirable for use with children and adults with pelvic obliquities (i.e., one hip is lower than the other).

In this regard, the separate cushion 7' can be used with the base seating member 7 without the preischial shelf extender 41. In this embodiment, the size and shape of the separate cushion 7' are substantially the same as the upper surface 21 of the forward section 15. Also, in this embodiment, the

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base seating member 7 and separate base member 7' may be used with or without a fluid pad 9. Removable accessories which are normally used on the upper surface of the seating member, such as abductors or adductors, can be placed on top of the separate base member 7' to further position the legs. The separate base seating member 7' may also be used when a pelvic obliquity accessory is used in the bottom of the seating well 23. In this case, the pelvic obliquity build-up is used in one side of the seating well 23 to compensate for a tilted pelvis. However, this lifts the whole pelvis somewhat higher than it would be without this accessory. To compensate for the increased height of the seating well surface, the separate base member 7' can be used to raise the thighs correspondingly.

With the modified step member 41" of Figures 20-22, the front seams 47 of the pouches 45 are also positioned forwardly of the edges 27 and 28. The modified step member 41" as shown includes a raised bump portion with a convex upper surface 21'''. Because this step member 41" is a separate, removable member, it can be positioned as desired alone or with other step members 41 and 41' (see Figures 20-22) to selectively position its bump portion 21''' relative to the user. The bump portion 21''' extends laterally across the base seating member 7 and serves essentially as a fulcrum. In this manner, the weight of the user's legs actually leverages the person's weight off the ischial tuberosities 25 to effectively reduce the ischial pressure. With some users, this bump portion or fulcrum 21''' is best positioned rearwardly (see Figures 20 and 22). With other users, it may be best positioned in the sandwiched arrangement

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of Figure 21 in between the substantially horizontally aligned, upper surfaces 21 and 21' of members 7 and 41'. In this manner, the raised bump portion 21''' can be custom fit to the user's needs. The forward edge 28 of the modified step member 41" in the arrangements of Figures 21 and 22 is actually forward of the upper edge 27 of the base seating member 7. In the arrangement of Figure 22, the lower edge 33" is then rearward of the lower edge 33 of the base seating cushion 7.

The arrangements of Figures 14-22 as discussed above can be used with or without the overlying fluid pad 9. However, if the fluid pad 9 is used, its front seams 47 of central pouches 45 are still preferably positioned as shown (i.e., forward of the extended upper edges 27', 27", and 27''' as well as forward of the original edge 27 and edge 28 of member 41"). Similarly, the pouches 45 are preferably dimensioned so that their rear seams 49 are always positioned rearwardly of the user's ischial tuberosities 25. In this manner, no lateral seams such as 47 or 49 are positioned over the step face 29 in the configuration of Figure 14 or over the second or third step faces 29' or 29" in the configurations of Figures 16 and 17 or over step face 29''' in the configuration of Figure 20.

The fluid pad 9 preferably has additional pouches 45' both forward and rearward of the central or step pouches 45. However, the fluid pad 9 with such additional pouches 45' is still preferably dimensioned to position the front seams 47 of the central pouches 45 immediately adjacent and forward of the edge 27 in the respective configurations of Figures 14, 16, 17, and 19. Additionally, the front seams 47 are

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preferably positioned substantially closer to the upper edge 27 than to the front surface 11 of the base seating member 7. These laterally extending seams 47 aid in keeping or trapping fluid in the forward pouches 45' in front of the seams 47 for proper support of the thighs. Similarly, the rear seams 49 of the central or step pouches 45 are positioned at least in the configurations of Figures 16, 17, and 19 closer to the respective lower edges 33' and 33" than to the rear surface 15 of the base seating member 7. Preferably, a longitudinal, central seam such as 51 in Figure 15 can also be provided for additional side-to-side stability. The purpose of this seam 51 is to prevent the fluid from migrating to one side and causing a pelvic obliquity (i.e., one hip lower than the other) with a resulting scoliosis of the spine. In this regard, its alignment with the central axis 19 of the base seating member 7 will place the seam 51 between the halves of the user's buttocks where bottoming out is not usually a problem. The fluid in the fluid pad 9 is preferably a high viscosity liquid but can be a gas, water, or other fluid if desired.

#### Back System

The adjustable back system 2 of the present invention has been specially designed to provide a low profile with minimum seat depth loss in its retracted position and to offer substantial forward adjustments about multiple axes in its extended positions.

The back system 2 (see Figure 23) includes an outer cover 4 as well as a mating pair of relatively rigid shell members 6 and 8 (see Figures 24 and 25) and back cushion 10 shown with a fluid spinal pad 12.

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In use as shown in Figure 23, the cover 4 extends over the pad 12 and cushion 10 and can additionally extend over portions of the forward shell member 8. To attach the back system 2 to the wheelchair 3, brackets 14 (see Figure 26) are first secured by screws 16 to the upright back posts 18 of the wheelchair 3 at the desired height. The wing latches 20 (see Figure 25) of the rearward shell member 6 are then swung about the back posts 18 within the brackets 14 (see Figure 26) and removably secured in place by twist locks 22.

The first and second shell members 6 and 8 as shown in Figures 25 and 27-28 are designed so that the contours of the front surface 24 of the shell member 6 and the back surface 26 of the shell member 8 substantially match and mate or nest with one another in the retracted position of Figure 27. Similarly, the cushion 10 is attached to the shell member 8 (e.g., preferably by hook and loop fasteners 43) wherein the back surface 30 of the foam cushion 10 is preferably shaped to match and substantially mate or nest against the front surface 28 of the shell member 8. In operation and with the shell members 6 and 8 in their retracted position of Figure 27, all of the surfaces 24, 26, 28, and 30 are preferably nested as shown in Figure 27 and extending substantially between and along the back posts 18. This gives the back 2 a very low profile vis a vis the back posts 18 as very little of the back 2 extends forwardly of the back posts 18 in the retracted position of Figure 27. Aiding in the ability of the back 2 to have very little of it extend forward of the front plane P (see Figure 27) that extends across the front of the back posts 18 is the nesting of central portions 42, 42', and 42" of members 6, 8, and 10. That is, as shown in

Figure 27, these nesting, central portions 42, 42', and 42" extend between and along posts 18 in the retracted position substantially behind or rearward of plane P. They also extend substantially between  
5 planes P and P' of the front and back of posts 18 to substantially fall within the depth profile of the back posts 18.

Additionally, to further aid in reducing the seat depth loss in the retracted position, the foam cushion  
10 10 is molded or cut to include depressions 32 (see Figures 27 and 28). These depressions 32 in the back surface 30 of the cushion 10 as shown in Figure 27 are dimensioned to receive the forward end portions 34 of the screw arrangements 36 when the screw arrangements  
15 36 are in their fully retracted positions. In these positions, the forward end portions 34 of the screw arrangements 36 pass through and project forwardly of the front surface 28 of the shell member 8 and into the depressions 32 in the cushion 10. More  
20 specifically, the first rigid shell member 6 as shown in Figures 27 and 28 is mounted with its C-shaped, wing portions 40 about the back posts 18 and its first or central portion 42 extending substantially between and along the back posts 18. The second shell member  
25 8 is then mounted by screw arrangements 36 to the first or central portion 42 of the shell member 6. In operation as explained in more detail below, the screw arrangements 36 can then be selectively operated to move the second shell member 8 relative to the first  
30 shell member 6 and back posts 18 about multiple axes.

Each screw arrangement 36 as best seen in Figures 29 and 30 includes first and second telescoping screw members 44 and 46. These screw members 44 and 46 are mounted to be selectively moved relative to each other

along the axis 48. The rearward end portion 50 of each screw arrangement 36 is spherical and mounted within a spherical bearing 52 to the rear shell member 6. In operation, the screw head 54 can be turned as desired to selectively extend and retract the telescoping screw members 44 and 46. In doing so, the forward or second end portion 34 of the screw arrangement 36 moves within and relative to the nut 56 which is fixed relative to the forward shell member 8. The nut 56 in turn helps maintain the screw members 44 and 46 aligned horizontally.

By selectively operating each of the four screw arrangements 36 by turning the screw heads 54 (see Figure 26), the forward shell member 8 and cushion 10 can be moved from the retracted position of Figures 27 and 31 with the shell surfaces 24 and 26 substantially adjacent or abutting each other to any number of extended positions including those of Figures 32-35. In Figure 32, each of the screw arrangements 36 has been extended its maximum distance (e.g., 2 to 3 or more inches). In doing so, the back surface 26 of the shell member 8 is maintained essentially in the same substantially vertical position as in its retracted position of Figure 31. It is also moved essentially along a substantially horizontal axis 48' which is substantially parallel to the axes 48 of the screw arrangements 36 and substantially perpendicular to the surface 24 of the rear shell member 6. By selectively extending only the top two screw arrangements 36 in Figure 33, the back surface 26 of shell member 8 can be inclined forwardly. Such inclination relative to, for example, a vertical plane extending through the upright, vertical back posts 18 of the wheelchair could be at 20 or so degrees. This inclination would

be essentially about a horizontal axis through such a reference vertical plane. Similarly, by extending only the bottom two screw arrangements 36 in Figure 34, the back surface 26 can be inclined rearwardly (e.g., 20 or so degrees about a horizontal axis in the reference vertical plane). Likewise, by extending the screw arrangements 36 in differing amounts as shown in the top plan view of Figure 35, the back surface 26 can be inclined laterally about a vertical axis substantially in the reference vertical plane.

In this manner, the selective extension of the four screw arrangements 36 in varying amounts enables the back cushion 10 to be positioned in a wide range of positions as a result of manipulating the back surface 26 of the shell member 8 about the above-mentioned multiple axes. Such manipulation can be done simultaneously or sequentially to properly fit and support the user on the seat 1 against the back 2. In doing so, the relatively rigid shell member 8 can be made of a material (e.g., plastic) that has some give or flex to it to further enable the shell member 8 to be positioned as desired by manipulation of the screw arrangements 36. As disclosed in Figure 26, the back system 2 preferably uses four screw arrangements 36 located essentially at the corners of a quadrilateral figure (e.g., rectangle); however, a fewer or greater number of screw arrangements 36 could be used as desired. Additionally, the back system 2 can be removed from the wheelchair 3 by simply twisting the locks 22 to free the wing portions 20. Once so removed, the screw arrangements 36 maintain the front shell member 8 and cushion 10 in whatever position they were relative to the rear shell member 6. That is, the attaching means at 20 and the shell

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moving means at 36 operate independently of each other. Consequently, when desired, the rear shell member 6 can then be re-attached by wing portions 20 and twist locks 22 to the upright back posts 18  
5 wherein the front shell member 8 and cushion 10 will be automatically returned to their previously set, desired position relative to the seat 1 and back posts 18.

10 While several embodiments of the invention have been shown on described in detail, it is to be understood that there is modifications and changes to be made to them without departing from the scope of the invention.

