Relatório

Mestrado em Product Design Engineering

Novos produtos e tecnologias avançadas de produção

Ana Isabel Costa Simões de Sousa Prates

Leiria, *Abril* de *2015*

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Relatório de Estágio de Mestrado realizado sob a orientação do Professor Doutor Artur Mateus, Professor da Escola Superior de Tecnologia e Gestão do Instituto Politécnico de Leiria e Vice-Director do Centro de Desenvolvimento Rápido e Sustentado de Produto (CDRsp).

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Dedicatória

Dedico este relatório aos familiares e amigos, pela ajuda, apoio e incentivo que me deram, em particular à minha mãe e irmão.

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Agradecimentos

A todos os que me apoiaram, incentivaram, acreditaram e se mantiveram ao meu lado.

Ao CDRsp, pela oportunidade e a todos os seus colaboradores que ajudaram ao longo do estágio.

Um agradecimento especial ao meu orientador, o Professor Doutor Artur Mateus que sempre se disponibilizou e me apoiou, também o agradecimento ao Director do CDRsp, o Professor Doutor Nuno Alves por todo o apoio disponibilizado.

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Resumo

Este relatório tem por base o trabalho desenvolvido no Centro de Desenvolvimento Rápido e Sustentado de Produto (CDRsp), no seguimento da bolsa de investigação e relativamente ao período compreendido entre 30 de Julho de 2014 e 29 de Janeiro de 2015, tendo esta sido renovada posteriormente por igual período dando continuidade ao trabalho desenvolvido.

As principais actividades desenvolvidas centraram-se nas seguintes premissas:

i. Desenvolvimento de produto e serviços

ii. Avaliação integrada de sustentabilidade de produto

iii. Aplicação de Tecnologias emergentes

iv. Desenvolvimento de metodologia multidisciplinar

No sentido de dar continuidade ao trabalho desenvolvido na referida instituição e recorrendo a todos os meios por esta disponibilizada, deu-se também seguimento ao desenvolvimento de novos produtos para o portfólio do CDRsp, em particular o desenvolvimento de um Pino Urbano Modular, assim como à organização e apoio à divulgação de projectos de investigação científico-tecnológica em áreas multidisciplinares, através de acções de disseminação do conhecimento através de seminários, simpósios e conferências.

Mais especificamente, no âmbito do desenvolvimento de produto e tecnologias avançadas de produção, o trabalho centrou-se em três projectos concretos:

1. Projecto de colar cervical com metodologia multidisciplinar, engenharia inversa, modelação 3D e fabricação aditiva.

Consiste no desenvolvimento de uma ortótese personalizada que combina novas técnicas de produção com materiais inteligentes e estruturas biomiméticas, em colaboração com médicos ortopedistas. O resultado será a impressão 3D multimaterial de um imobilizador de pescoço, numa impressora multimaterial que será futuramente disponibilizada no CDRsp.

2. Projecto de cadeira hospitalar em parceria com entidade empresarial

Consiste na investigação e desenvolvimento de uma cadeira destinada a ambiente hospitalar, utilizando vários tipos de matérias e compósitos plásticos de forma a cumprir os requisitos da área médica. O trabalho desenvolvido incidiu na fase de desenvolvimento de conceito.

3. Processo de produção e otimização de desempenho através do design modular de um Pino Urbano feito com borracha reciclada.

Este pino urbano visa otimizar os processos de produção e permitir diferentes aplicações através de um design modular. O módulo simplifica o processo de produção, uma vez que necessita apenas de um molde menor o que acelera todo o processo, permitindo que o utilizador final adeqúe o pino com a altura necessária. Os anéis são produzidos com material fotoluminescente e a tampa superior pode ser personalizada.

Os objectivos específicos dos trabalhos desenvolvidos são:

Incorporar processos e metodologias multidisciplinares no desenvolvimento de produto com apoio de tecnologias emergentes e na avaliação integrada de sustentabilidade de produto.

Estratégias de maximização do valor acrescentado no design de produto.

Incorporação de material reciclado/reciclável em novos produtos

Design modular para uma produção sustentada e personalizada

Aplicação de métodos de produção para um desenvolvimento de produto de qualidade de forma rápida e inovadora, envolvendo digitalização, desenho personalizado e produção de protótipos.

Aplicação de competências dinâmicas integradas no desenvolvimento de produtos e apoiadas em conhecimentos técnico-científicos.

Palavras-chave: Digitalização, Modelação, Fabricação Aditiva, Design, Inovação

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Abstract

This report is based on the work developed at the Centre for Rapid and Sustainable Product Development (CDRsp), following the research scholarship for the period between July 30, 2014 and January 29, 2015 which has been subsequently renewed for the same period, continuing the work done.

The main activities undertaken focused on the following assumptions:

i. Product development and services

ii. Integrated sustainability assessment of product

iii. Application of Emerging Technologies

iv. Development of multidisciplinary methodology

In order to continue the work developed in the Centre using all the available resources and technologies, and to pursue the development of new products to the CDRsp portfolio, in particular a Modular Urban Bollard, I've also carried out the organization and support of dissemination projects of scientific and technological research in multidisciplinary areas, through events, seminars, symposiums, conferences, and others.

More specifically, in the product development and advanced production technology context, the work focused on three specific projects:

1. Orthoses design of a cervical collar with multidisciplinary methodology, reverse engineering, 3D modeling and additive manufacturing.

Development of a custom orthosis that combines new production techniques with smart materials and biomimetic structures, in collaboration with orthoprosthesic specialists. The result will be a multi-material 3D printed cervical orthosis.

2. Project Patient Chair in partnership with business entity

Is the research and development of a chair designed to hospital environment, using various types of plastics and composite materials in order to meet the requirements of the medical field.

3. Production process and performance optimization through modular design of Urban Bollard made with recycled rubber.

This bollard aims to optimize production processes and allow different uses through a modular design. The module simplifies production, since it needs only a smaller mould and it speeds up the process, while allowing the end user to customize the bollard to their needed height. The rings are photo luminescent and the top cover can be customized.

The specific objectives of the work to achieve are:

Incorporate processes and multidisciplinary methodologies in product development to support emerging technologies and integrated sustainability assessment of product.

Strategies for maximizing the added value in the product design.

Incorporation of recycled / recyclable materials into new products

Modular design for sustained, customized production

Application of production methods to develop a quality product rapidly and innovatively, involving scanning, custom design and prototyping.

Application of dynamic competences in product development integrated and supported in technical and scientific knowledge.

Keywords: Scanning, Modeling, Additive Manufacturing, Design, Innovation

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Lista de figuras

Figura dos modelos comerciais (Patient Chair)

A) Nala Patient Chair

B) Centé Patient Chair

C) Patient Chair

D) Nourish Patient Chair

E) Warren Sled Base Chair

F) Solis Patient Chair

G) Trace patient chair

H) Embody Chair

I) Setu chair

J) SAYL

K) Verte chair

Figura das patentes (Patient Chair)

Patente 1 - Vista em perspectiva e vista lateral da cadeira “Patient Chair”.

Patente 2 - Vista em perspectiva e vista posterior da cadeira “Multi-purpose patient chair”.

Patente 3 - Vista em perspectiva e vista lateral da cadeira “Patient chair system“

Patente 4 - Vista em perspectiva e vista lateral da cadeira “Patient’s chair”.

Patente 5 - Vista em perspectiva e vista lateral da cadeira “Mobile rocking patient chair and method of use”.

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Lista de tabelas

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Lista de siglas

SLS – *Selective Laser Sintering*

SLM - *Selective Laser Melting*

3DP – *3D Printing*

FDM – *Fused Deposition Modeling*

SLS – Estereolitografia - *Stereolithography Apparatus*

RX – Raio X

TAC - Tomografia Axial Computadorizada/Computorizada

CT - *Computerized Tomography*

CAD/CAM - *Computer Aided Design/ Computer Aided Manufacture*

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Índice

1. Introdução

O presente relatório aborda questões como o desenvolvimento de produto e serviços, no âmbito dos projectos existentes na entidade de acolhimento do estágio (CDRsp) e na prestação de serviços de investigação científica e tecnológica, com a aplicação de tecnologias emergentes, num meio multidisciplinar.

Surge no seguimento do estágio realizado para a conclusão do Mestrado de Product Design Engineering em que os principais objectivos serão a aplicação de conhecimentos adquiridos durante o processo de formação assim como a aquisição de novos conhecimentos e desenvolvimento de competências.

A metodologia utilizada para o desenvolvimento deste relatório tem por base o uso de referências bibliográficas e a descrição detalhada das tarefas realizadas em contexto real de trabalho. Como tal, o relatório em si pretende dar uma noção de tudo o que foi efetuado durante o decorrer do mesmo.

1.1. Entidade de acolhimento

A entidade de acolhimento do estágio foi o Centro para o Desenvolvimento Rápido e Sustentado de Produto (CDRsp), unidade orgânica de investigação do Instituto Politécnico de Leiria (IPL). O CDRsp visa contribuir para o avanço da ciência e da tecnologia, promovendo a criação de novos produtos, materiais e processos mais sustentáveis e eficazes, e que se traduzam em valor acrescentado para a indústria.

Para o efeito, o CDRsp dispõe de um grupo multidisciplinar de investigadores que dão suporte às diversas áreas de atuação do centro. Um grupo focado na aproximação às empresas, presta serviços de investigação científica e tecnológica, consultadoria e formação nas áreas definidas como estratégicas para o desenvolvimento de produtos de forma rápida e sustentada.

A própria localização do edifício (atual e futura) é estratégica. Instalado no seio da zona industrial da Marinha Grande, o CDRsp pretende uma efetiva transferência de tecnologia e conhecimento entre o meio empresarial e o académico. O crescimento do CDRsp, quer ao nível da investigação fundamental, quer ao nível dos projetos de aplicação

industrial, foi exponencial desde 2008. São muitas as parcerias estabelecidas desde então, quer com empresas, sobretudo da região, quer com outros Centros de Investigação, Laboratórios de Universidades e Centros Tecnológicos, nacionais e internacionais. Um reconhecimento crescente que tem alargado a área de intervenção geográfica do CDRsp.

O CDRsp tem delineados como eixos estratégicos a Investigação, o Desenvolvimento e a Inovação com caracter de excelência em áreas de forte impacto económico, social e ambiental para a região e para o país. Para cumprir esta missão, foram definidos temas estratégicos - tecnologias emergentes, materiais avançados, green manufacturing, sistemas de produção, integração de materiais, processos de fabrico e novos modelos de negócio.

Na próxima secção é a apresentada a estrutura em que este relatório foi desenvolvido, fazendo menção aos laboratórios e projectos envolvidos.

1.2. Estrutura do relatório

O relatório de estágio apresenta-se dividido em quatro capítulos. Inicia-se com a introdução, fazendo referência aos objectivos e metodologia do estágio e, caracteriza-se a respectiva entidade de acolhimento. O capítulo 2 refere-se à revisão de literatura, esta inclui a definição do conceito de tecnologias avançadas de produção assim como de desenvolvimento de novos produtos, integrando uma metodologia multidisciplinar e uma avaliação sustentável de produto.

No capítulo 3 encontram-se descritas as actividades desenvolvidas no decorrer do estágio, nomeadamente o desenvolvimento de uma ortótese fabricada por impressão 3D, envolvendo essencialmente os laboratórios de Fabricação Aditiva e de Engenharia Inversa e Realidade Aumentada; uma cadeira hospitalar no âmbito de um projecto existente e ainda em desenvolvimento no CDRsp, e um pino urbano modular de borracha reciclada, desenvolvido nos laboratórios de Design de Produto, de Engenharia e Tecnologias de Produção e de Fabricação Aditiva; assim como de outras actividades decorrentes do trabalho desenvolvido no centro.

No último capítulo são discutidos resultados e são tecidas considerações a ter em conta em trabalho futuro.

2. Revisão da Literatura

A revisão da literatura, através do recurso a referências bibliográficas, define os conceitos e os temas a desenvolver no relatório de estágio.

Indo ao encontro do título deste relatório "Novos produtos e tecnologias avançadas de produção", segue-se uma descrição dos conceitos abordados ao longo do relatório e respectivos temas.

2.1. Conceito de tecnologias avançadas de produção

O conceito de tecnologias avançadas de produção, engloba as ferramentas e os meios disponibilizados pelo CDRsp, assim como de tecnologias emergentes e de aplicação futura.

A Fabricação Aditiva é uma tecnologia desenvolvida no início dos anos 80, como técnicas de prototipagem rápida, destinadas essencialmente à produção de modelos conceptuais devido a limitações nas propriedades mecânicas dos materiais utilizados. No inicio dos anos 90, a Fabricação Aditiva evoluiu no sentido de permitir a produção rápida de ferramentas de produção (*Rapid Tooling*). Consequência dos desenvolvimentos ao nível dos materiais e tecnologias de produção evoluiu, no final da década, no sentido da produção de produtos finais (*Rapid Manufacturing*) ou, mais recentemente, na produção de substitutos biológicos para aplicações em Engenharia de Tecidos (Biofabricação).

O centro dispõe de vários equipamentos comerciais de Fabricação Aditiva para a produção de modelos protótipos de validação (Tabela 1).

A Fabricação Aditiva é uma tecnologia avançada de produção de peças numa estratégia camada-a-camada. As peças podem ser simples ou de elevada complexidade no seu design. Estas tecnologias permitem processar estruturas alargadas de mono ou multimateriais com ou sem cor, com o objectivo de se produzirem peças para as mais diversas aplicações.

Principais Tecnologias de Fabricação Aditiva	Materiais
SLS/SLM	Metais, Polímeros
3DP	Metais, Polímeros, Areia de Fundição
FDM	Polímeros
SLA	Fotopolímeros

Tabela 1 – Tecnologias de Fabricação Aditiva e Materiais

Outra tecnologia avançada para o desenvolvimento de produtos é a Digitalização 3D, uma ferramenta da Engenharia Inversa que possibilita digitalizar objectos de diversas geometrias e tamanhos sem contacto e com um elevado rigor.

O equipamento de digitalização de luz estruturada é composto, normalmente, por um projector e uma câmara de vídeo, em que é projectada luz em forma de franjas verticais e horizontais (estruturada) sobre o objecto. O *software* lê as imagens captadas pela câmara de vídeo e cria uma nuvem de pontos, correspondente à forma do objecto.

Esta geometria também pode ser apreendida por luz infravermelha através de um equipamento em que as lentes servem para fazer o varrimento, projectando uma luz infravermelha no objecto, que por sua vez é captada pela câmara. Através do *software* obtém-se a geometria do objecto, com base do que é captado pelo sensor ou pelo *tracker* (informa a localização dos pontos no espaço, através de marcadores do equipamento ou do objecto).

Alguns equipamentos de digitalização permitem ainda apreender as cores e texturas da superfície do objecto analisado.

As Fabricação Aditiva em conjunto com a Digitalização 3D possibilitam actualmente uma diversidade de abordagens e aplicações nas mais diversas áreas de actuação.

Com o desenvolvimento tecnológico surge também o desenvolvimento de novos materiais, chamados materiais inteligentes, como os materiais com efeito de memória de forma. São materiais com propriedades particulares cuja constituição química lhes permite reagir a determinado estímulo, seja luz, temperatura, campo magnético ou eléctrico.

Todos estes elementos referidos anteriormente são abordados e explorados no relatório e no decorrer do estágio.

2.2. Conceito de novos produtos através de método multidisciplinar e sustentável

O desenvolvimento de novos produtos integrando uma metodologia multidisciplinar e uma avaliação sustentável de produto é um conceito que permite a ligação entre as diferentes áreas presentes nos projectos, possibilitando a evolução dos trabalhos até à sua conclusão.

Uma abordagem multidisciplinar leva à obtenção de resultados com maior eficiência e de valor acrescentado, reduzindo o tempo de resposta, ao maximizar a abrangência da área do conhecimento e a sua assertividade.

Mais objectivamente no que diz respeito aos trabalhos desenvolvidos, a sua aplicação integrou-se em questões relacionadas com a optimização dos processos, de estruturas, seguindo princípios biomiméticos, com a introdução de matéria reciclada, assim como pelos *inputs* gerados por uma equipa multidisciplinar, desde a área médica, à engenharia e ao design, envolvida directa ou indirectamente nos projectos.

O projecto "Pino Urbano Modular" integrou uma metodologia focada no reaproveitamento de resíduos de borracha, onde foram melhorados os meios para alcançar o produto final, como descrito mais à frente neste relatório.

No desenvolvimento do projecto "CoRal Cervical" a abordagem passou pela imagiologia médica, pelo tratamento e planeamento integrado, em colaboração com a área médica e com especialistas da área da fabricação aditiva, engenharia inversa, de tecnologias de produção e de modelação e simulação, à semelhança do projecto "*Patient Chair*". Todos estes elementos serão mais detalhados ao longo do relatório, em particular no capítulo que se segue.

Também alguns princípios de design eco sustentável, caracterizado pelo pensamento de ciclo de vida, em que as questões ecológicas ou ambientais são ponderadas em todas as fases do ciclo de vida dos produtos, permitiram introduzir elementos de grande relevância para desenvolvimento dos projectos, visando a integração das considerações ambientais

nos procedimentos de engenharia ao longo de todo o processo de desenvolvimento do produto.

Desta forma é possível equacionar diferentes modos de produção, sendo os seus limites discutidos e testados. Novos materiais e técnicas de construção poderão ser tidas em conta e discutidas de modo a alcançar os melhores resultados com o mínimo desgaste em termos de recursos, humanos, financeiros, económicos e de tempo.

Tratou-se portanto de uma metodologia multidisciplinar com significativas vantagens na chamada "transferência de tecnologia", o que traz numerosos benefícios para o desenvolvimento da solução final, assim como de todo o processo prévio correspondente, criando sinergias no interior do grupo de trabalho que poderão dar origem a novas soluções produtivas.

3. Actividades desenvolvidas ao longo do estágio

Neste capítulo serão descritas as principais actividades desenvolvidas durante o estágio, tendo em conta os conceitos referidos anteriormente e centrando-se em cinco actividades principais. O desenvolvimento de uma ortótese cervical (CoRal Cervical), de uma cadeira hospitalar (*Patient Chair*), de um pino de delimitação urbana (Pino Urbano Modular), a organização de acções de disseminação técnico-científicas, assim como a descrição de outras actividades que acompanharam todo o tempo de estágio, referentes ao trabalho desenvolvido na área da comunicação interna do CDRsp e de responsabilidades internas de gestão do laboratório de Engenharia Inversa e Realidade Aumentada, e do Auditório do centro.

3.1. CoRal Cervical

Este projecto consiste no desenvolvimento de uma ortótese personalizada fabricada por impressão 3D, multi-material, que combina novas técnicas de produção com materiais inteligentes e estruturas biomiméticas, alternativas aos tradicionais imobilizadores de pescoço e cabeça.

Pressupõe no seu desenvolvimento que a ortótese seja projetada especialmente para cada paciente, em colaboração com médicos ortopedistas, em que é identificado o local da lesão e respectivo tipo de tratamento. Através de um scan-3D, são determinados o padrão e a estrutura específicos para cada caso, gerando uma estrutura diretamente relacionada com o local da lesão, seguindo princípios biomiméticos, inspirados na estrutura dos corais (CoRal) e na hidrofobicidade da superfície da flor de lótus.

O resultado será a impressão 3D/4D multimaterial de um imobilizador de pescoço, em que a parte interior da estrutura se adapta ao corpo do utilizador através de um material

com memória de forma, o qual reage à temperatura corporal deste, tornando-a mais confortável com uma superfície de contacto que facilita a livre respiração da pele [16].

A estrutura exterior manter-se-ia inalterada e rígida cumprindo a sua função imobilizadora.

O CoRal cervical proporciona uma utilização mais leve, impermeável, ventilada, reciclável, higiénica e personalizada.

Existem no entanto vários tipos de ortóteses, como serão descritas na secção que se segue. Este projecto centrou-se no grupo de ortóteses estáticas, apresentando uma solução híbrida que permite dinamizar o processo de tratamento da lesão, optimizando as soluções já existentes para o mesmo tipo de aplicação, dentro dos colares cervicais macios, semi-rígidos e rígidos.

3.1.1. Ortóteses cervicais

O termo ortótese (*Orthosis*) oriundo da palavra grega "*orthos*" significa direito, em linha recta.

Utilizada desde a antiguidade, sem princípios técnicos e de construção artesanal, é actualmente entendida como um equipamento, aparelho ou dispositivo ortopédico de uso externo, que permite auxiliar/corrigir uma parte do corpo que apresente anomalias, substituindo ou auxiliando na sua função.

As ortóteses podem dividir-se em dois grandes grupos: Ortóteses Estáticas e Ortóteses Dinâmicas.

As Ortóteses Estáticas caracterizam-se por serem talas imóveis, desenhadas para imobilizar articulações de modo a evitar deformações, lesões nos tecidos moles ou contracturas. As Ortóteses Dinâmicas integram mecanismos que reproduzem o movimento que o corpo já não consegue produzir, mantendo activa a capacidade funcional [10].

Dentro destes grupos de ortóteses, estão as ortóteses cervicais com diferentes características e objectivos terapêuticos.

Estas actuam essencialmente como sinalizadores cinesiológicos para limitar o movimento do pescoço, no entanto também incluem efeitos de distracção, redução da carga cefálica, alívio de compressões nervosas, limitação do movimento e relaxamento muscular.

Os principais objectivos na utilização destas ortóteses são:

- ✓ Estabilizar articulações, músculos e tendões que não têm condições de sustentação própria, quer a nível anatómico quer a nível funcional.
- ✓ Prevenir, impedir ou minimizar a estruturação de deformidades articulares;
- ✓ Reduzir movimentos involuntários.

Os tradicionais métodos manuais para a criação de ortóteses personalizadas incluem um trabalho intenso, moroso e um processo impreciso que pode afectar o conforto das ortóteses e a qualidade no tratamento de lesões.

As ortóteses actuais podem ser constituídas por diversos materiais: Plástico (termoplásticos e os termoendurecíveis); Gesso; Metal (aço, alumínio e titânio); Elementos de couro; Borracha como o neoprene; Espuma; Madeira ou Tecido (algodão ou tecidos sintéticos como o poliéster e o nylon).

Recentemente o desenvolvimento de ortóteses está a ser levado a outro nível devido à introdução de métodos inovadores com uma visão de futuro, que integram tanto tecnologias emergentes como novos materiais, contribuindo para um tratamento mais preciso [8].

No âmbito da ortoprotesia, um sector em franco desenvolvimento, verifica-se que a prevalência e incidência de patologias que levam à necessidade de cuidados orto protésicos, aumentou. No desenvolvimento de próteses essa aplicação já se encontra bastante desenvolvida, no entanto no das ortóteses verifica-se que a evolução se encontra suspensa [5].

O contributo do design neste campo é visto como uma mais-valia no que diz respeito à aceitação dos doentes/utentes destes dispositivos o que consequentemente vai aumentar a sua eficácia. A inserção de designers, em equipas multidisciplinares no desenvolvimento de ortóteses cervicais, que interagem para alcançar uma finalidade comum, permitirá ir ao encontro de soluções optimizadas e de uma maior percepção de valor acrescentado.