**WE CLAIM:**

1. An adjustable, anti-thrust seating system for properly fitting and supporting a user's thighs and buttocks, said seating system including:

5 a base seating member having forward and rearward sections adjacent one another, said forward section having an upper surface forming a shelf to support the user's thighs and said rearward section having an upper surface to support the user's buttocks  
10 including the user's ischial tuberosities,

said upper surfaces of said forward and rearward sections meeting to form an edge extending substantially across said base seating member, said upper surface of rearward section forming a depressed,  
15 seating well having at least two portions with the first portion extending downwardly of said edge in an area immediately adjacent said edge to form a first step face and with the second portion of the upper surface of said rearward section extending rearwardly  
20 of said first step face, said second portion intended to support the user's ischial tuberosities and said first step face of said first portion intended to form a first anti-thrust barrier to prevent undesirable forward movement of the user's ischial tuberosities,  
25 and

said seating system further including means for extending said first step face rearwardly to form a second anti-thrust barrier, said second anti-thrust barrier being positioned rearwardly of said first  
30 anti-thrust barrier.

2. The adjustable, anti-thrust system of claim 1 wherein said extending means includes separate step

means with a second step face and means for positioning said separate step means immediately adjacent and rearwardly of said first step face with the second step face of said separate step means located rearwardly of said first step face to form said second anti-thrust barrier, said second anti-thrust barrier being positioned rearwardly of said first anti-thrust barrier wherein if the first anti-thrust barrier formed by the first step face is undesirably positioned too far forwardly for the user, said separate step means and the second step face thereof can be positioned to effectively extend said first step face and the first anti-thrust barrier formed thereby rearwardly to the desired position of said second step face and the second anti-thrust barrier formed thereby to properly fit and support the user.

3. The adjustable, anti-thrust seating system of claim 2 wherein said means for positioning said separate step means includes means for removably positioning said separate step means immediately adjacent and rearwardly of said first step face.

4. The adjustable, anti-thrust seating system of claim 2 further including a second separate step means and means for positioning said second separate step means immediately adjacent and rearwardly of said first separate step means.

5. The adjustable, anti-thrust seating system of claim 2 wherein said base seating member extends along a central axis and said first and second step faces extend laterally across the central axis of said

base seating member for a distance of at least about 3 to 8 inches, said distance being at least equal to the distance between the user's ischial tuberosities.

5           6.    The adjustable, anti-thrust seating system of claim 2 wherein said first and second step faces slope downwardly at substantially the same angle.

10           7.    The adjustable, anti-thrust seating system of claim 2 wherein each of said first and second step faces extends upwardly from the upper surface of the second portion of the rearward section for a height of about 2 inches to present an effective barrier against forward movement of the user's ischial tuberosities.

15           8.    The adjustable, anti-thrust seating system of claim 2 wherein said separate step means has an upper surface substantially aligning with and serving to effectively extend rearwardly the thigh supporting shelf formed by the upper surface of the forward section of said base seating member.

20           9.    The adjustable, anti-thrust seating system of claim 8 wherein said upper surface of said separate step means and the step face of said separate step means meet to form a second edge wherein said second edge of said separate step means serves to effectively move rearwardly said first mentioned edge and to  
25   define a new edge between the upper surfaces of the forward and rearward sections of the base seating member.

10.   The adjustable, anti-thrust seating system of claim 8 further including a separate base seating

member having an upper surface and means for positioning said separate base seating member and the upper surface thereof above the upper surface of the forward section of the base seating member to effectively extend upwardly the thigh supporting shelf formed by the upper surface of said forward section of the base seating member.

11. The adjustable, anti-thrust seating system of claim 10 wherein said positioning means positions said separate base seating member and the upper surface thereof above the upper surface of said forward section and the upper surface of said separate step means to effectively extend upwardly both the upper surface of said forward section and the upper surface of said separate step means and in effect also to extend the upper surface of said forward section upwardly and rearwardly.

12. The adjustable, anti-thrust seating system of claim 2 wherein said base seating member extends along a central axis and the two portions of the upper surface of the rearward section of the base seating member meet to form a first lower edge extending substantially across the central axis of the base member and wherein the second step face of the separate step member meets the second portion of the upper surface of the rearward section to form a second lower edge therewith positioned rearwardly of the first lower edge between the two portions of the rearward section.

13. The adjustable, anti-thrust seating system of claim 2 further including a pad having at least one

pouch filled with a fluid and means for positioning said pouch over said separate step member.

5 14. The adjustable, anti-thrust seating system of claim 13 wherein said pouch has a front seam and said pad positioning means positions said pouch over said separate step member with said front seam forward of the edge between the upper surfaces of said forward and rearward sections of said base seating member.

10 15. The adjustable, anti-thrust seating system of claim 14 wherein said pad positioning means positions said pouch over said separate step means with said first seam immediately adjacent said edge and substantially closer to said edge than to the front of said base seating member.

15 16. The adjustable, anti-thrust seating system of claim 14 wherein said pad has at least an additional pouch filled with fluid, said additional pouch being positioned over the upper surface of the forward section of said base seating member forwardly of said  
20 at least one pouch.

25 17. The adjustable, anti-thrust seating system of claim 14 wherein said pouch has a rear seam, the second step face of the separate step means meets the second portion of the upper surface of the rearward section of the base seating member to form a lower edge therewith extending substantially across the  
30 central axis of the base seating member, and the pad positioning means positions said pouch over said separate step means with said rear seam rearward of said lower edge.

18. The adjustable, anti-thrust seating system of claim 17 wherein said pad has at least an additional pouch filled with fluid, said additional pouch being positioned over the surface of the rearward section of the base seating member rearwardly of said at least one pouch.

19. The adjustable, anti-thrust seating system of claim 14 wherein said pad further includes a second pouch adjacent said first pouch, said second pouch having a front seam and being separated from the first pouch by a central seam extending rearwardly from the front seams of said pouches wherein said pad positioning means positions said pouches over said separate step means with the front seams thereof forward of said edge and said central seam substantially aligned with the central axis of said base seating member.

20. The adjustable, anti-thrust seating system of claim 13 wherein said pouch has a rear seam, the second step face of the separate step means meets the second portion of the upper surface of the rearward section of the base seating member to form a lower edge therewith extending substantially across the central axis of the base seating member, and the pad positioning means positions said pouch over said separate step means with said rear seam rearward of said lower edge.

21. The adjustable, anti-thrust seating system of claim 20 wherein said pad positioning means positions said pouch over said separate step means with said rear seam closer to said lower edge than to

the rear of said base seating member.

22. The adjustable, anti-thrust seating system of claim 20 wherein said pad has at least an additional pouch filled with fluid, said additional  
5 pouch being positioned over the surface of the rearward section of the base seating member rearwardly of said at least one pouch.

23. The adjustable, anti-thrust seating system of claim 20 wherein said pad further includes a second  
10 pouch adjacent said first pouch, said second pouch having a rear seam and being separated from the first pouch by a central seam extending forwardly from the rear seams of said pouches wherein said pad  
15 positioning means positions said pouches over said separate step member with the rear seams thereof rearward of said edge and said central seam substantially aligned with the central axis of said base seating member.

24. The adjustable, anti-thrust seating system  
20 of claim 13 wherein said fluid is a highly viscous liquid.

25. The adjustable, anti-thrust seating system of claim 13 wherein said fluid is a gas.

26. The adjustable, anti-thrust seating system  
25 of claim 2 further including a pad having at least two adjacent pouches filled with fluid, said pouches having front and rear seams and a central seam extending substantially between said front and rear seams to create said at least two pouches, and said

base seating member extends along a central axis wherein said pad positioning means positions said pouches over said separate step means with the central seam substantially aligned with the central axis of  
5 the base seat member.

27. The adjustable, anti-thrust seating system of claim 2 further including a back member, means for supporting said back member in a first substantially vertical position above the rearward section of said  
10 base seating member, and means to selectively adjust said back member forwardly and rearwardly of said first vertical position relative to said rearward section of said base seating member to properly position and stabilize the user's back in a  
15 substantially vertical position when the user's ischial tuberosities are properly positioned and stabilized in the seating well of said rearward section against the second step face of the separate step means.

28. The adjustable, anti-thrust seating system of claim 2 further including a back member, means for supporting said back member in a first substantially vertical position above the rearward section of said  
20 base seating member, and means to selectively adjust said rearward section forwardly and rearwardly of said first vertical position to properly position and stabilize the user's back in a substantially vertical position when the user's ischial tuberosities are  
25 properly positioned and stabilized in the seating well of said rearward section against the second step face  
30 of the separate step means.

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29. The adjustable, anti-thrust seating system of claim 1 wherein said first step face slopes downwardly and rearwardly.

5 30. The adjustable, anti-thrust seating system of claim 29 wherein the slope of said first step face is about 45 degrees.

31. An adjustable seating system for properly fitting and supporting a user's thighs and buttocks, said seating system including:

10 a base seating member having a front and a rear and having forward and rearward sections, said forward section having an upper surface forming a shelf to support the user's thighs and said rearward section having an upper surface to support the user's  
15 buttocks including the user's ischial tuberosities, said seating system further including means for extending said thigh supporting shelf rearwardly.

32. The adjustable seating system of claim 31 wherein said shelf extending means includes separate  
20 means having an upper surface and means for positioning said upper surface immediately adjacent and rearward of said upper surface of said forward section wherein the upper surface of said separate means serves to effectively extend rearwardly the thigh  
25 supporting shelf formed by the upper surface of the forward section of said base seating member.

33. The adjustable seating system of claim 32 wherein said positioning means positions the upper surface of said separate means in substantial  
30 alignment with the upper surface of said forward

section.

34. The adjustable seating system of claim 32 wherein said positioning means removably positions said separate means including the upper surface thereof adjacent the upper surface of said forward section.

35. The adjustable seating system of claim 32 wherein the upper surface of said separate means has a raised bump portion wherein the upper surface of said separate means serves to effectively extend rearwardly and upwardly the thigh supporting shelf formed by the upper surface of the forward section of said base seating member.

36. The adjustable seating system of claim 35 further including second separate means having an upper surface and means for positioning said upper surface immediately adjacent and rearward of the upper surface of said first mentioned separate means.

37. The adjustable seating system of claim 36 wherein said positioning means positions the upper surface of said second separate means in substantially horizontal alignment with the upper surface of said forward section with the raised bump portion of the upper surface of the first separate member therebetween.

38. The adjustable seating system of claim 35 wherein said raised bump portion extends laterally across said base seating member.

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39. The adjustable seating system of claim 35 wherein the upper surface of said separate means is substantially convex.

5 40. A seating system for properly fitting and supporting a user's thighs and buttocks, said seating system including:

10 a base seating member having a front and a rear and having forward and rearward sections adjacent one another and together extending essentially from the front to the rear of the base seating member along a central axis, said forward section having an upper surface forming a shelf extending substantially along and across said central axis to support the user's thighs and said rearward section having an upper surface extending substantially along and across said central axis to support the user's buttocks including the user's ischial tuberosities,

15 said upper surfaces of said forward and rearward sections meeting to form an edge extending substantially across the central axis of said base seating member on each side of said central axis, said upper surface of rearward section forming a depressed, seating well having at least two portions with the first portion extending downwardly of said edge in an area immediately adjacent said edge to form a step face and with the second portion of the upper surface of said rearward section extending rearwardly of said step face, and

20 said seating system further including a pad having at least one pouch filled with fluid and having a front seam and means for positioning said pouch over said step face with said front seam extending substantially laterally across said central axis

immediately forward of the edge between the upper surfaces of said forward and rearward sections of said base seating member.

5 41. The seating system of claim 40 wherein said pad positioning means positions said pouch over said step face with said first seam immediately adjacent said edge and substantially closer to said edge than to the front of said base seating member.