O designer poderá estabelecer a ponte entre as várias disciplinas, projectando uma solução que englobe as diversas valências inerentes a cada uma delas.

O estudo prévio do que se pretendia solucionar permitiu identificar quais os efeitos indesejáveis das aplicações tradicionais assim como quais as principais vantagens e benefícios no desenvolvimento de uma alternativa de imobilizador de pescoço.

Desvantagens das aplicações tradicionais (efeitos indesejáveis):

- ✓ Odor
- ✓ Atrofia muscular
- ✓ Lesão do nervo
- ✓ Lesão cutânea
- ✓ Pesada
- ✓ Método de remoção intimidatório
- ✓ Não há indicação visível de cura
- ✓ Infecção da pele
- ✓ Dificuldade em manter higiénica
- ✓ Inchaço
- ✓ Dor e/ou Desconforto
- ✓ Alteração da auto-imagem
- ✓ Dependência física e/ou psicológica

Benefícios/vantagens de uma aplicação:

- ✓ Evitar cirurgia desnecessária
- ✓ Evitar a atrofia muscular
- ✓ Método de fácil colocação e remoção
- ✓ Prevenir a infecção de pele
- ✓ Arejada
- ✓ Leve
- ✓ Impermeável
- ✓ Reciclável
- ✓ Intervenção localizada e precisa
- ✓ Higiénica

- ✓ Confortável
- ✓ Personalizada.

É igualmente importante ter em conta que a maioria das ortóteses cervicais são dispositivos temporários, cujo uso deve ser interrompido tão cedo quanto possível.

A sua utilização temporária ou prolongada revela também uma carga social de impacto negativo relevante. A utilização de uma ortótese pode condicionar diversos efeitos indesejáveis, físicos e psicológicos, potencialmente responsáveis por uma má adesão ao tratamento.

3.1.1.1. Colar cervical macio

O colar cervical macio é indicado em situações de pequenos traumas na zona vertebral, transversal e tecidos moles. É também indicado como protecção pós-operatório, para casos de cervicobraquialgias, traumatismos ósseos leves e problemas reumáticos.

Este colar cervical permite limitar a flexo-extensão e, em menor grau, a rotação da coluna cervical. Serve também como recordatório para a restrição dos movimentos da cabeça e do pescoço e para diminuir a pressão sobre os discos intervertebrais.

Habitualmente fabricado em material de espuma de poliuretano ou polietileno e forro de algodão, fecha na parte posterior através de um velcro e está disponível em vários tamanhos e alturas.

3.1.1.2. Colar cervical semi-rígido

O colar cervical semi-rígido mais comum integra uma placa de polipropileno que fixa no exterior através de velcros, ao retirá-la, o colar passa a ter a funcionalidade de colar cervical macio.

Maioritariamente este colar é indicado para situações de dor cervical, nevralgia cervico-braquial, entorse cervical benigno e traumatismo nas cervicais.

É disponibilizado em vários tamanhos e regulável em altura por velcros.

3.1.1.3. Colar rígido

Mais vocacionado para traumatismo agudo nas cervicais, pode ser com ou sem apoio mentoniano, mostrando desde já a importância da sua aplicação consoante o tipo de tratamento prescrito para cada caso.

O colar cervical rígido é habitualmente fabricado em plastozote e polipropileno de alta densidade nos apoios occipital e mentoniano (alguns com peças metálicas), estando igualmente disponível em vários tamanhos e alturas.

Para o desenvolvimento da ortótese proposta optou-se por uma metodologia multidisciplinar sendo esta vocacionada para área médica e produzida com tecnologias avançadas de produção. Na secção seguinte será abordada a metodologia que foi adoptada.

3.1.2. Desenvolvimento de metodologia multidisciplinar

O desenvolvimento de soluções personalizadas alternativas ao gesso, às ligaduras e aos imobilizadores utilizados nas fracturas, deformações ou entorses de pernas, braços, dedos, coluna, cabeça e pescoço, através de novas tecnologias avançadas, e de um fluxo de trabalho apoiado numa metodologia multidisciplinar transversal ao desenvolvimento de produto, permite gerar soluções passiveis de ser aplicadas com uma maior rapidez e direccionadas para o tratamento mais adequado, planeado e controlado pelo médico.

Através da integração de métodos e técnicas provenientes de diferentes campos de aplicação e investigação como a engenharia inversa, imagiologia, simulação computacional e fabricação aditiva, estas soluções apresentam uma forma de tratamento que permitirá uma utilização mais leve, impermeável, arejada, reciclável, localizada, higiénica e personalizada [13].

A partir da radiografia da lesão e do scan-3D, são determinados o padrão e a estrutura específicos para cada caso, gerando uma estrutura directamente relacionada com o local da lesão seguindo princípios biomiméticos.

Mais especificamente, no desenvolvimento de um colar cervical, a metodologia é apoiada no plano de tratamento do paciente e no tipo de lesão que será intervencionada. Esta partirá num primeiro momento no hospital em que este é assistido e finalizará na aplicação personalizada de uma ortótese fabricada por impressão 3D.

A parte interior da estrutura adapta-se ao corpo do utilizador, tornando-a mais confortável, permitindo a livre transpiração da pele assim como a higiene diária do paciente, sem a necessidade da sua remoção. A estrutura exterior rígida cumpre a sua função imobilizadora.

Processo (Tabela 2):

1. Lesão ocorre

2. Primeiro diagnóstico no hospital por um médico

3. Tomografia computadorizada feita para completar o processo de diagnóstico, este tipo de exame também fica guardado como um modelo 3D em dados hospitalares

4. Avaliação completa por um cirurgião ortopédico.

5. Técnico de Fabricação aditiva gera uma estrutura com base no *CT Scan* do paciente, digitalização 3D e modelação 3D com base nos dados fornecidos pelo médico.

6. Envia para a impressora multimaterial 3D

7. Utilização de material rígido e flexível com memória de forma para a impressão

8. Aplicação no paciente

9. Local da lesão do paciente é totalmente imobilizada

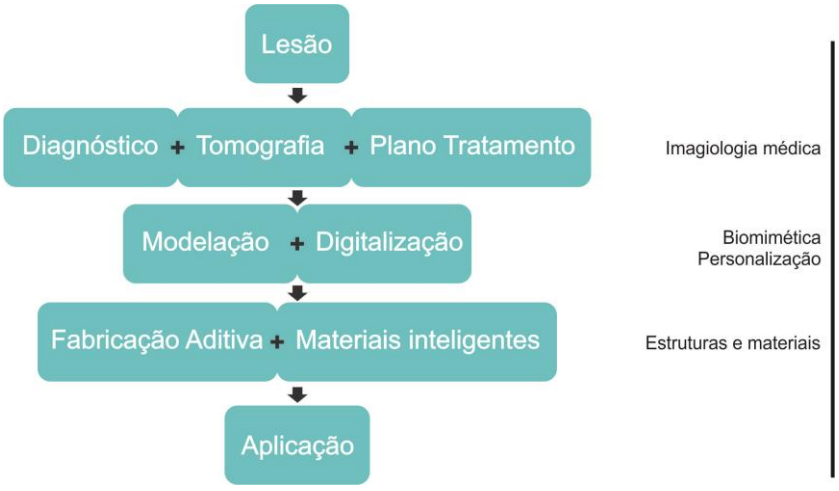


Tabela 2 – Processo metodológico do CoRal

3.1.2.1. Imagiologia médica

Os sistemas de CAD/CAM (*Computer Aided Design/ Computer Aided Manufacture*) para Ortoprotesia estão em franco desenvolvimento, sendo uma tecnologia bastante promissora. O RX é ainda o exame mais utilizado no trauma cervical. No entanto, a utilização da TAC helicoidal permite uma rápida aquisição de imagens, em corte axial e reconstruções sagital e coronal, motivo pelo qual a sua utilização tem vindo a ser mais recorrente apesar dos conhecidos riscos que se prendem com os altos níveis de radiação, a que os pacientes são sujeitos.

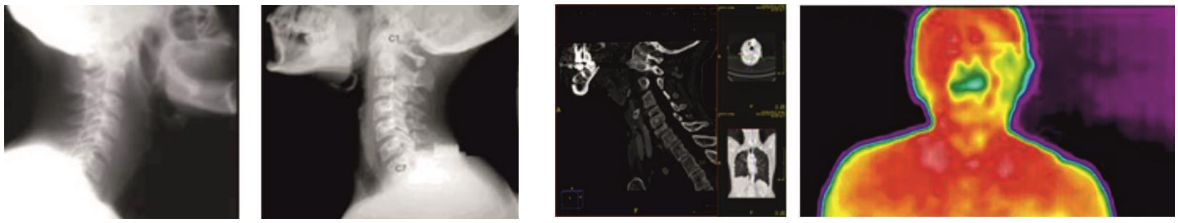


Figura 1 – Imagiologia médica

Estes dados clínicos do paciente serão interpretados pelo médico e poderão ser conjugados com tecnologias de digitalização 3D.

3.1.2.2. Digitalização

Através de um equipamento de digitalização 3D, rapidamente e de uma forma simples é possível a aquisição da geometria do paciente gerando dados tridimensionais, que em conjunto com os dados médicos, permitirão reproduzir uma imagem fiel da zona a ser intervencionada.

O equipamento utilizado para este caso em específico foi uma plataforma giratória com um scan 3D integrado de luz infravermelha, que com o programa correspondente (Figura 2), permitiram a apreensão da geometria da superfície, em poucos minutos.

Com o modelo 3D obtido por esta via e em conjunto com o modelo 3D hospitalar, é possível pós-processar o modelo (Figura 3) de forma a promover uma melhor adequação da ortótese ao tratamento daquele paciente em específico (Figura 4).

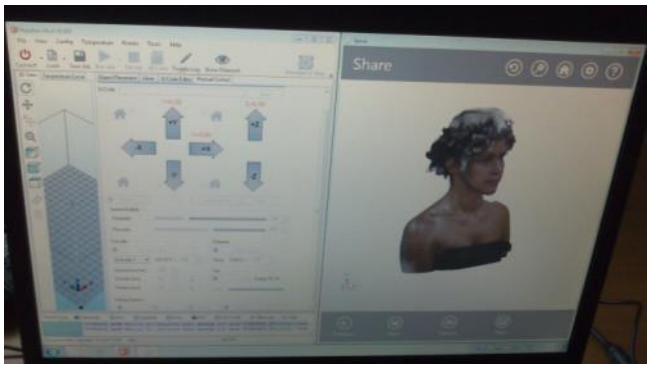


Figura 2 – Programa para controlo de rotação da plataforma e de digitalização 3D

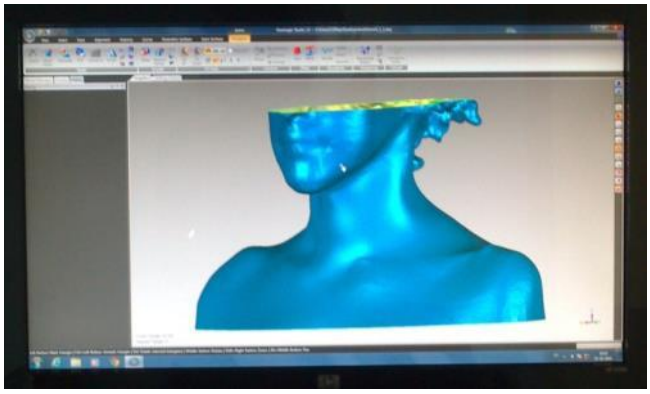


Figura 3 – Pós-processamento

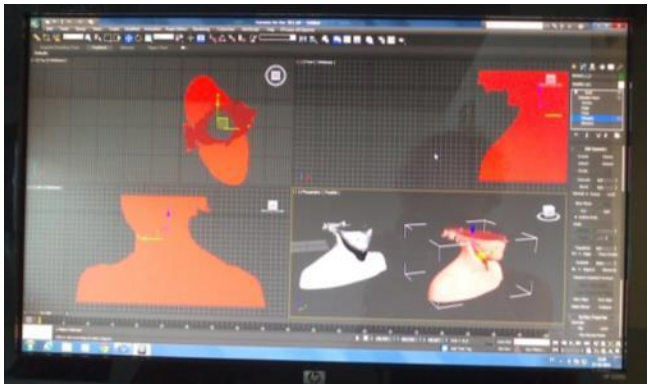


Figura 4 – Modelação e manipulação 3D

3.1.2.3. Personalização

A combinação de técnicas de produção inovadoras com materiais inteligentes pode gerar um produto altamente personalizado, cujo valor acrescentado pode ser apreendido pelos seus atributos e aplicações diferenciadas.