10 42. The seating system of claim 40 wherein said pad has at least an additional pouch filled with fluid, said additional pouch being positioned over the upper surface of the forward section of said base seating member forwardly of said at least one pouch.

15 43. The seating system of claim 40 wherein said pouch has a rear seam, the step face meets the second portion of the upper surface of the rearward section of the base seating member to form a lower edge therewith, and the pad positioning means positions said pouch over said step face with said rear seam rearward of said lower edge.

25 44. The seating system of claim 43 wherein said pad has at least an additional pouch filled with fluid, said additional pouch being positioned over the surface of the rearward section of the base seating member rearwardly of said at least one pouch.

45. The seating system of claim 40 wherein said pad further includes a second pouch adjacent said first pouch, said second pouch having a front seam and being separated from the first pouch by a central seam

extending rearwardly from the front seams of said pouches wherein said pad positioning means positions said pouches over said step face with the front seams thereof forward of said edge and said central seam substantially aligned with the central axis of said base seating member.

46. The seating system of claim 40 wherein said pouch has a rear seam, the step face meets the second portion of the upper surface of the rearward section of the base seating member to form a lower edge therewith, and the pad positioning means positions said pouch over said step face with said rear seam rearward of said lower edge.

47. The seating system of claim 46 wherein said pad positioning means positions said pouch over said step face with said rear seam closer to said lower edge than to the rear of said base seating member.

48. The seating system of claim 46 wherein said pad has at least an additional pouch filled with fluid, said additional pouch being positioned over the surface of the rearward section of the base seating member rearwardly of said at least one pouch.

49. The seating system of claim 46 wherein said pad further includes a second pouch adjacent said first pouch, said second pouch having a rear seam and being separated from the first pouch by a central seam extending forwardly from the rear seams of said pouches wherein said pad positioning means positions said pouches over said step face with the rear seams thereof rearward of said edge and said central seam

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substantially aligned with the central axis of said base seating member.

50. The seating system of claim 40 wherein said fluid is a highly viscous liquid.

5 51. The seating system of claim 40 wherein said fluid is a gas.

52. An adjustable seating system for properly fitting and supporting a user's thighs and buttocks, said seating system including:

10 a base seating member having forward and rearward sections, said forward section having an upper surface forming a shelf to support the user's thighs and said rearward section having an upper surface to support the user's buttocks including the  
15 user's ischial tuberosities, said adjustable seating system further including a separate base seating member having an upper surface substantially conforming to the upper surface of said forward section and means for positioning said separate base  
20 seating member and the upper surface thereof above the upper surface of the forward section of the base seating member to effectively extend upwardly the thigh supporting shelf formed by the upper surface of said forward section of the base seating member.

25 53. The adjustable seating system of claim 52 wherein the upper surface of said forward section and the upper surface of said separate base seating member are about the same size and shape.

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54. The adjustable seating system of claim 52 wherein said positioning means removably positions said separate base seating member above the upper surface of the forward section.

5 55. The adjustable seating system of claim 52 further including a pad having at least one pouch filled with fluid and means for positioning said pad over at least part of the upper surface of said separate base seating member.

10 56. An adjustable back system primarily intended for use with a wheelchair having two upright back posts, said system including:

first and second relatively rigid shell members, means for attaching said first shell member  
15 to the back posts of said wheelchair, said first shell member having a first portion extending substantially between and along said back posts, said attaching means attaching said first shell member to said back posts in a first position fixed relative to said back  
20 posts, and means for mounting said second shell member to the first portion of said first shell member, said mounting means including means for moving said second shell member relative to said first shell member and said back posts.

25 57. The adjustable back system of claim 56 wherein said moving means selectively moves said second shell member from a retracted position adjacent said first shell member to an extended position spaced from said first shell member, said second shell member  
30 in said retracted position having a first portion extending substantially between and along said back

posts.

58. The adjustable back system of claim 57 wherein said back posts have a depth profile extending substantially between two planes with one plane extending substantially between and along said back posts in front thereof and the second plane extending substantially between and along said back posts in back thereof, said first portion of said second shell member being positioned substantially rearwardly of said front plane when said first and second shell members are in said retracted position.

59. The adjustable back system of claim 57 wherein said first portion of said second shell member is positioned immediately adjacent the first portion of said first shell member in said retracted position.

60. The adjustable back system of claim 56 wherein said moving means selectively moves said second shell member from a retracted position adjacent said first shell member to an extended position spaced from said first shell member, said first shell member having a front surface and said second shell member having a back surface, said moving means moving said front and back surfaces into a substantially abutting relationship in said retracted position.

61. The adjustable back system of claim 60 wherein said front and back surfaces have mating contours wherein said front and back surfaces nest with each other in said retracted position.

62. The adjustable back system of claim 56 wherein said second shell member has a front surface and said back system further includes a back cushion member having a back surface and means to attach said  
5 cushion member to the second shell member with the back surface of said cushion member substantially adjacent the front surface of said second shell member.

63. The adjustable back system of claim 62  
10 wherein said back posts have a depth profile extending substantially between two planes with one plane extending substantially between and along said back posts in front thereof and the second plane extending  
15 substantially between and along said back posts in back thereof, said front surface of said second shell member and the back surface of said cushion being positioned substantially between and along said back posts substantially rearwardly of said front plane when said first and second shell members are in the  
20 retracted position.

64. The adjustable back system of claim 62 wherein said back surface of said cushion member and the front surface of said second shell member have mating contours wherein said back surface of said  
25 cushion member and the front surface of said second shell member nest with each other.

65. The adjustable back system of claim 62 wherein said back surface of said cushion member and the front surface of said second shell member  
30 substantially abut each other.

66. The adjustable back system of claim 56 wherein said second shell member has a front surface and said back system further includes a back cushion member having a back surface and means to attach said back cushion member to the second shell member with the back surface of said cushion member with the back surface of said cushion member substantially adjacent the front surface of said second shell member and wherein said moving means selectively moves said second shell member from a retracted position adjacent said first shell member to an extended position spaced from said first member, said moving means including at least one means projecting forwardly of the front surface of said second shell member in at least said retracted position, said back surface of said cushion member having at least one depression therein dimensioned to receive said one projecting means when said second shell member is in said retracted position to further minimize the profile depth of said back system.

67. The adjustable back system of claim 66 wherein said moving means includes at least one means extending along an axis, said one means having first and second end portions spaced from each other along said axis and means for mounting said first end portion to said first shell member with said second end portion projecting forwardly of the front surface of said second shell member and into the depression in the cushion member at least when said second shell member is in said retracted position.

68. The adjustable back system of claim 67 wherein said at least one means has at least two

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members and means for mounting said first and second members for movement relative to each other along said axis.

5 69. The adjustable back system of claim 68 wherein at least portions of said first and second members telescope with each other.

10 70. The adjustable back system of claim 56 wherein said moving means of said mounting means includes at least three moving arrangements, each moving arrangement being spaced from each other and extending between the first portion of said first shell member and the second shell member.

15 71. The adjustable back system of claim 70 wherein each of said moving arrangements includes at least one means extending along an axis, said one means having first and second end portions spaced from each other along said axis and means for mounting said first end portion to said first shell member with said second end portion projecting forwardly of the front surface of said second shell member at least when said second shell member is in said retracted position.

20 72. The adjustable back system of claim 71 wherein said at least one means of each moving arrangement has first and second members and means for mounting said first and second members for movement relative to each other along said axis.

25 73. The adjustable back system of claim 72 wherein at least portions of said first and second members telescope with each other.

74. The adjustable back system of claim 70 further including at least a fourth moving arrangement spaced from the other three moving arrangements and extending between the first portion of said first shell member and the second shell member.

75. The adjustable back system of claim 74 wherein said four moving arrangements are positioned relative to each other substantially at the corners of a quadrangle.

76. The adjustable back system of claim 70 wherein said quadrangle is substantially a rectangle.

77. The adjustable back system of claim 56 wherein said second shell member has a front surface and said back system further includes a back cushion member having a back surface and means to attach said cushion member to the second shell member with the back surface of said cushion member substantially adjacent the front surface of said second shell member, said back surface of said back cushion extending substantially between and along said back posts when said first and second shell members are in said retracted position.

78. The adjustable back system of claim 77 wherein said back posts have a depth profile extending substantially between two planes with one plane extending substantially between and along said back posts in front thereof and the second plane extending substantially between and along said back posts in back thereof and wherein said back cushion has a rear portion immediately forward of the back surface of

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said cushion, said rear portion of said cushion being positioned substantially between and along said back posts substantially rearwardly of said front plane when said first and second shell members are in said retracted position.

79. The adjustable back system of claim 77 wherein said front surface of said second shell member extends substantially between and along said back posts when said first and second shell members are in said retracted position.

80. The adjustable back system of claim 56 wherein said second shell member has a back surface and said moving means selectively moves said second shell member from a retracted position adjacent said first shell member to a second position spaced from said first shell member with said back surface substantially vertical in said second position.

81. The adjustable back system of claim 56 wherein said back posts extend substantially vertically and parallel to each other, said second shell member has a back surface, and said moving means moves said second shell member from a retracted position adjacent said first shell member to a second position with said back surface inclined about a substantially vertical axis in a substantially vertical plane containing said back posts.

82. The adjustable back system of claim 56 wherein said back posts extend substantially vertically and parallel to each other, said second shell member has a back surface, and said moving means

5 moves said second shell member from a retracted position adjacent said first shell member to a second position with said back surface inclined about a substantially horizontal axis in a substantially vertical plane containing said back posts.

83. The adjustable back system of claim 56 wherein said back posts extend substantially vertically and parallel to each other, said second shell member has a back surface, and said moving means  
10 moves said second shell member from a retracted position adjacent said first shell member to a said second position with said back surface inclined about both a substantially vertical axis and a substantially horizontal axis in a substantially vertical plane  
15 containing said back posts.

84. The adjustable back system of claim 56 wherein said attaching means includes means for removably attaching said first shell member to said back posts, said removable attaching means being  
20 operable independently of the means for moving said second shell member relative to the first portion of said first shell member wherein said first shell member can be removed from said back posts and re-attached to said back posts with said first and second  
25 shell members remaining in the same position relative to each other.

85. The adjustable, anti-thrust seating system of claim 1 further including a back member and means to selectively adjust said back member relative to  
30 said base seating member to properly position and stabilize the user's back when the user's ischial

tuberosities are properly positioned and stabilized in the seating well of said rearward section selectively against one of said first and second anti-thrust barriers.

5           86. The adjustable, anti-thrust seating system  
of claim 1 further including a back member, means for  
supporting said back member in a first substantially  
vertical position above the rearward section of said  
base seating member, and means to selectively adjust  
10 said rearward section forwardly and rearwardly of said  
first substantially vertical position to properly  
position and stabilize the user's back in a  
substantially vertical position when the user's  
ischial tuberosities are properly positioned and  
15 stabilized in the seating well of said rearward  
section selectively against one of said first and  
second anti-thrust barriers.

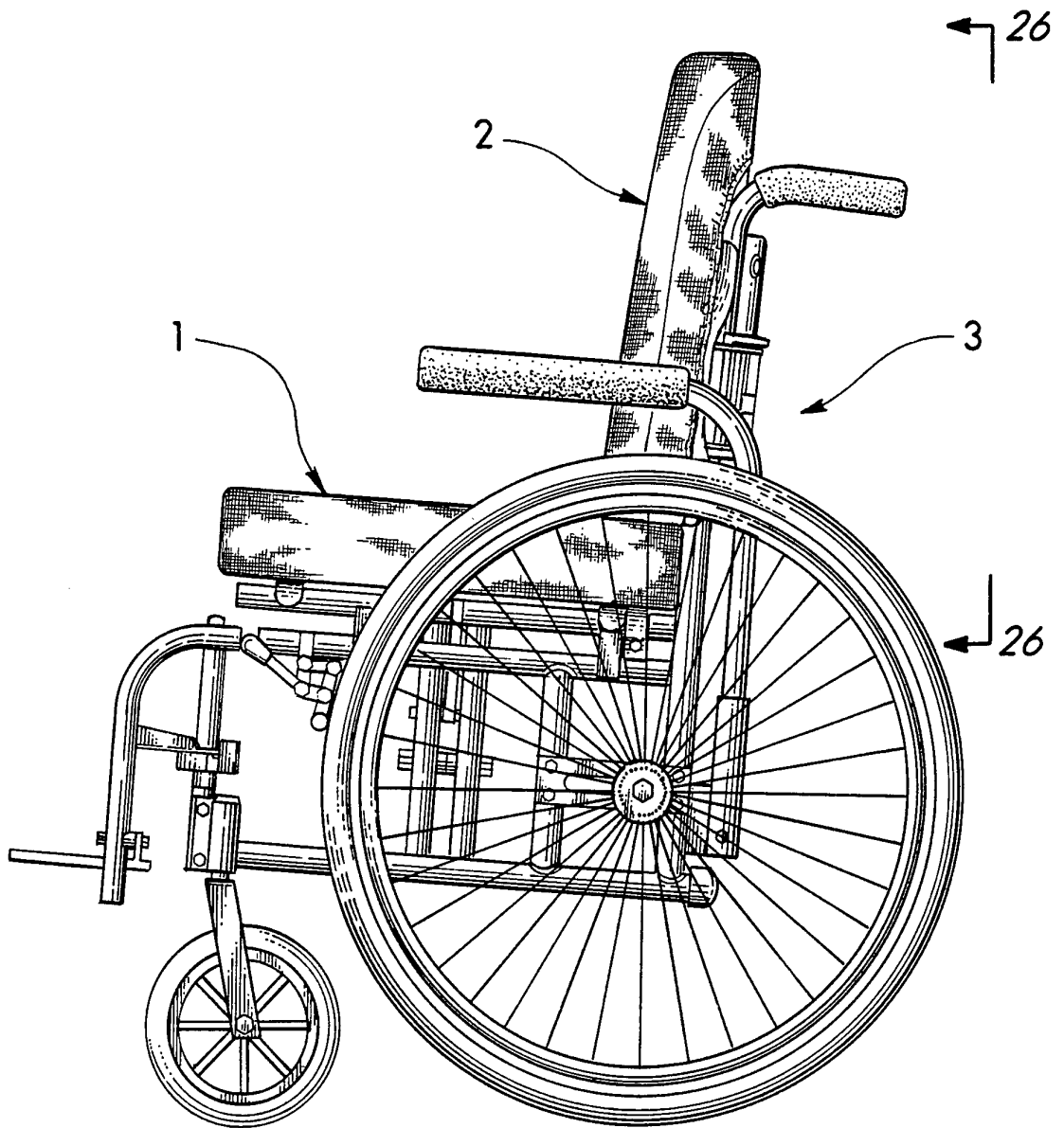


Fig. 1

Fig. 2

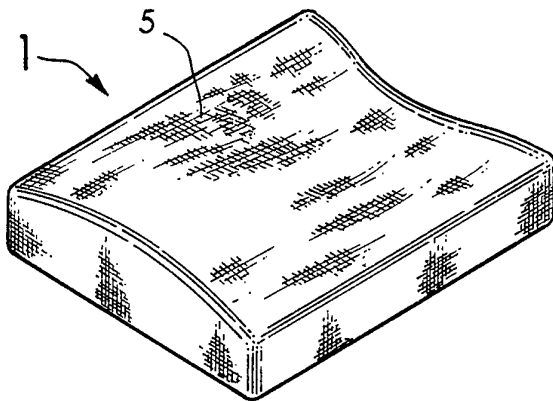


Fig. 3

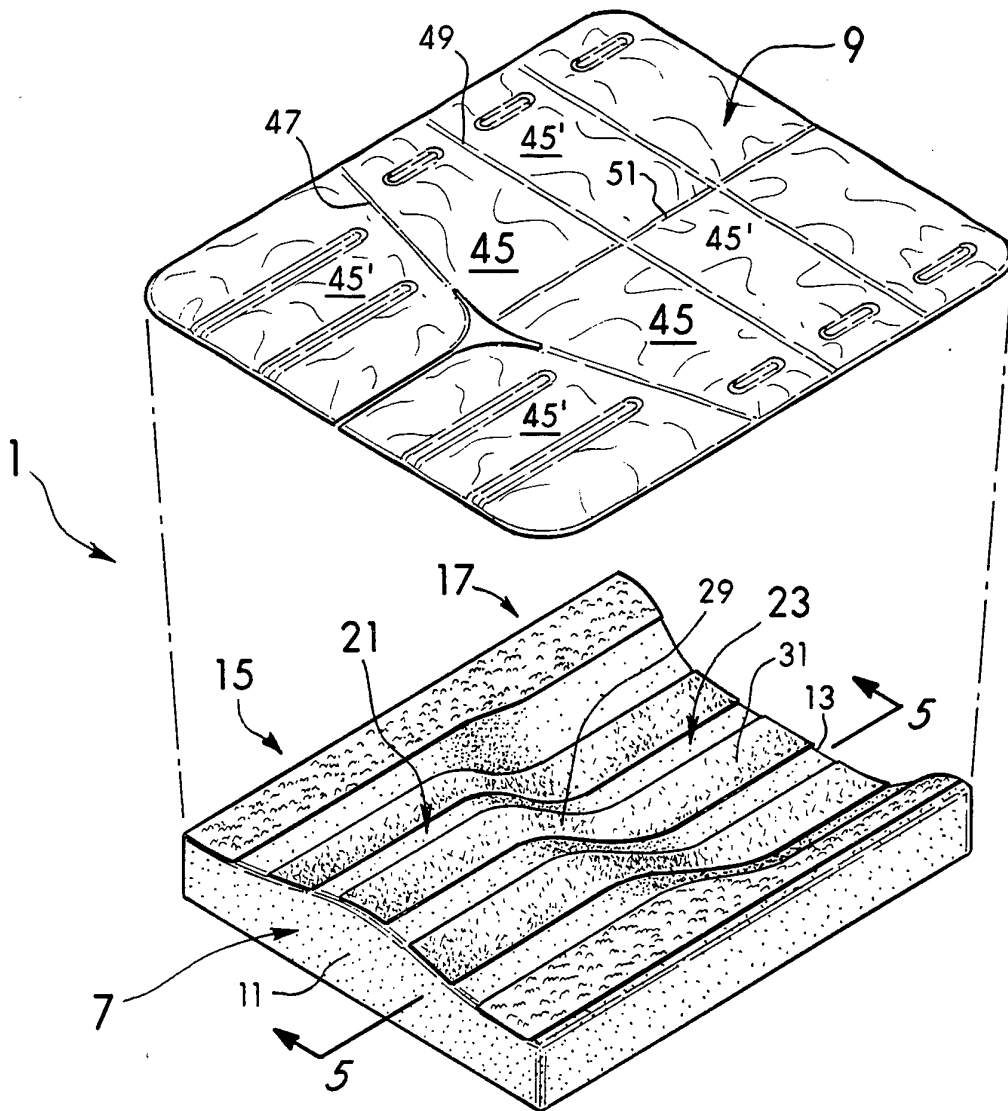
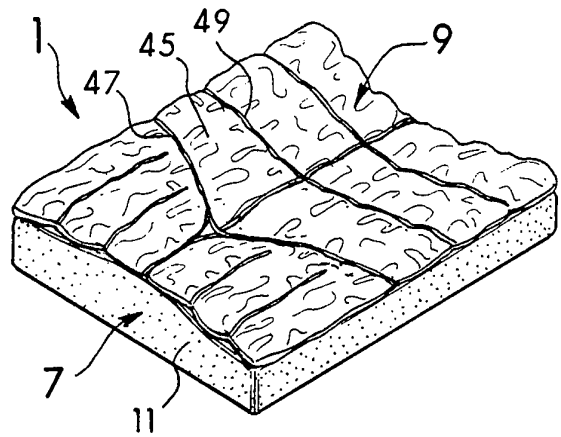