Este nível de rigor e eficácia poderá ser atingido através do desenvolvimento de uma aplicação simples paramétrica, que gera estruturas orgânicas (Figura 5), adequadas ao tipo de tratamento e local de intervenção, com simulação computacional e completamente ajustadas à morfologia de cada paciente.

Com a personalização das ortóteses é também possível fazer a ponte entre o campo pessoal e tecnológico assumindo uma extensão do estilo e personalidade do utilizador/paciente.

Seja uma utilização temporária ou por longos períodos de tempo, estes elementos revelam também um fardo social de impacto negativo que poderá ser reduzido quando a identidade do utilizador e o seu estilo de vida são reflectidos tanto ao nível formal como visual.

A possibilidade de adequar o colar cervical à personalidade do utilizador na fase de projecto, permite que este altere a maneira como vai percepcionar e se relacionar com o produto final, sem interferir com as características funcionais do modelo e contribuindo assim para uma maior eficácia do tratamento.

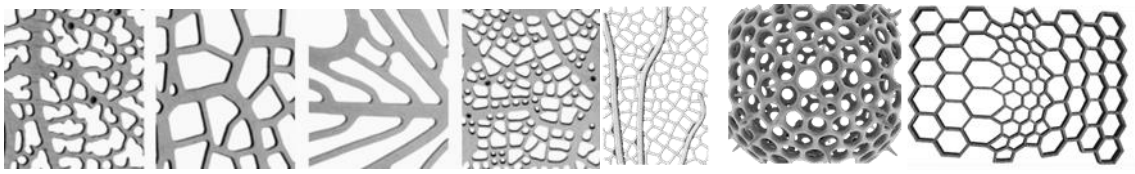


Figura 5 – Exemplo de estruturas orgânicas passíveis de personalização

3.1.2.4. Estrutura e materiais

A importância de desenhar uma estrutura baseada nas indicações médicas de tratamento, com o apoio de tecnologias 3D e de *software* paramétrico, permite-nos chegar a uma estrutura inspirada em algoritmos que imitam padrões e processos na natureza (Figura 6), com o objectivo de optimizar a utilização do material e o reforço estrutural para determinadas zonas do colar, mantendo a sua eficiência [12]. Esta abordagem dá-nos mais possibilidades para determinar as características formais, o comportamento do material, desempenho estrutural, e outras.

Figura 6 – Modelação estrutural bio inspirada

3.1.2.5. Biomimética

Um dos principais estímulos da biomimética é também a transferência de funções, mecanismos e princípios de um campo para outro.

Inspirados pelas estruturas de recifes de coral e da exploração sistemática de como o padrão e a forma surgem na natureza e as suas estratégias de crescimento, pretende-se que no desenvolvimento da ortótese, estas estratégias sejam também aplicadas, contrapondo com a pura imitação visual desta [7].

Estruturas fractais como por exemplo os favos de mel encontrados na natureza, são responsáveis por uma rigidez excelente, vários padrões e formas.

Também na natureza encontramos superfícies de fibras multinível com pontas especializadas que ajudam a reduzir a fricção e a controlar o atrito sugerindo uma "cobertura natural (biológica) do corpo" [15].

Reduzir a adesão, utilizando um material inspirado nos nano filamentos da flor de lótus (Figura 6a) com características hidrofóbicas que permitem que a pele respire, transpire sem se tornar húmida, promove uma ortótese mais confortável.

A estrutura do esqueleto da esponja de vidro *Euplectella aspergillum* (Figura 6b) exibe uma uma organização de fibras, que lhe conferem propriedades estruturais superiores.

Analisando e sintetizando estas estruturas pré-optimizadas da natureza e as suas propriedades funcionais, poderemos chegar a uma carcaça hiper-estrutural, uma superfície hidrofóbica em material com memória de forma (Figura 6c) de comportamento orgânico, onde o material é aplicado de forma eficiente, apenas onde é necessário [14].

A ortótese a desenvolver terá elementos inspirados na geometria dos corais, contém elementos vazados em toda a sua estrutura, e na hidrofobicidade da superfície da flor de lótus, em que toda a superfície interior é composta por minúsculos filamentos permitindo a livre transpiração da pele [3].

Figura 6 – a) Flor de lótus; b) Euplectella aspergillum; c) efeito de memória de forma

3.1.2.6. Fabricação aditiva

Hoje em dia estamos a assistir a uma revolução industrial que promete mudar a nossa maneira de projectar e produzir "objectos".

O trabalho dos Ortoprotésicos na fabricação de determinados componentes de próteses ou ortóteses, poderá ser facilitado, mais rápido e eficaz, dando continuidade ao trabalho personalizado feito em laboratório, reproduzindo-as computacionalmente.

As impressoras de fabricação aditiva permitem uma liberdade de formas e um rigor dimensional completamente ajustado às especificações e geometria de cada paciente (Figura 7). Esta tecnologia tem vindo a ganhar terreno no desenvolvimento de novos produtos e tem tido um reconhecimento das suas mais-valias em aplicações médicas [1].

Disponível em diversos materiais de impressão (Figura 8), o colar cervical seria produzido em material flexível no seu interior e rígido no exterior, de forma a atribuir algum conforto durante a sua utilização, ao mesmo tempo que cumpre a sua função imobilizadora.

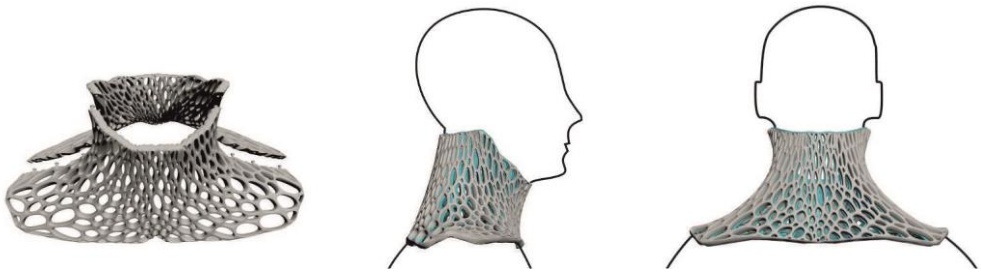


Figura 7 – Modelo 3D para impressão

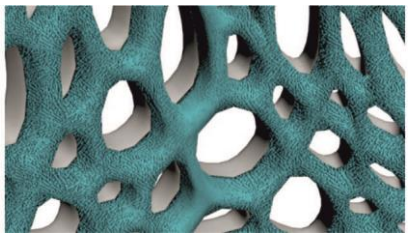


Figura 8 – Fabricação em impressora multimaterial Objet500 Connex™

3.1.3. Testes, ensaios e aplicação

O desenvolvimento deste colar pressupõe a impressão de um protótipo que permita testar, ensaiar e aplicar, partindo de um caso real de tratamento.

A tecnologia avançada para a produção deste colar cervical já foi identificada conforme identificado na figura anterior (*Objet500 Connex*™). No âmbito do presente período de estágio não foi possível a produção do referido produto.

3.1.4. Síntese

A colaboração e os *inputs* trazidos para o desenvolvimento de novos produtos partindo da área médica, com o apoio de designers, engenheiros, especialistas em fabricação aditiva, assim como do próprio utilizador do produto, poderão contribuir para gerar um produto melhor e mais eficiente e de aplicações diferenciadas.

A revolução industrial em que vivemos permitirá uma nova visão de como se poderão projectar, desenhar e conceber novos produtos, assim como abrir o leque ao tipo de aplicações possíveis.

Depois da impressão 3D se tornar cada vez mais acessível e optimizada, a impressão 4D vai sem dúvida, fazer a diferença expandindo os limites do "fazer".

O conceito de impressão 4D foi inicialmente proposto pelo Instituto de Tecnologia de Massachusetts, pelo membro Skylar Tibbits, no início do ano de 2014. O conceito de impressão 4D proposto, permite que os materiais impressos se "auto-montassem" em estruturas 3D [18].

Estudos recentes representam um forte avanço na fabricação aditiva com compósitos poliméricos, programados com memória de forma [2].

Em Outubro de 2013, os investigadores na Universidade Boulder do Colorado, demonstraram a importância da localização e orientação das fibras no interior do material compósito, a fim de determinar o grau de efeito de memória de forma como dobragem, enrolamento, estiramento ou torção, e a capacidade para controlar os efeitos por aquecimento ou arrefecimento do material compósito [4].

Para trabalhos futuros pretende-se integrar no desenvolvimento de ortóteses cervicais esta nova abordagem e conceito inovador.

3.2. Patient Chair

O Projeto All in Plastics consiste na investigação e desenvolvimento de um produto para a área médica, a *Patient Chair*. Esta cadeira é constituída por costas, assento, apoio de braços e pés e destina-se a utilizadores de instituições de saúde em geral e utilizadores residenciais que necessitem de apoio e cuidados permanentes de terceiros. A cadeira deverá ter um sistema que permita a reclinação do assento e das costas. Este produto será constituído por vários tipos de materiais e compósitos plásticos de forma a cumprir todos os requisitos propostos para a cadeira, assim como, todos os requisitos da área médica.

Integrada na equipa de I&D, foi disponibilizado um conjunto de recursos técnicos e tecnológicos considerados adequados à persecução e realização dos objectivos. A equipa de desenvolvimento do projecto apresentou as valências ao nível das tecnologias que se pretendiam aplicar e estudar, e também experiência e participação em actividades de investigação e desenvolvimento.

De forma a responder a problemas apresentados por produtos similares existentes no mercado propôs-se uma integração de tecnologias para obtenção de um produto plástico de elevado desempenho na vertente estrutural, estética, asséptica e ergonómica e que possa ser aplicada no mercado hospitalar/saúde, substituindo soluções existentes no mercado que não estão preparadas para este tipo de exigências.

No presente estudo pretendeu-se abordar as tecnologias que permitem a produção do produto respeitando os diversos parâmetros impostos (geométricos, modularidade, ergonómicos, design, resistência mecânica, assépticos e de produção).

As tecnologias a abordar no projeto teriam de possibilitar uma redução dos custos, reduzir o número de componentes, facilitar a montagem, o manuseamento do produto, bem como, a substituição de componentes danificados.

O fluxo de trabalho foi orientado para uma distribuição de tarefas pela equipa, para que esta evoluísse em conjunto, focada nas suas principais valências. Mais especificamente numa fase inicial a equipa do CDRsp, composta por mim, Tania Viana e Sara Biscaia, no

que diz respeito ao estado da arte, pesquisa de patentes e requisitos legais e normativos. E posteriormente apenas por mim, no desenvolvimento conceptual do projecto.