Fig. 4

Fig. 5

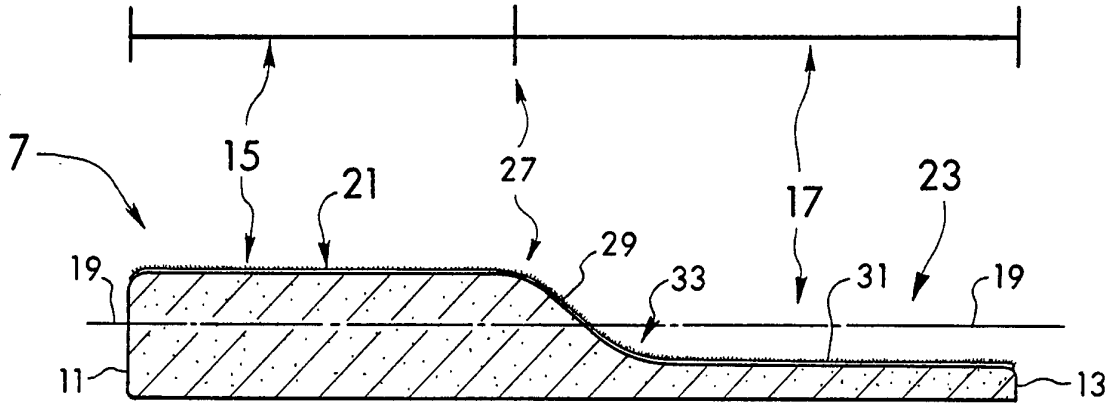
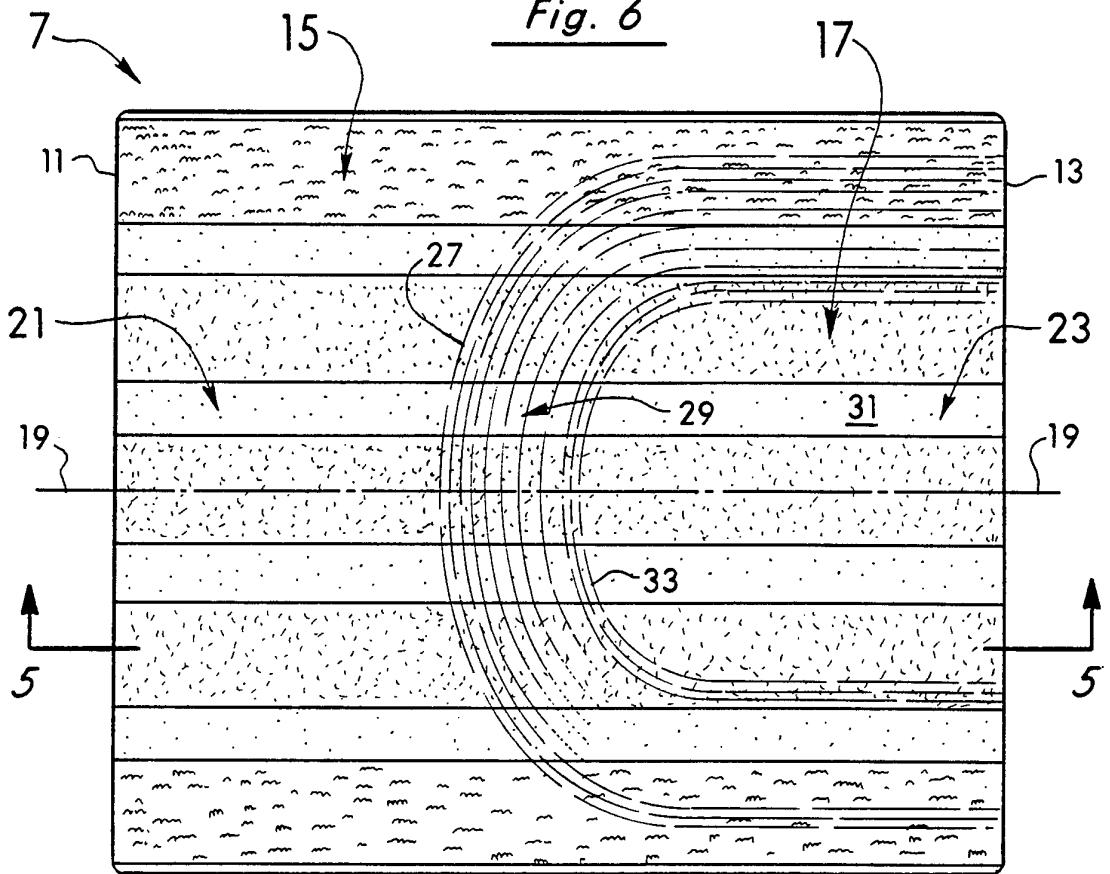
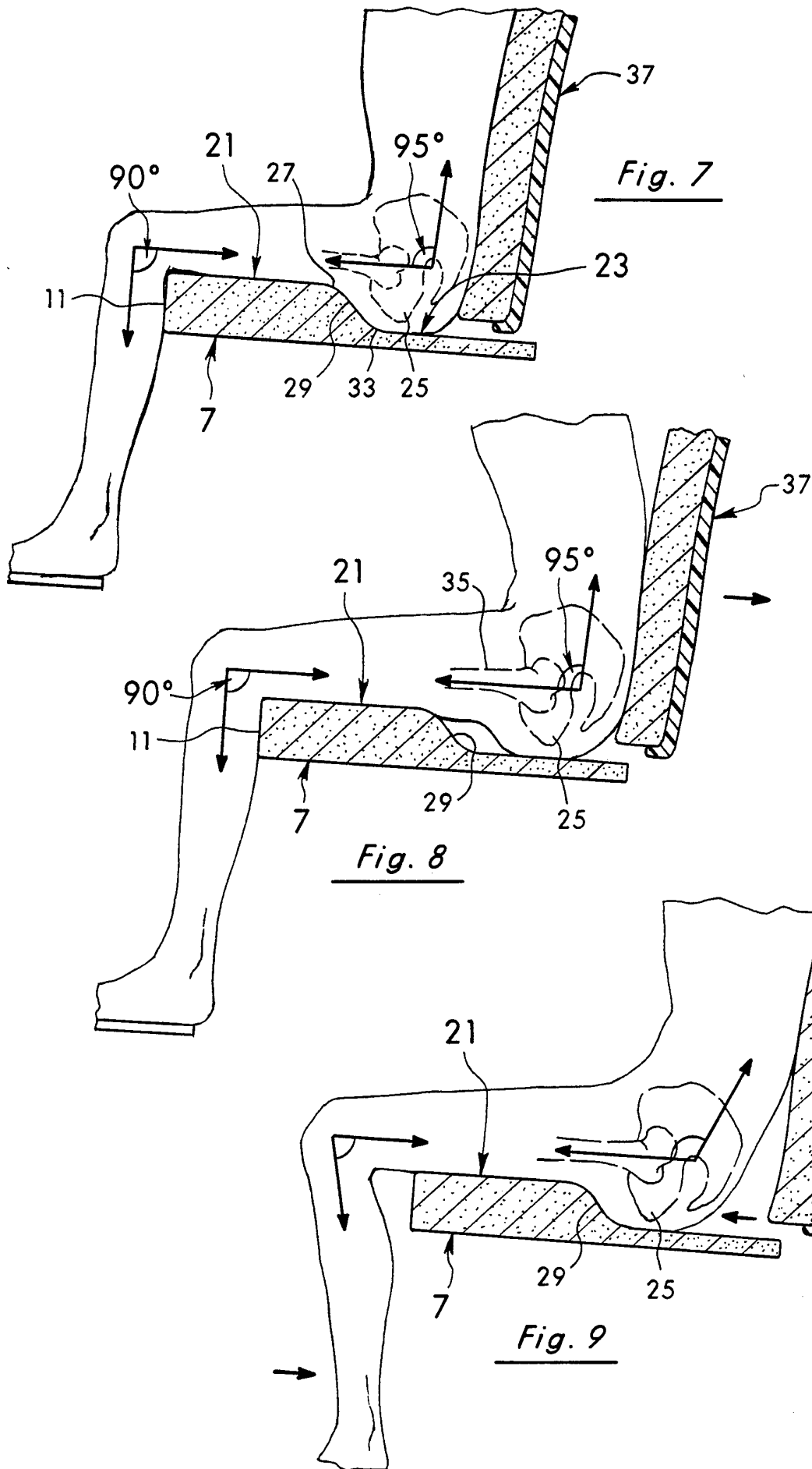


Fig. 6





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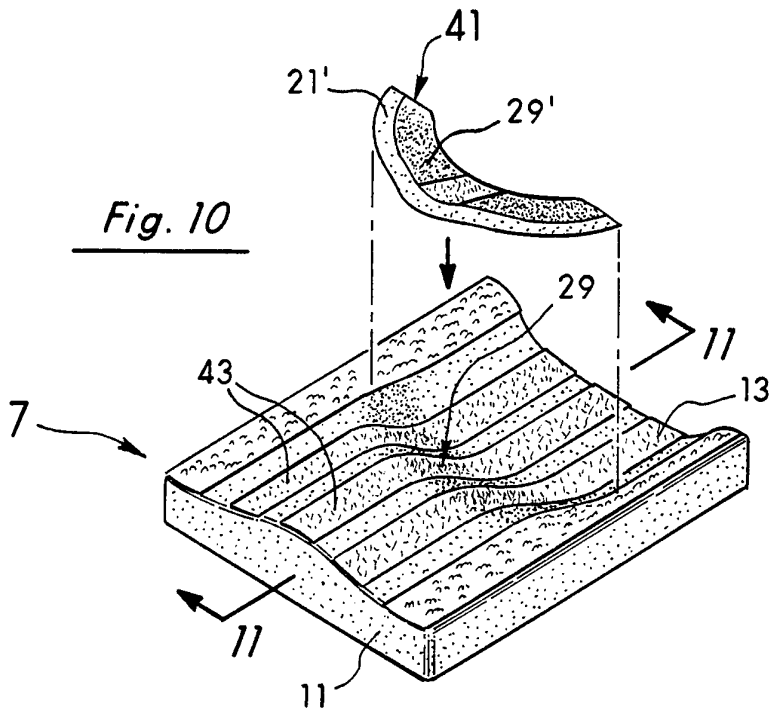


Fig. 10

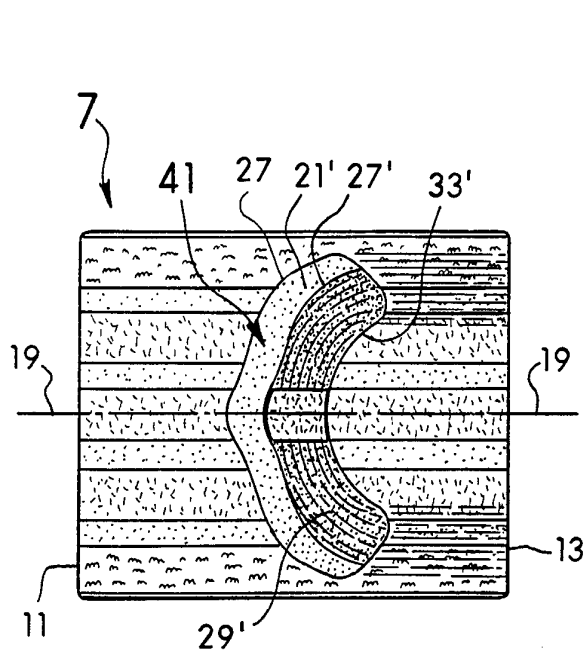


Fig. 12

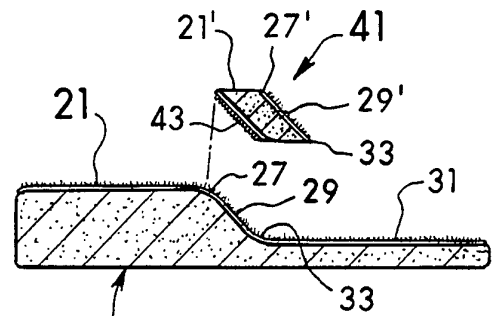
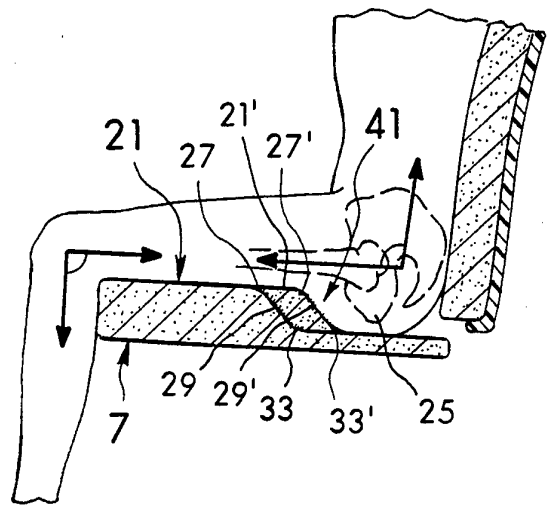


Fig. 11

Fig. 13



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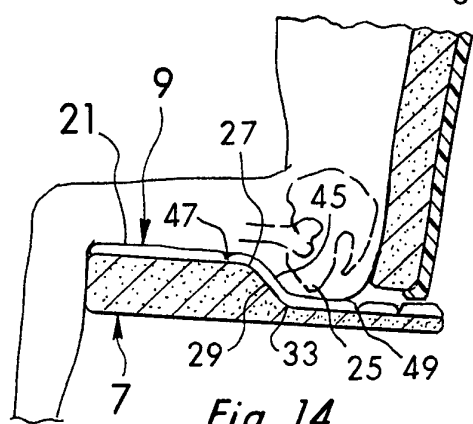