3.2.1. Estudos preliminares

O estudo iniciou tendo atenção, em desenvolvimentos futuros, visto o presente projeto se encontrar num limiar entre ser considerado um produto ligado ao bem-estar e saúde ou dispositivo médico. Tendo em conta os objectivos do *All in Plastic*, a equipa não pretende que seja considerado dispositivo médico, os requisitos terão como limitação esta realidade.

Foi compilada informação acerca dos requisitos genéricos do produto, bem como o estado da arte no que diz respeito às soluções que existem no mercado. Realizou-se igualmente o levantamento das patentes de cadeiras ergonómicas, normas e legislação.

A nível de tecnologias, foi reunida informação acerca das tecnologias que melhor se adaptavam aos parâmetros pretendidos. Por outro lado, pretende-se que este produto possibilite uma redução de custo, de componentes e que seja fácil de montar.

Foi realizado o estudo acerca dos materiais e processos que poderão ser utilizados no âmbito deste projeto, nos quais se incluiu a possibilidade de utilização de materiais compósitos, espumas viscoelásticas, soluções bio inspiradas e materiais e processos sustentáveis. Outro aspeto importante referenciado no estudo foi a compatibilidade entre materiais.

Definiram-se, com base na investigação realizada, os requisitos que o projecto deve ter, em termos de parâmetros geométricos, de modularidade, de ergonomia, design, resistência mecânica, asséticos e de produção.

Realizou-se o desenvolvimento de conceitos de produto. Após este desenvolvimento aferiu-se as possibilidades de realização dos conceitos em termos de materiais e processos tecnológicos. Posteriormente, os conceitos foram avaliados e escolhidas as soluções que melhor respondessem aos requisitos definidos para o produto.

3.2.1.1. Estado da Arte

Na pesquisa que se segue apresentam-se cadeiras sem uma aplicação definida abrangendo cadeiras de lazer, escritório e para fins hospitalares. O motivo pelo qual se apresentam todas estas vertentes de cadeiras deve-se ao facto de na constituição delas existirem mecanismos ou soluções técnicas que estão protegidas por patentes.

Para não se incorrer na duplicação destas soluções parece importante interiorizar todas essas soluções e assim garantirmos que o nosso processo de produção de soluções não decalca as já existentes e o nosso consequente esforço não cai por terra aquando do patenteamento das soluções produzidas.

Nesta pesquisa foram tidas em conta características dimensionais, estéticas, as propriedades do produto, os mecanismos, os materiais, as certificações, a modularidade, a adaptabilidade, a manutenção, a acessibilidade e a eficiência.

Pesquisa de Modelos Comerciais

A) Nala Patient Chair

Herman Miller/Continuum

O objectivo foi o de atender às necessidades tanto do paciente como do cuidador.

O movimento de inclinação sincronizado do encosto e do assento da cadeira Nala imita o movimento natural do corpo do paciente.

O encosto e o assento do banco abrem quando o paciente reclina e inclina em torno dos pontos de articulação, no tornozelo, joelho e quadril.

O correcto suporte do corpo é mantido em todas as posições, independentemente do peso do paciente.

Informação Comercial

- Marca: Herman Miller/Continuum
- Linha: Patient Chair
- Modelo: Nala Harmonic (CR43/CR900)

Informação Dimensional:

CR43

- W: 33
- H: 50.5
- D: 28.5

CR900

- W: 25.25
- H: 16.25
- D: 16

Uso

- Capacidade max. de peso para assento é de 158,75kg/350lbs
- Garantia 12 anos

Materiais

- Poliuretano sem PVC e polyesters sem antimónio.
- Espuma de Alta Densidade nos assentos
- Estrutura metálica

Mecanismos

- Inclinação do encosto até 24 graus.
- Controlos de reclinação nos braços
- Sistema de inclinação e Leaf Spring facilitam o movimento de reclinação.
- Sistema de rodízios traseiros accionado quando inclinado.

- Braços de transferência levantam facilitando a saída lateral.
- Barra traseira para ajudar a mover a cadeira.
- Encosto de cabeça ajustável em 23cm e arredondados adaptando-se à cabeça do utilizador.
- Suporte lombar.

Certificações

- *McDonough Braungart Design Chemistry (MBDC)*
- *Silver Cradle to Cradle (C2C)*
- 33% elementos reciclados e 86% recicláveis

Opções

- Texteis: Herman Miller Quilty, Squash; Maharam Droplet, Cayenne; Maharam Chime, Flame; Maharam Kernel, Shilling

B) Centé Patient Chair

Herman Miller

Vários critérios adicionais influenciam o desenho da cadeira: conforto, o facto de que o tamanho do paciente médio continua a aumentar, a facilidade de utilização, e a escala.

O resultado é uma cadeira simplificada com um tecido de suporte em malha de poliéster, a capacidade de suportar pacientes até 160 Kg, e os controlos que tornam o processo de cura mais facilitado para o doente e para o prestador de cuidados.

As cadeiras Centé são apropriadas para o uso em salas de tratamento cirúrgico e pós-cirúrgico, e nos quartos de pacientes, internados e em reabilitação.

Informação Comercial

- Marca: Herman Miller
- Linha: Patient Chair
- Modelo: Centé

Informação Dimensional

CNXX-00002

Tilt chair

- W: 28
- D: 31
- H: 48.75

CNXX-00003

Flex chair

- W: 28
- D: 31
- H: 48.75

Uso

- Capacidade max. de peso para assento é de 158,75kg/350lbs
- Garantia 12 anos
- Componentes amovíveis para facilitar a limpeza e a manutenção.
- Manípulo de controlo facilmente acessível ao utilizador e ao cuidador.

Materiais

- Malha de polyester no assento.
- Assento e costas também disponíveis em malhas de vinyl e poliuretano de Maharam
- Estrutura metálica

Mecanismos

- Sistema amortecimento do assento promove um movimento flexível confortável e a elevação do utilizador.
- Inclinação frontal de elevação de 3 graus e mecanismo de controlo.

- Inclinação traseira de 10 graus.
- Sistema de inclinação promove a redução de pressão do corpo.
- Sistema de rodízios traseiros accionado quando inclinado.
- Braços de transferência levantam facilitando a saída lateral.
- Materiais que permitem a circulação do ar no assento e no encosto da cadeira.

Certificações

- *GREENGUARD Indoor Air Quality Certified®*
- *GREENGUARD Children & Schools Certified*

Opções

- Estofo para o assento e para as costas
- Rodízios traseiros

C) Patient Chair

PearsonLloyd's

Tampas de assento removíveis, estofamento impermeável e superfícies lisas incentivam a limpeza regular e melhora o conforto do paciente.

O pacientes do hospital são incentivados a sentarem-se numa cadeira, em oposição à cama para ajudar na recuperação, como tal, cadeiras de pacientes são utilizadas por cerca de 2-8 horas por dia, aumentando o risco de úlceras de pressão, dano tecidual e aumento da acumulação de bactérias no quadro e almofada.

A cadeira dispõe de um receptáculo de plástico aerodinâmico e o número mínimo de juntas e cruzamentos para reduzir a capacidade da cadeira para abrigar germes e torná-lo fácil de lavar. A almofada do assento é preenchida com um novo material de gel, que proporciona alívio de pressão e conduz a humidade para longe do paciente. O estofo é limpo e fixo ao receptáculo, graças à imans integrados. Almofadas extras são cobertas com roupa de cama, de modo a que cada paciente receba uma cadeira nova.

Informação Comercial

- Marca PearsonLloyd's
- Linha Patient Chair
- Modelo Patient Chair

Informação Dimensional

- n/a

Uso

- Componentes amovíveis facilitam a limpeza e a manutenção.
- Manípulo de controlo de elevação
- Utilização de 2-8 Horas diárias
- Permite a rotação total sobre o eixo central
- Estrutura plástica com apoio de braços integrados

Materiais

- A almofada do assento é preenchida com gel para alívio de pressão
- Receptáculo de plástico
- Base metálica com rodízios em dois apoios

Mecanismos

- Tampas de assento removíveis, impermeáveis e com superfície lisa facilitam a limpeza e a manutenção
- Estofo é fixo através de ímans integrados.
- Rodízios traseiros
- Encosto para cabeça almofadado e amovível

Certificações

- n/a

Opções

- Almofadas extras

D) Nourish Patient Chair

Globalcare

Informação Comercial

- Marca Globalcare
- Linha Seating Series
- Modelo Nourish Patient Chair

Informação Dimensional

- Altura dos assentos disponíveis entre 17’’/43,18cm e 20’’/50,8cm e de 20’’ a 23’’/58,42cm

Uso

- Capacidade de peso para assento é de 158,75kg/350lbs e 340,20 kg/750 lbs para os modelos bariátricos.

Materiais

- Espuma de alta densidade Ultracell Bio Foam no assento
- Estrutura metálica

Mecanismos

- Ajuste da altura dos pés até 3’’/7,62cm.

- Rodízios traseiros com sistema “tilt and move" para que a cadeira possa ser convenientemente reposicionada sem elevação.
- Braços de transferência dobram-se facilitando a saída lateral, quando o gatilho é solto.
- Barra traseira para ajudar a mover a cadeira.
- Encosto de cabeça de profundidade ajustável
- Suporte lombar de profundidade ajustável

Certificações

- *Greenguard*

Opções

- Pés ajustáveis em altura em todos os modelos (excepto modelos Bariatric e ottoman).
- Modelos disponíveis com costas flexíveis ou fixas.

E) Warren Sled Base Chair

KI Furniture & Wall Systems

Informação Comercial

- Marca KI Furniture & Wall Systems
- Linha Patient Chair
- Modelo Warren Sled Base Chair

Informação Dimensional

- n/a

Uso

- A estrutura do assento permite um balanço que vai facilitar o acto de levantar e sentar do utilizador

Materiais

- Estrutura metálica
- Malha que permite a ventilação do tecido e um contacto com a pele reduzindo a fricção

Mecanismos

- Permite um movimento de balanço, mesmo com o seu apoio base plano.
- Barra traseira para facilitar movimentar a cadeira
- Rodízios traseiros
- Cobertura amovível para facilitar substituição e limpeza
- A curvatura das costas permite um maior apoio lombar

Certificações

- n/a

Opções

- Diversidade de estofos e coberturas

F) Solis Patient Chair

Krug

Solis foi criado para abordar os critérios complexos citados por pacientes e funcionários de cuidado para fornecer serviços de saúde.

Informação Comercial

- Marca Krug
- Linha Patient Chair
- Modelo Solis Patient

Informação Dimensional

- Total de 4 tamanhos 21”, 24”, 30” e 44”

Uso

- Permite a substituição de componentes
- Costas e pernas traseiras com dimensões que permitem a utilização sem danificar as paredes
- Encosto de cabeça amovível
- Facilidade de limpeza dos componentes

Materiais

- Acabamento Microban (inibe germes, micróbios e bactérias)
- Espuma de alta densidade
- Estrutura metálica

Mecanismos

- Coberturas amovíveis do assento e encosto
- Costas flexíveis
- Guarda/Cobertura por baixo do assento que promove a ventilação do assento e a sua limpeza.