Fig. 14

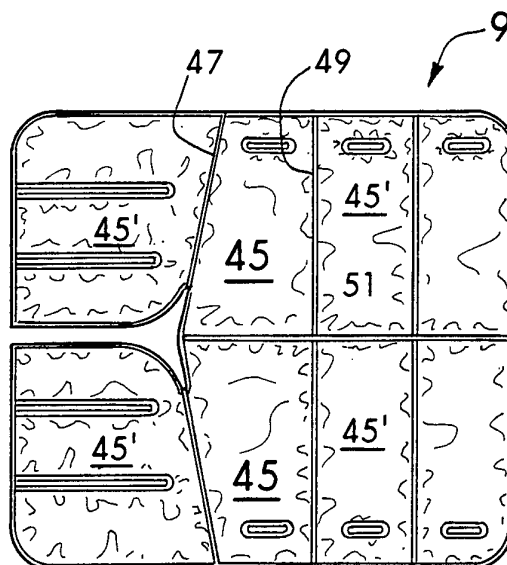


Fig. 15

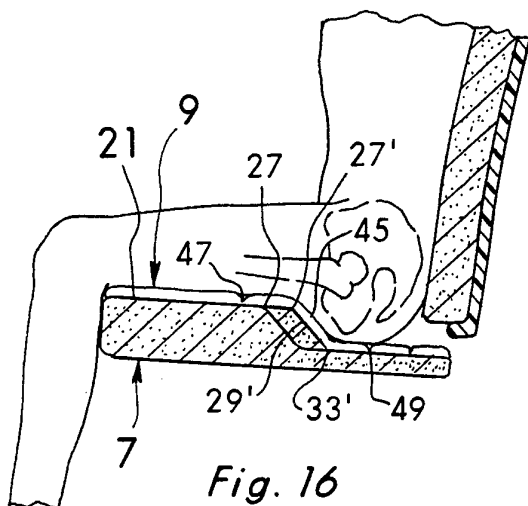


Fig. 16

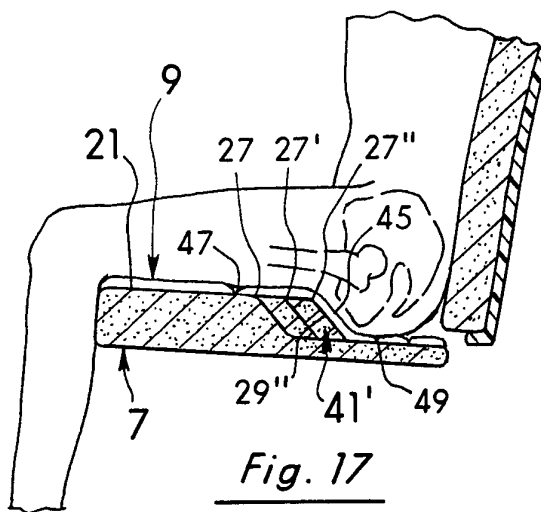


Fig. 17

Fig. 18

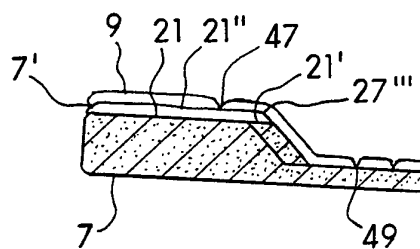
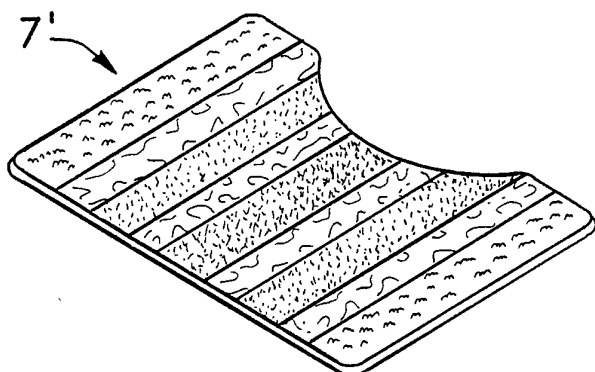


Fig. 19

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Fig. 20

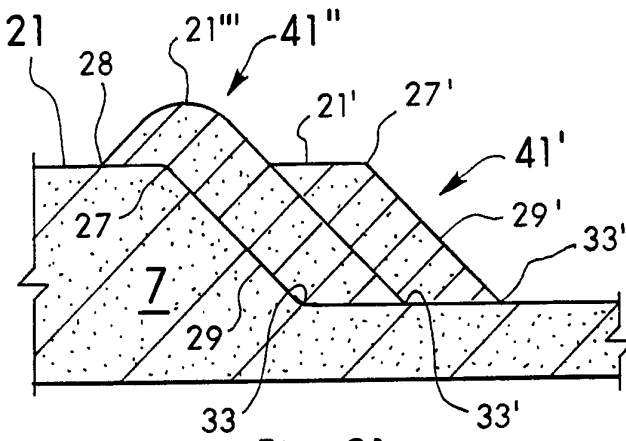
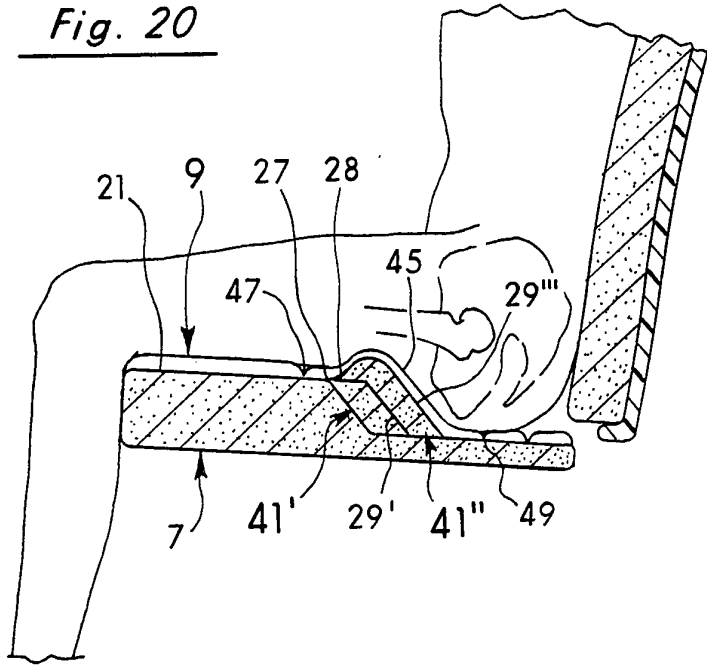


Fig. 21

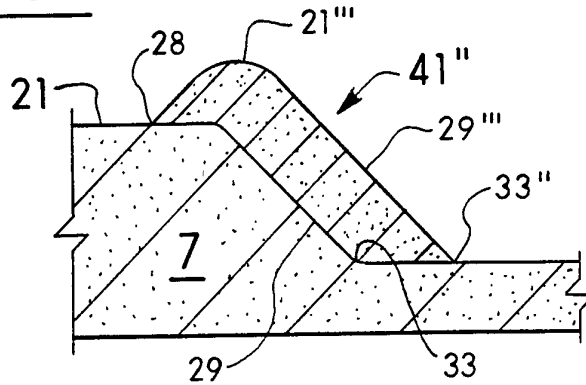


Fig. 22

Fig. 23

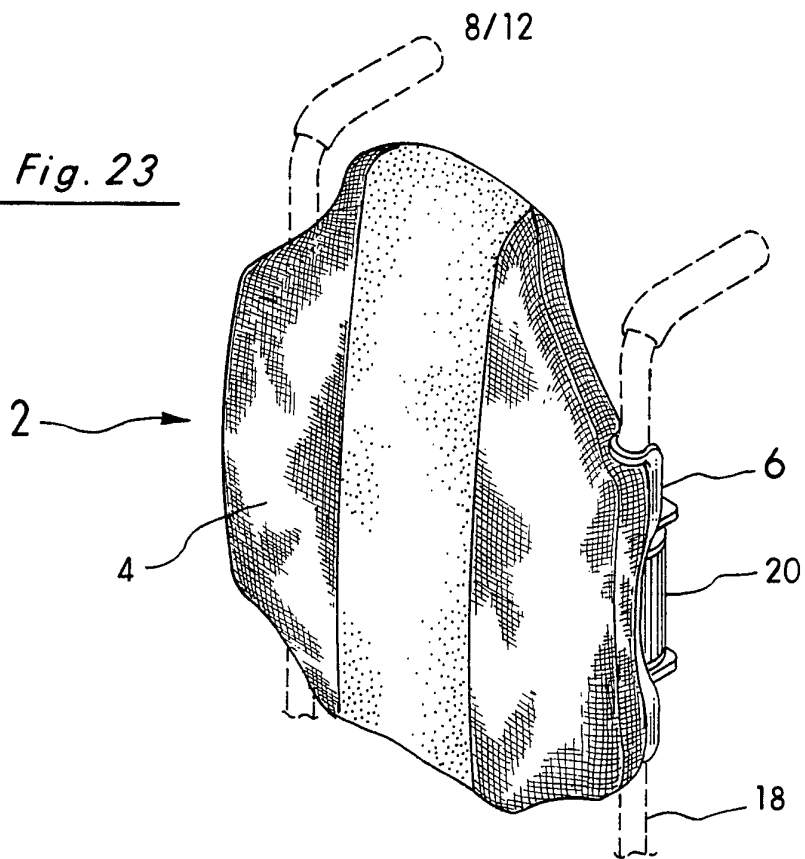
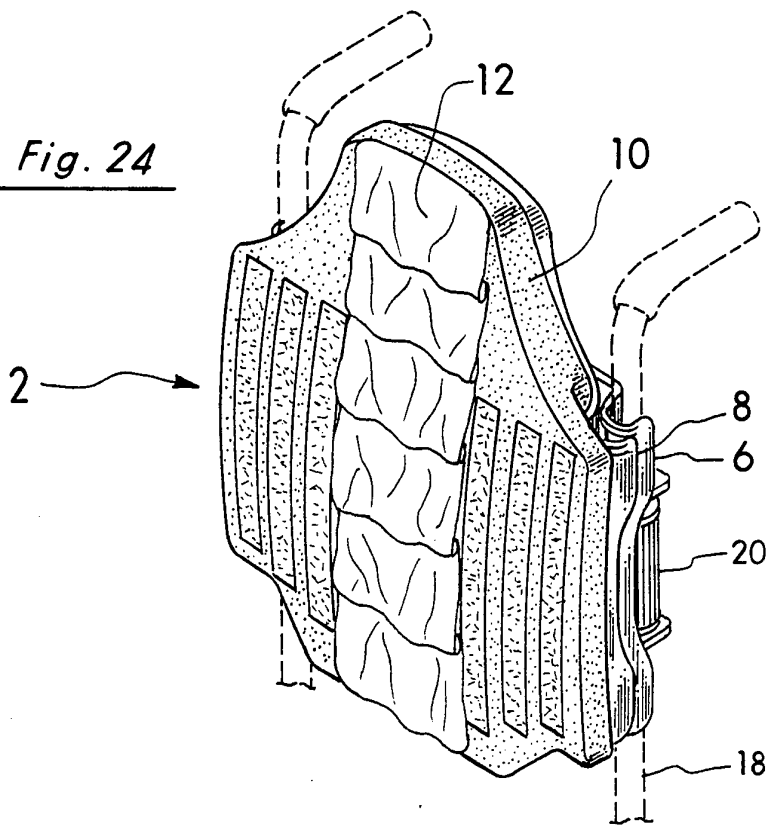