Certificações

- *Greenguard*
- *LEED* specifications

Opções

- Braços e moldura lateral em madeira
- Encosto de cabeça amovível

G) Trace patient chair

by Wieland

Informação Comercial

- Marca Wieland
- Linha Patient Chair
- Modelo Trace

Informação Dimensional

- Tamanhos de 20'' e 30''

Uso

- Estrutura não permite o ajuste de altura nem reclinação
- Sem rodízios
- Curvatura de Costas para adicionar conforto

Materiais

- Estrutura metálica
- Moldura em madeira (braço, base do assento e costas)
- Estofos em tecido

Mecanismos

- Estrutura com curvatura protectora de paredes

Certificações

- n/a

Opções

- Variedade de padrões para o estofo

H) Embody Chair

Weber and Stumpf's/Herman Miller

Suportada por uma matriz dinâmica de pixels que cria uma superfície no assento e encosto que automaticamente se adapta a todos os movimentos e distribuem o peso uniformemente. Ajustando a sua forma e reduzindo a pressão na posição sentada, a cadeira aumenta a circulação sanguínea, melhora o fluxo de oxigénio e diminui a frequência cardíaca.

A cadeira Embody adapta-se automaticamente à grande variação de tamanhos, formas, posturas e curvas da coluna de pessoas diferentes. A profundidade do assento ajusta-se a diferentes comprimentos da coxa e os movimentos do apoio de braços adequam-se às mais amplas extensões.

Informação Comercial

- Marca Weber and Stumpf's/Herman Miller
- Linha Patient Chair
- Modelo Embody Chair

Informação Dimensional

- H: 42–45 in.

- W: 29.5 in.
- D: 15–18 in.

Uso

- Movimento multidireccional
- Assento com tecnologia responsiva de costas para promover a postura correcta
- Adaptação aos vários tamanhos do utilizador
- Costas com apoio de pontos articulados
- Utilização para longos períodos de tempo
- Adaptação e apoio contínuo ao longo do dia e nas diferentes posições
- Estabilização pélvica
- Garantia de 12 anos

Materiais

- Estrutura e moldura metálica
- Estofo em tecido

Mecanismos

- Tecnologia responsiva de costas
- Controlos reguladores de posição
- Quatro rodízios multidireccionais
- Costas da cadeira com apoios semelhantes à coluna cervical e costelas humanas
- Superfície dinâmica baseada em apoios
- Várias camadas permitem uma ventilação adequada

Certificações

- *MBDC Cradle to Cradle Silver certified*
- *GREENGUARD® certified*
- *Level™ 3 certified*

Opções

- Diversidade de molduras e estofos

I) Setu chair

Herman Miller

A Setu tem um duo único de coluna vertebral flexível que permite que a cadeira se mova com o utilizador. Ao sentar-se na cadeira esta ajusta-se às costas do utilizador e reclina com ele. O único ajuste que irá encontrar é a altura do assento.

Informação Comercial

- Marca Herman Miller
- Linha Lounge
- Modelo Setu chair

Informação Dimensional

- H: 41.375 in.
- W: 27.375 in.
- D: 16.875 in

Uso

- 12 anos de Garantia
- Permite ajuste da altura do assento

Materiais

- 92% material reciclável
- 51% material reciclado
- Tecido elastómero
- Não contém PVC

Mecanismos

- Sistema de coluna cinemática que acompanha todos os movimentos, sem componentes articulados
- Tecido permite elasticidade de material e ajuste ao corpo do utilizador

Certificações

- *MBDC Cradle-to-CradleSM Silver*
- *GREENGUARD®*
- *Level™ 2 certified*

Opções

- Rodízios ou pés fixos

J) SAYL

Yves Béhar/Herman Miller

O suporte das costas é moldado directamente no material *3D Intelligent*. O material de suspensão é esticado da torre-Y na parte de trás da cadeira, assim como cabos que se estendem numa ponte suspensa.

A tensão é maior nas zonas de transição, a partir do tórax, para as áreas lombares e entre a região lombar e sacro. Os "pontos articulados" permitem que que essas áreas possam flectir e apoiar uma rotação posterior saudável do pélvis. Ao mesmo tempo, menos tensões noutras partes das costas estimulam uma gama completa do movimento sentado.

Informação Comercial

- Marca Yves Béhar/Herman Miller

- Linha Work chair
- Modelo SAYL

Informação Dimensional

- H: 34.25-38.75 in.
- W: 24.5 in.
- D: 24.5 in

Uso

- Pontos articulados permitem flectir e apoiar uma rotação posterior saudável do pélvis
- As costas com pontos de suspensão permitem movimentos livres e com o apoio apropriado

Materiais

- *Material 3D Intelligent.*
- 93% Material reciclável
- Tecido elastómero
- Não contém PVC

Mecanismos

- Suporte de costas com pontos articulados idênticos aos de uma ponte
- Rodízios
- Altura regulável

Certificações

- *MBDC Cradle-to-CradleSM Silver*
- *GREENGUARD®*
- *Level™ 3 certified*

Opções

- n/a

K) Verte chair

RFM

Como um verdadeiro aparelho ortopédico, a sua adaptabilidade infinita e, sistema de suporte de vértebras flexível ajuda a aliviar a dor e melhora a postura, realmente ensinando a coluna a relaxar enquanto o utilizador se encontra na posição sentado.

Informação Comercial

- Marca RFM
- Linha Serie 2200
- Modelo Verte chair

Informação Dimensional

- Assento - largura 21”
- Assento - profundidade 19 1/2”
- Costas - largura 19 1/2”
- Costas - altura 22 1/2” - 30”

Uso

- Capacidade máx. de peso de 158,75kg/350lbs
- Permite regular a posição através de uma avalanca

Materiais

- Cobertura dos assentos e costas em pele ou tecido
- Assento com duas densidades de espuma

Mecanismos

- Sistema de suporte dual de vertebras flexível

- Alavanca para regular posição e altura

Certificações

- *MAS Green Certified*

Opções

- Variedade de coberturas em tecido e pele

Em modo de síntese, para o *benchmarking*, pesquisa de soluções comerciais existentes no mercado, foram tidas em consideração os exemplos que se apresentaram anteriormente.

As conclusões porém tiram-se de uma alargada pesquisa que procura sumarizar as especificações de produto encontradas e que se procuram transportar para o produto em desenvolvimento. Terão de ser vistas como sugestões sintéticas de um conjunto de práticas observadas, servindo como guia para o trabalho desenvolvido.

Relativamente aos materiais e às dimensões utilizadas há que referir que se encontram uma vasta gama de coberturas para estofos disponíveis na grande parte das marcas de cadeiras.

As dimensões da altura de assentos variam entre os 43,2cm (17'') e os 112cm (44'') e o peso max. situam-se entre os 160kg e os 340kg.

A inclinação do encosto varia entre os 24 graus (traseira) e os 3 graus (frontal).

Entre os materiais mais frequentemente utilizados encontram-se o poliuretano, o poliéster, espumas de alta densidade, estruturas metálicas, tecidos elastómeros, gel e a preocupação em incorporar a parte significativa de material reciclado ou reciclável na produção da cadeira.

Quantos aos sistemas integrados na cadeira apresentam-se:

- ✓ Sistemas de inclinação/reclinação
- ✓ Sistemas de pontos articulados
- ✓ Sistema de amortecimento flexível (promove o movimento confortável e postura correctas ao longo do tempo de utilização da cadeira)

- ✓ Sistemas de ímans integrados
- ✓ Sistema de rodízios accionados com reclinação da cadeira
- ✓ Sistema de cobertura que permitem a circulação do ar

Os controlos de movimento dizem respeito essencialmente à reclinação, altura do assento e aos braços de transferência. Estes últimos facilitam a saída lateral do utilizador da cadeira. Os manípulos pretendem-se acessíveis tanto ao utilizador como ao cuidador

Os componentes amovíveis permitem uma maior facilidade de limpeza assim como a manutenção e substituição de peças da cadeira sempre que necessário.

Existem elementos opcionais como, a barra traseira da cadeira que facilita a sua movimentação, o encosto de cabeça ajustável e amovível, braços e moldura em madeira, modelos com e sem costas fixas, braços fixos ou rodízios, e uma variedade de coberturas e estofos para o assento e costas.

Na geometria da cadeira, as costas têm uma curvatura para o suporte lombar que permite um apoio constante e correcto da coluna. É também tido em consideração a eventual aproximação da cadeira a uma parede sem a danificar, através dos pés da cadeira que promovem esse afastamento.

3.2.1.2. Pesquisa de Patentes

Para o desenvolvimento do produto objectivo de recolher informação sobre cadeiras ergonómicas patenteadas. A informação recolhida teve em conta vários aspectos que poderão ser aplicados ao longo do desenvolvimento e concepção do produto, tanto em termos de funcionalidades do mesmo, bem como outros aspectos como ergonomia e design.

"*Patient chair*", Patente nº US D654713 S1

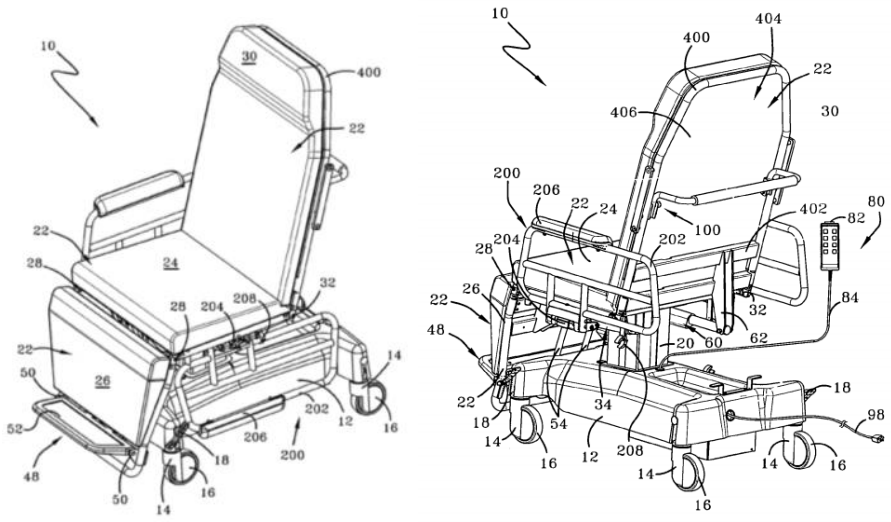
A cadeira "*Patient chair*" tem a possibilidade de rodar em torno de si, além de possuir na sua base rodas traseiras para uma fácil deslocação. O assento regulável, o apoio de braços e cabeça, além do design da cadeira, possibilitam ao utilizador uma postura confortável e adequada [23].

Patente 1 - Vista em perspectiva e vista lateral da cadeira "Patient Chair".

A empresa PearsonLloyd Design Ltd comercializa o produto patenteado. A cadeira foi concebida para dar o máximo de conforto ao utilizador e compreende um número mínimo de juntas para facilitar a limpeza. O assento é revestido por um gel que permite uma diminuição da pressão [25].

"Multi-purpose patient chair", Patente nº US 7069608 B2

A cadeira para uso em ambiente hospitalar, fornece um encosto e um apoio de pernas regulados através de um controlo remoto, permitindo que a sua configuração varie entre a estrutura de uma cadeira e a estrutura de uma maca. Além disso, acoplada cadeira existe uma plataforma para colocar os pés paralelos à secção do assento, consoante a posição do apoio de pernas. É também de salientar, a existência de apoio de braços e rodas para a deslocação da cadeira [19]

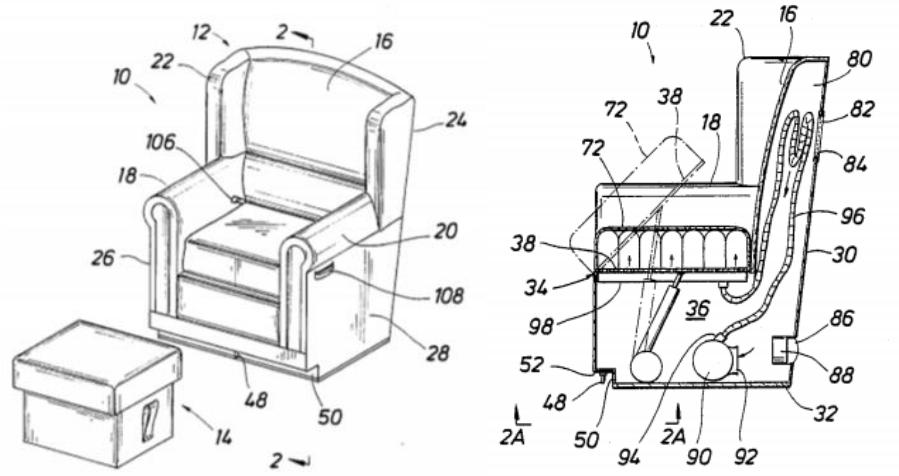


Patente 2 - Vista em perspectiva e vista posterior da cadeira "Multi-purpose patient chair".

O produto patenteado é comercializado pela empresa TransMotion Medical. O equipamento pode ser convertido de cadeira a maca, com encosto, apoio de pernas e altura reguláveis através de um comando. Tendo em conta todo o mecanismo do equipamento, este pode ser utilizado como cadeira, maca, dispositivo de transporte e mesa de procedimento [25].

"Patient chair system", Patente nº US 4729598 A

A cadeira para utilizadores de instituições de saúde e residências de idosos, compreende um encosto, um apoio de braços e um apoio de cabeça. Uma estrutura de suporte na zona do assento permite a elevação do utilizador de uma posição sentada para uma posição inclinada, facilitando o levantamento do utilizador para uma posição de pé. O assento é também composto por bolsas de ar que permitem filtrar e arrefecer o ar disponibilizando um fluxo de ar suficiente para a inflação das bolsas [21].



Patente 3 - Vista em perspectiva e vista lateral da cadeira "Patient chair system"

"Patient's chair", Patente nº US D311509 S

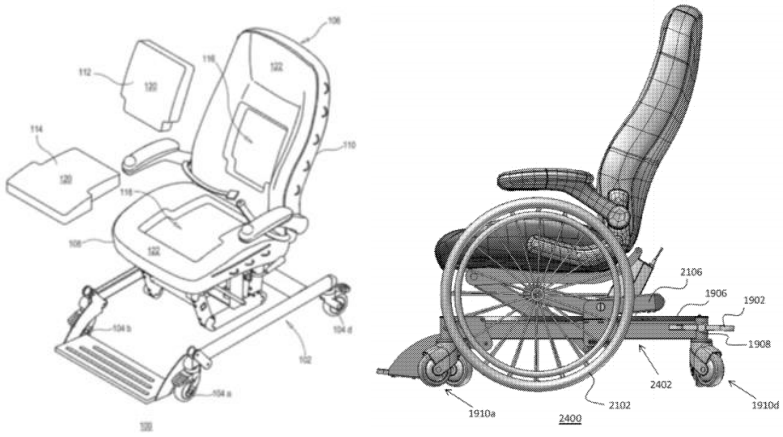
A cadeira "Patient's chair" é constituída por um encosto regulável, assim como o apoio de pernas. A altura do assento também pode ser ajustada para uma posição sentada mais adequada para o utilizador. O apoio de braços e a plataforma para os pés permitem um maior conforto e ergonomia. Por outro lado, para facilitar o transporte a base é constituída por rodas [18].

Patente 4 - Vista em perspectiva e vista lateral da cadeira "Patient's chair".

Esta versátil cadeira que facilmente é regulada de uma posição sentada para uma posição deitada, simplifica o trabalho durante o tratamento do utilizador. O produto é comercializado pela empresa Hausted [20].

"Mobile rocking patient chair and method of use", Patente nº US 20120292877 A1

A patente consiste numa cadeira móvel com quatro rodas na base e duas rodas laterais para a sua movimentação. Para a remoção das rodas laterais, a cadeira possui uma alavanca de cada lado. A altura e o encosto reguláveis permitem uma posição mais correcta por parte do utilizador. Para além disso, o apoio de braços e a plataforma para os pés também estão integradas neste equipamento. Outras funcionalidades como suportes laterais e um tabuleiro estão acoplados nesta cadeira móvel [22].



Patente 5 - Vista em perspectiva e vista lateral da cadeira "Mobile rocking patient chair and method of use".

3.2.1.3. Avaliação preliminar de tecnologias, materiais e processos para produto integrado

Esta fase foi desenvolvida em paralelo pelos restantes parceiros de projecto.

"Efectuou-se um estudo acerca das tecnologias que permitam a produção do produto respeitando os diversos parâmetros impostos (geométricos, modularidade, ergonomia, design, resistência mecânica, assépticos e de produção). Foram consideradas as tecnologias de sobremoldação, RIM, decoração no molde e insert moulding.

Outro aspecto importante referenciado no relatório será a compatibilidade entre materiais. Foram abordados os requisitos necessários para que um material e/ou produto seja considerado asséptico, os meios de propagação de microrganismos e os respectivos métodos usados para desinfecção e esterilização dos plásticos. Foi feito o levantamento de alguns dos testes que se devem realizar para caracterizar os materiais em termos de resistência química e térmica, características essenciais para os materiais assépticos."

3.2.1.4. Requisitos legais e normativos de ergonomia

A Patient Chair ao ser uma cadeira idealizada para utilizadores de instituições de saúde em geral e utilizadores residenciais, pretende responder a determinados requisitos impostos por normas e regulamentação, relativos às áreas da saúde e bem-estar.

Este encontra-se num limiar entre duas áreas altamente regulamentadas, nomeadamente os espaços ligados à saúde e bem-estar e os dispositivos médicos. No entanto a regulamentação relativa a este tipo de espaços não inclui normalmente disposições precisas relativamente a mobiliário.

O mobiliário de assento é objeto de normalização fortemente estruturada em termos internacionais e tendo em conta os mercados alvo definidos no projecto, será importante adequar o produto aos requisitos normativos em vigor nesses espaços territoriais.

No espaço Europeu existem normas EN, das quais deverão ser seleccionadas as que dizem respeito aos assentos para uso não-doméstico (EN…). No entanto e tendo em conta a possível utilização doméstica deverão ser tomadas em conta as normas para os assentos domésticos (EN…). O que se verifica no entanto é que as normas para uso não-doméstico são mais exigentes dos que as de uso doméstico o que não impede o cumprimento dos testes que não sejam comuns.

Em relação aos Estados Unidos existe normativa concebida em parceria pela AmericanNational Standards Institute (ANSI) e pela Business and Institutional Furniture Manufacturers Association (BIFMA), a associação do sector do mobiliário para o mobiliário não-doméstico. A BIFMA refere no seu site a normativa relativa ao mobiliário para o sector do Healthcare.

Existem diversas normas, no entanto apenas algumas são aplicáveis no produto em questão.

Seguidamente estão identificadas algumas das normas aplicáveis.

- ✓ ANSI/BIFMA e3-2011e Furniture Sustainability
- ✓ ANSI/BIFMA x5.1-2011
- ✓ ANSI/BIFMA X5.4-2012
- ✓ ANSI/BIFMA M7.1-2011
- ✓ FED - STD 834A
- ✓ ISO 7250-1:2008
- ✓ EN 1022-2005
- ✓ EN 1728-2012
- ✓ EN 1520-2010
- ✓ EN 15373-2007
- ✓ EN 13761-2002
- ✓ NF BS EN 1021-1
- ✓ NF EN 1021-2
- ✓ BS 7176
- ✓ D2-2000 of the GPEM
- ✓ EN 12520:2010

Um dos muitos requisitos avaliados refere-se ao correto dimensionamento da cadeira, de acordo com as medidas antropométricas tabeladas.

Nenhuma cadeira é adequada para todos os tipos de corpo. A cadeira perfeita para um programador informático pode ser ineficaz e até mesmo prejudicial se usado por longos períodos de tempo por um dentista.

A cadeira deve proporcionar conforto na posição anatómica sentada e ser ergonómica e ajustável ao seu corpo. Na posição anatómica sentada o centro da gravidade do corpo humano encontra-se na proximidade da segunda vértebra sacra. Esta localização varia de acordo com a constituição anatómica e a posição que o corpo adota.

A cadeira para ser a mais indicada, ergonomicamente, deve ter em consideração os seguintes requisitos:

i. Tolerância de peso corporal
ii. Assento
    a. Altura do assento
    b. Profundidade do assento
    c. Largura do assento
    d. Ângulo do assento
iii. Encosto
    a. Altura do encosto e largura
    b. Ajuste de altura do encosto
    c. Ângulo de inclinação do encosto
iv. Apoio de braço
    a. Altura do apoio de braço
    b. Comprimento do apoio de braço
    c. Distância entre apoios de braços
v. Controlos de ajuste
vi. Base
vii. Rodízios

i. Tolerância de peso corporal

A cadeira deve poder suportar um indivíduo com até 200 Kg, não afetando os mecanismos de reclinação, durabilidade e acima de tudo segurança da cadeira.

ii. Assento

a. Altura do assento

Na posição sentada a base de suporte, compreendida como a região onde o corpo se apoia, na posição sentada é dada pela superfície de contato com o assento.

O assento da cadeira deve apoiar as coxas de maneira uniforme, enquanto as pernas e joelhos descansam confortavelmente aquando o apoio dos pés no chão ou no apoio de pés.

A altura da zona frontal do assento deve ser igual ao comprimento da perna (altura poplítea). Se o indivíduo se sentar muito baixo as costas tendem a arquear, tornando até um bom encosto ineficaz. Para além disso, é gerada uma pressão sobre as nádegas e cóccix.

Se por outro lado se sentar muito alto, é produzida uma pressão atrás dos joelhos, que pode promover dormência ou inchaço nos pés (Medina, 2007).

b. Profundidade do assento

O indivíduo deve ser capaz de se conseguir sentar na cadeira, com as costas bem apoiadas pelo encosto, e com o apoio adequado das nádegas e coxas, sem a existência de pressões na parte posterior dos joelhos.

c. Largura do assento

O assento deve ser maior que os quadris do indivíduo, de modo a subsistir espaço para o movimento e para as roupas.

d. Ângulo do assento

A generalidade das pessoas prefere um assento inclinado para a frente para estar sentado na parte da frente, um assento quase horizontal para a posição sentada, e um assento reclinável para estar inclinado para trás.

A cadeira deve permitir o fácil ajuste da inclinação do assento em função da massa corporal do indivíduo, através de um sistema semelhante a uma cadeira de balanço. O facto de os indivíduos terem massas corporais diferentes faz com que alguns sistemas de inclinação ajustáveis existentes sejam muito duros para pessoas com baixa massa corporal e muito soltas para pessoas com massa corporal superior.

O ajuste do ângulo do assento não deve permitir um ângulo tronco-coxa inferior a 90º.

iii. Encosto

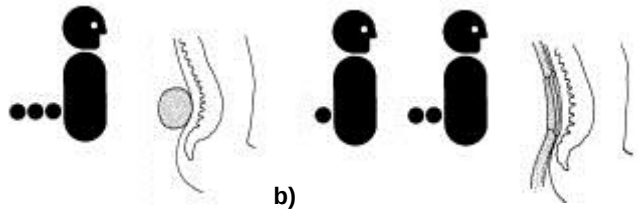
a. Altura do encosto e largura

Todos os encostos devem apoiar coluna lombar e permitir uma folga para as nádegas.

Encostos baixos (abaixo das omoplatas) e encostos estreitos (não maior do que a largura da cintura) são melhores para tarefas que exigem mobilidade superior do corpo, de modo a não interferir com o seu movimento do braço.

Encostos altos, que suportam os ombros são os mais indicados para cadeiras reclináveis. Neste caso, a zona inferior, isto é a zona lombar deve estar apoiada e a pressão deve ser inferior na parte superior das costas (Moraes, 2000).