Fig. 24



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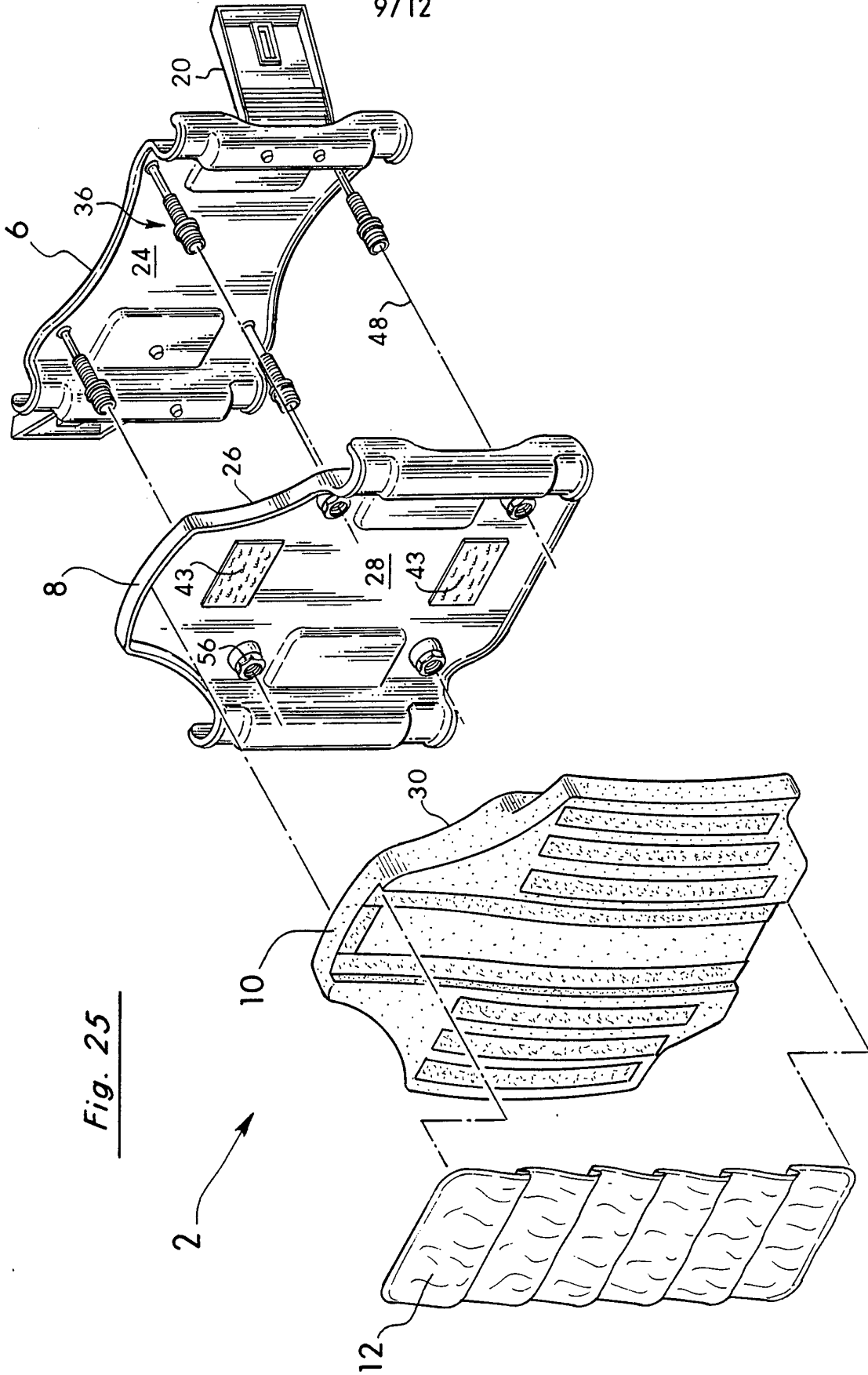


Fig. 25

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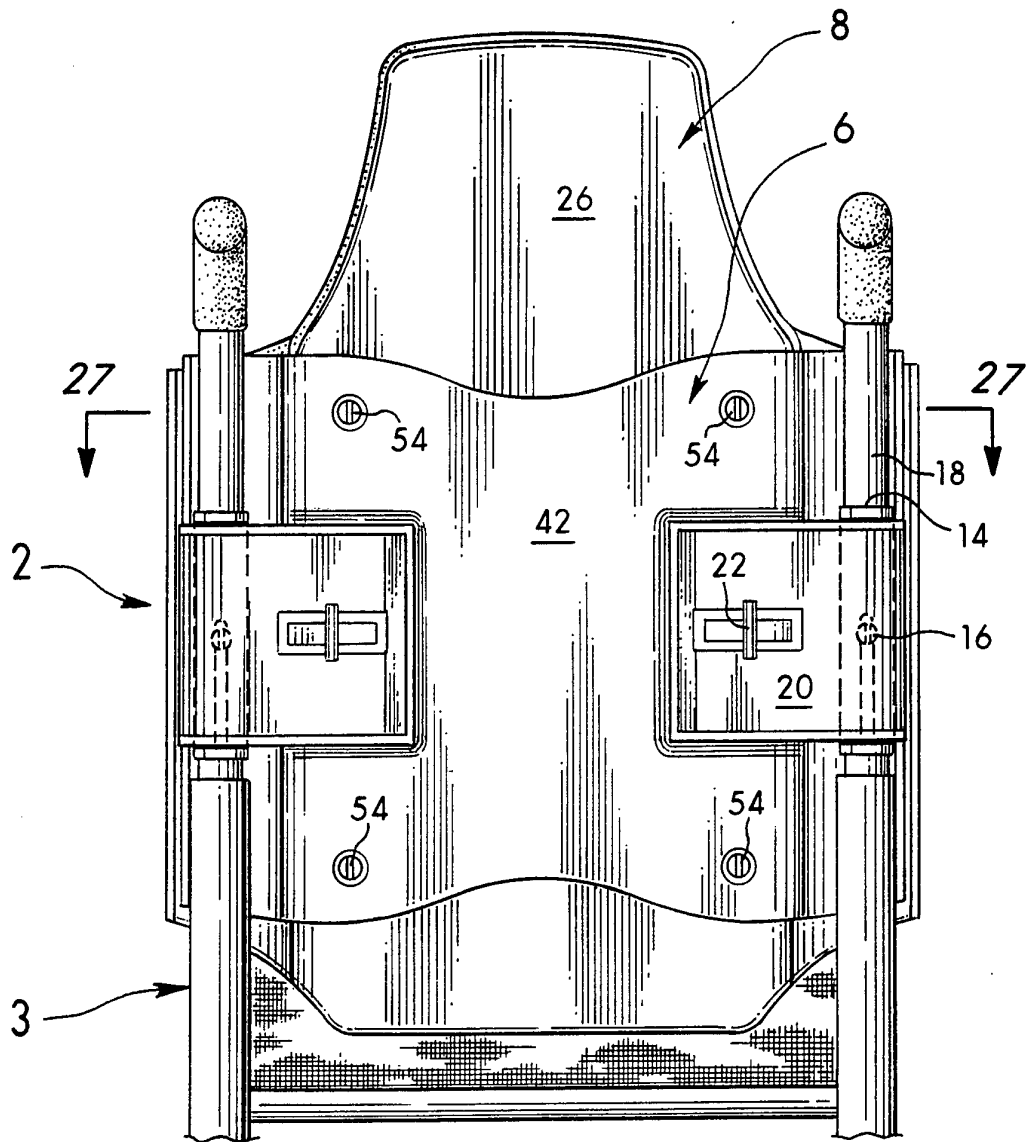


Fig. 26

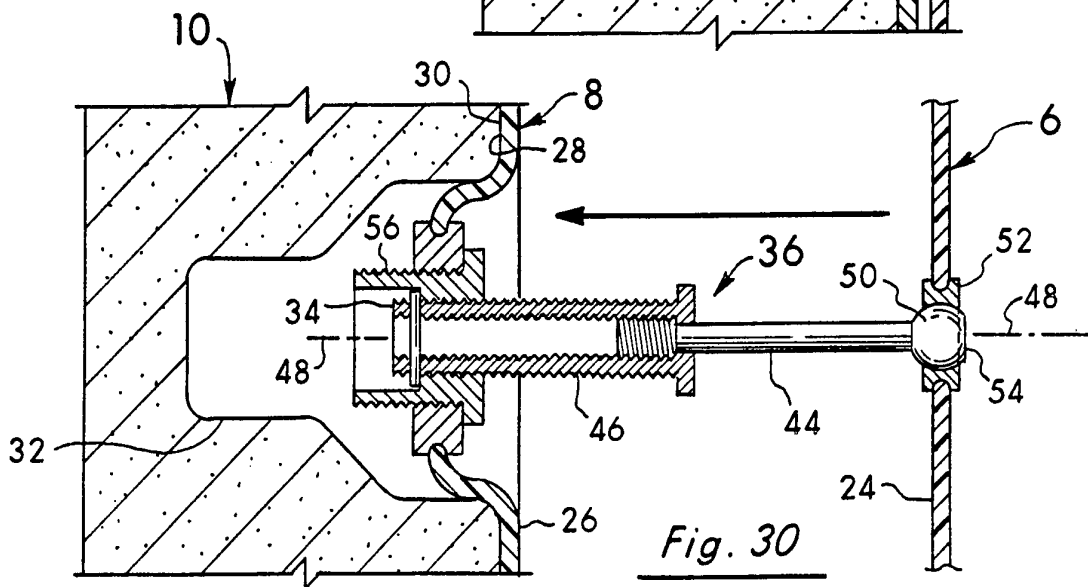
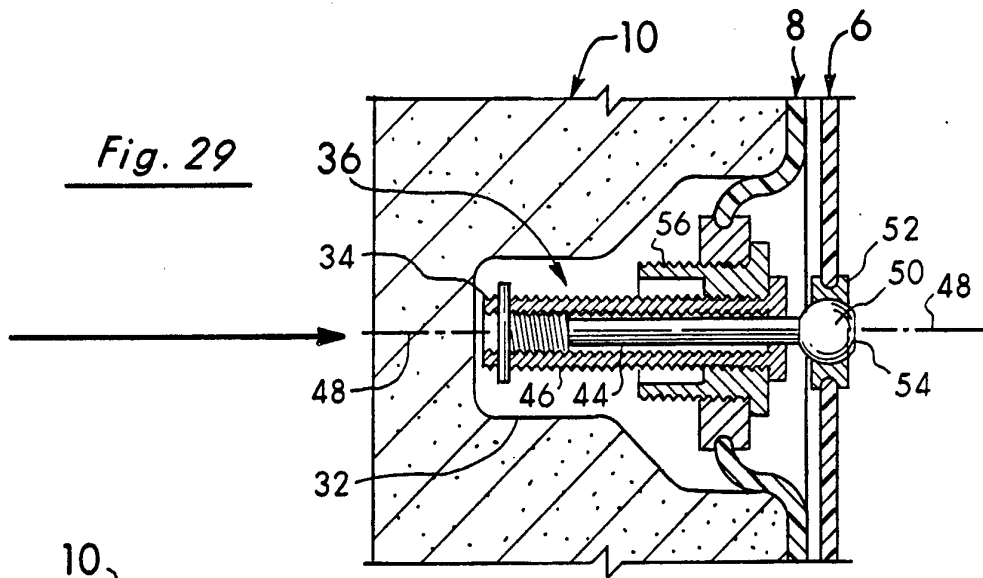
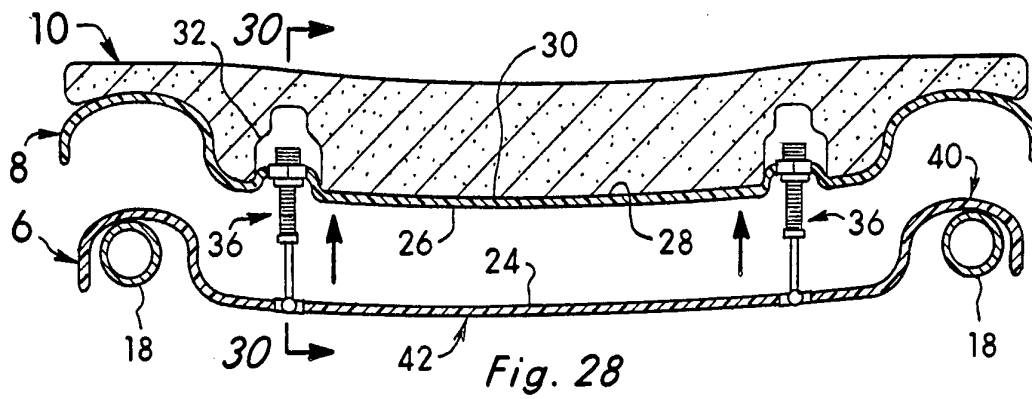
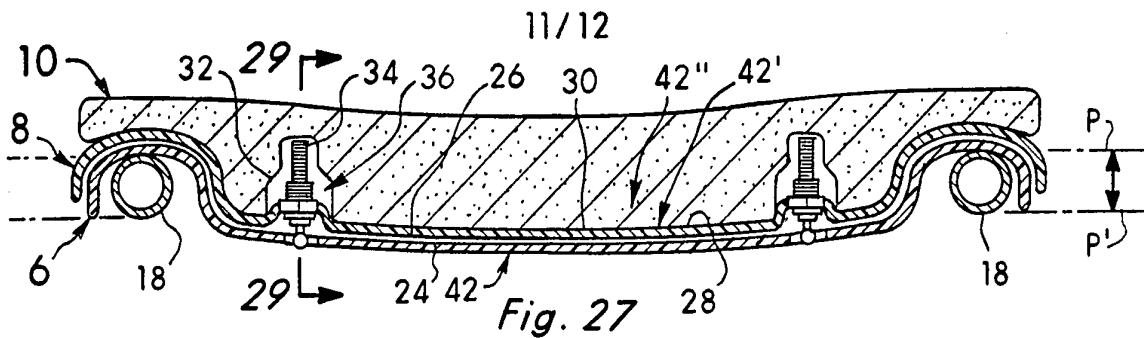


Fig. 31

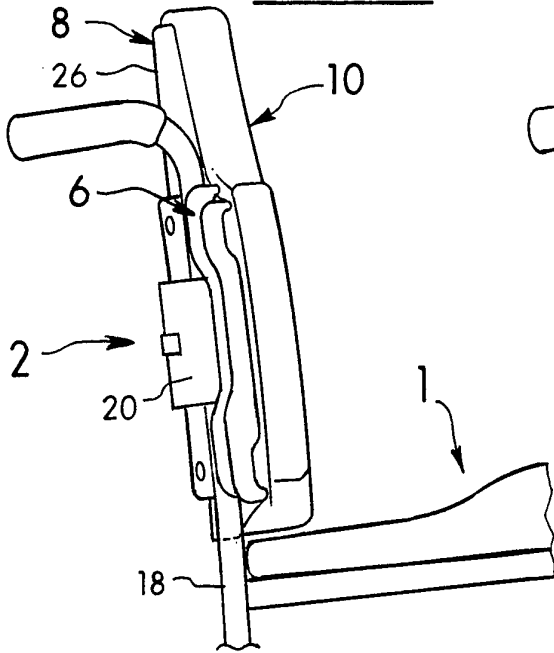


Fig. 32

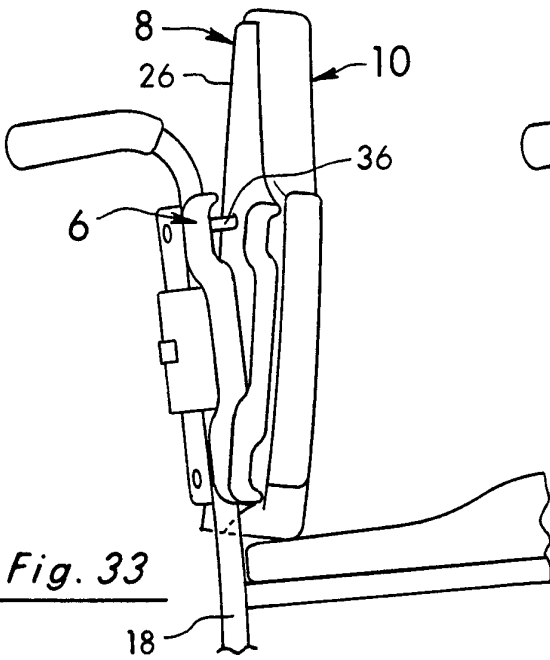
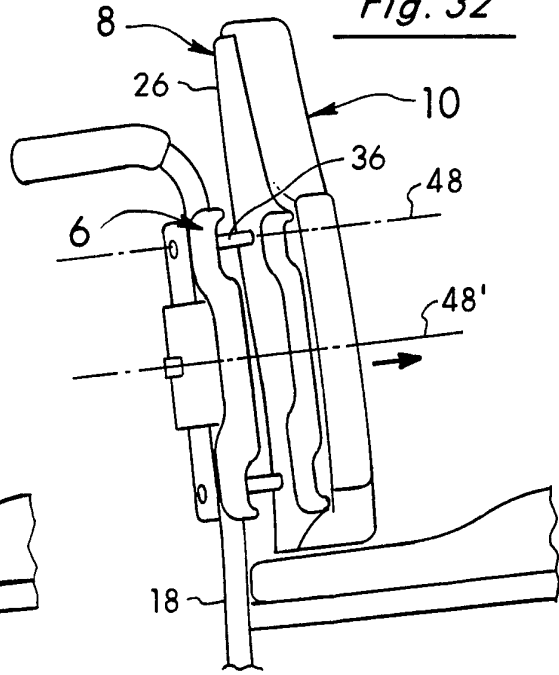


Fig. 33

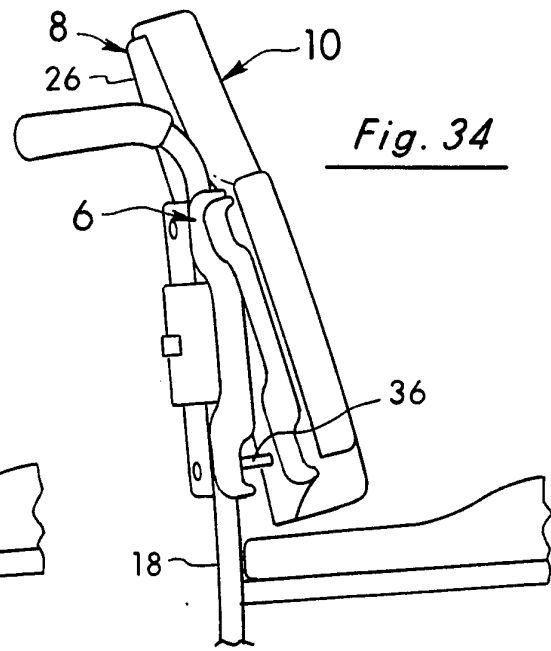


Fig. 34

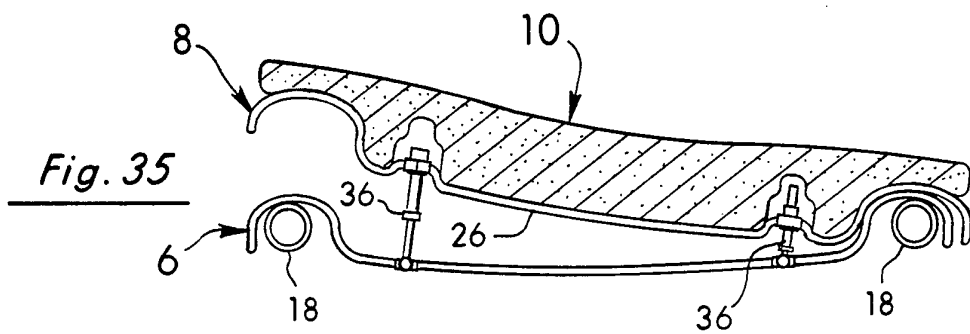


Fig. 35

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US93/08478

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(5) :A47C 7/02, 27/15

US CL :5/653; 297/284.1, 452.21, 452.26

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 5/654,448,481, 297/452.23, DIGEST 1, DIGEST 6,

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
|-----------|--|-----------------------|
| X         | US,A, 4,726,624 (JAY) 23 FEBRUARY 1988<br>note fluid filled envelope 22, (and/or cover) which when placed on the shaped tray, will define a second anti-thrust barrier | 1-3,5-7,12,29-34      |
| A,P       | US,A, Des 335,235 (Hildreth) 04 May 1993   | 1-3,5-7,12,24-34      |
| A         | US,A, 5,018,790 (JAY) 28 MAY 1991  | 1,31                  |
| A         | US,A, 4,951,334 (Maier) 28 August 1990   | 1,31                  |

 Further documents are listed in the continuation of Box C.
  See patent family annex.

|   |  |
|---|--|
| * Special categories of cited documents:  | *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention  |
| *A* document defining the general state of the art which is not considered to be part of particular relevance   | *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone   |
| *E* earlier document published on or after the international filing date  | *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | *G* document member of the same patent family  |
| *O* document referring to an oral disclosure, use, exhibition or other means  |  |
| *P* document published prior to the international filing date but later than the priority date claimed  |  |

Date of the actual completion of the international search

22 NOVEMBER 1993

Date of mailing of the international search report

07 JAN 1994

 Name and mailing address of the ISA/US  
 Commissioner of Patents and Trademarks  
 Box PCT  
 Washington, D.C. 20231

Facsimile No. NOT APPLICABLE

Authorized officer

  
 ALEXANDER GROSZ

Telephone No. (703) 308-2168

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US93/08478

**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

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

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

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

Please See Extra Sheet.

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
1-9, 12, 29-39

Remark on Protest  The additional search fees were accompanied by the applicant's protest.  
 No protest accompanied the payment of additional search fees.

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

The claimed seating systems contain the following four patentably distinct species:

- I) The species of claims 1-9, 12, 29-39 relating to an adjustable anti-thrust seating system.
- II) The species of claims 52-55, 10, 11 relating to a seating system with a separate base seating member, best shown in Figure 18.
- III) The species of claims 40-51, 13-26, relating to a seating system with fluid filled elements.
- IV. The species of claims 56-86, 27, 28 relating to adjustable back systems.