O apoio lombar deve ser firme, sem pontos de pressão localizados.



a) **b)**

Figura 9 – Suporte para uma curva lombar: a) profunda e b) plana ou média.

b. Ajuste de altura do encosto

Os contornos do encosto devem coincidir com a colocação das curvas da coluna vertebral.

c. Ângulo de inclinação do encosto

O ângulo coxa-tronco, e, portanto o ângulo do encosto de uma cadeira inclinado para trás, afeta a postura da coluna vertebral. Numa cadeira, quanto menor for o ângulo de reclinação do encosto para trás, mais plana estará a coluna vertebral do indivíduo, independentemente da agressividade do apoio lombar.

A curva lombar forma um arco consoante a abertura do ângulo coxa-tronco. Com o levantar dos braços a curva lombar é maior, enquanto se o indivíduo se sentar num banco

baixo, o ângulo coxa-tronco fecha, formando uma curva lombar direcionada para a frente (Figura 7).

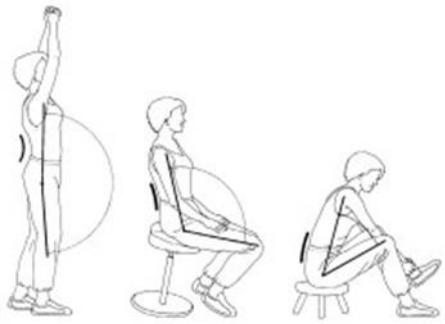


Figura 10 – Ângulos coxa-tronco.

iv. Apoio de braço

a. Altura do apoio de braço

Os membros superiores devem estar paralelos ao tronco. O indivíduo deve ser capaz de suportar, confortavelmente, os antebraços e/ou cotovelos no apoio de braço, sem curvar os ombros (apoio de braço muito alto), inclinar-se para o lado a fim de alcançar o apoio de braço (apoio de braço demasiado grande) ou cair bruscamente (apoio de braço demasiado baixo). Os apoios de braços devem ter a altura dos braços aquando estes perfazem um ângulo de 90º com os antebraços (Figura 8).

Figura 11 – Ângulo do apoio de braços.

Os apoios de braço podem reduzir a fadiga no pescoço e costas, facilitar os movimentos corporais quando o indivíduo está sentado, e simplificar as cargas aplicadas nas pernas aquando do movimento de sentar e levantar da cadeira.

b. Comprimento do apoio de braço

Os apoios de braço devem permitir apoiar os antebraços, na sua totalidade, assim como os cotovelos, mantendo o contacto da lombar com o encosto.

c. Distância entre apoios de braços

Apoios de braços colocados corretamente aliviam a tensão no pescoço e nas costas e auxiliam no sentar e levantar da cadeira. A distância entre apoios de braços é muito relevante pois, os apoios muito juntos podem interferir no movimento do braço, já os apoios muito afastados não são úteis para o descanso ou apoio dos braços e originam o posicionamento dos mesmos de modo incorreto. Indivíduos com ombros estreitos que se sentam num assento largo estão a comprometer a sua postura, uma vez que a largura do assento geralmente afeta a largura dos apoios de braços.

A distância entre os apoios de braços deve permitir o entrar e sair da cadeira facilmente, assim como a passagem dos quadris dos indivíduos confortavelmente, sem qualquer impedimento (Medina, 2007 & Moraes, 2000).

v. Controlos de ajuste

Os controlos de ajuste devem ser de fácil acesso a partir de uma posição sentada, especialmente, os controlos de inclinação do assento e do encosto.

vi. Base

A base é um dos parâmetros mais importantes da cadeira, pois é esta que vai proporcionar a estabilidade da mesma. Bases de maiores diâmetros proporcionam maior estabilidade, sendo ainda mais importante uma base larga em cadeiras com elevado ângulo de inclinação.

vii. Rodízios

Os rodízios são especialmente úteis para movimentar a cadeira, portanto é necessário que estas deslizem na perfeição e acima de tudo que suportem o peso do indivíduo, caso a intenção seja movimentar a mesma com utilizador.

A existência de diferenças de alturas, variações anatómicas em comprimentos de braço individuais e proporções do corpo entre indivíduos incita a necessidade de conceção de uma cadeira que permita o ajuste de diversos parâmetros, a fim de alcançar uma boa postura do indivíduo na posição sentada, com ou sem inclinação.

Apesar de ser possível regular os parâmetros relacionados com o assento, o encosto e os apoios de braços, estes apenas devem possibilitar o seu ajuste até uma determinada percentagem, dentro das escalas antropométricas, isto é, de acordo com os percentis existentes.

Percentis

O percentil é uma categoria de percentagem que indica qual a medida das tabelas antropométricas que deve ser utilizada por relação a um grupo humano que esteja na média, acima ou abaixo duma média. Exemplifique-se com a altura das pessoas, respetivamente, o 50º percentil diz respeito à média, o 95º percentil respeita aos 5% de pessoas mais altas, o 5º percentil responde aos 5% de pessoas mais baixas.

Em cada grupo existe um conjunto de indivíduos que muito embora tenham características em comum, apresentam antropometrias distintas. Assim, para um dado indicador antropométrico é possível traçar a sua distribuição em frequência e determinar o valor para o qual existe uma maior incidência de indivíduos. Por norma, esse valor aproxima-se muito do valor médio do indicador em estudo e designa-se por percentil 50, onde 50% da população desse grupo tem dimensões inferiores ou iguais às descritas por esse percentil (Figura 9) (Bornmann, 2013).

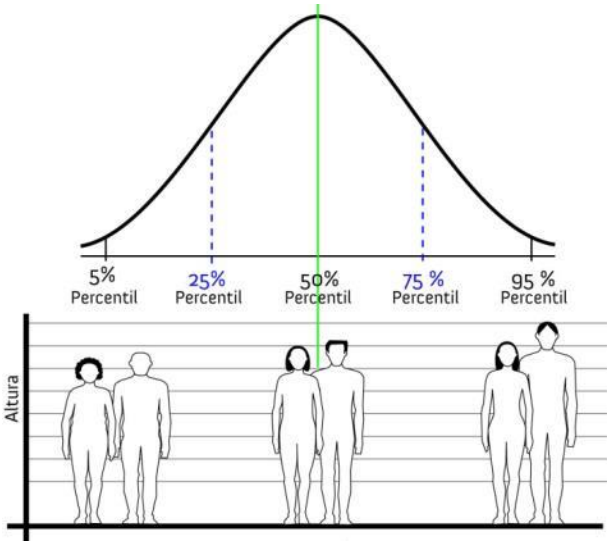


Figura 12 – Percentis.

Dependendo do tipo de população alvo, ou seja, consoante os mercados alvo definidos, neste caso EUA e alguns países Europeus, existem diferentes normas e

regulamentos a respeitar. No que respeita às medidas antropométricas, existem diferentes bases de dados com tabelas de medidas que devem ser consideradas na criação do produto. Numerosas organizações, em todo o mundo, conduzem inquéritos antropométricos rotineiros, de populações diferentes (por exemplo, militares, civis, etc.) e organizam a informação em bases de dados. Nas pesquisas que visam representar fielmente a constituição dessas populações (referidas como "populações de referência"), os indivíduos são avaliados de acordo com variáveis demográficas, como idade, sexo, raça, etnia, etc. A informação antropométrica e demográfica detalhada e a elevada quantidade de informação nas bases de dados faz com que estas sejam ferramentas valiosas.

Relativamente à população dos EUA as duas bases frequentemente utilizadas são a ANSUR e a NHANES.

A ANSUR corresponde a uma base de dados criada a partir do levantamento de dados antropométricos de soldados do exército dos EUA de 1988. Esta é amplamente utilizada devido ao grande número de dados que este contém e às técnicas usadas na criação da mesma (The Open Design Lab. 2013a).

Nas figuras 10-14 estão representadas as medidas antropométricas, desta base de dados, mais importantes a considerar na posição sentada para o Homem e para a Mulher.

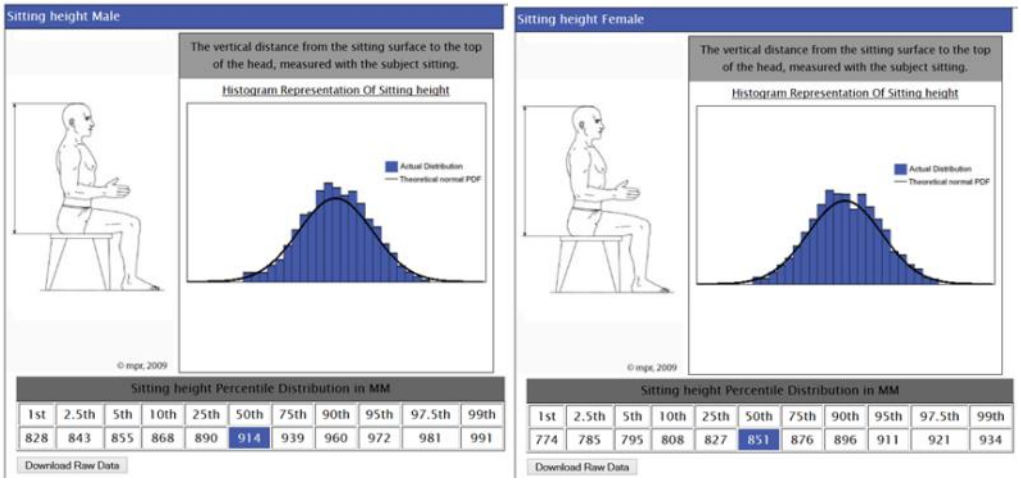


Figura 13 – Medidas antropométricas da distância vertical entre o assento até à parte superior da cabeça, na posição sentada, para o Homem e para a Mulher.

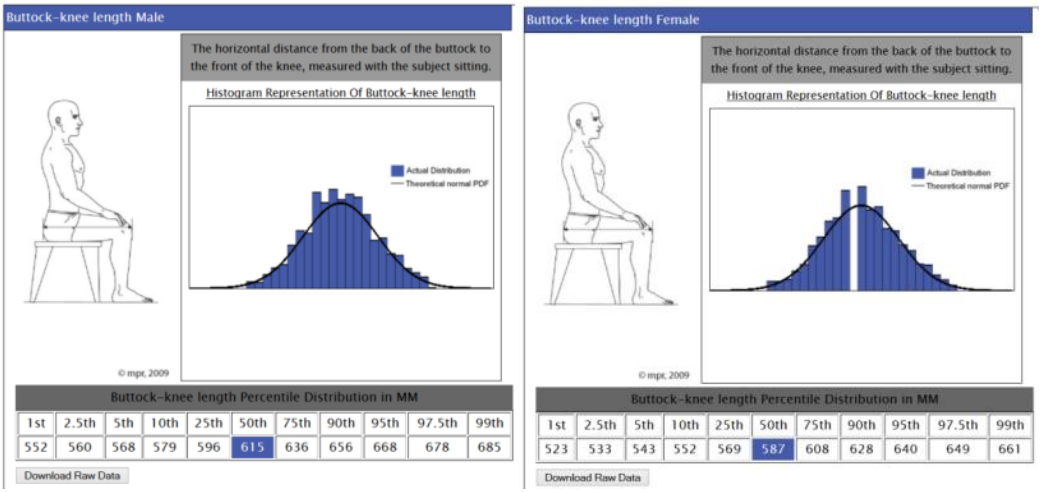


Figura 14 – Medidas antropométricas da distância horizontal da parte posterior das nádegas até à parte anterior do joelho, na posição sentada, para o Homem e para a Mulher.

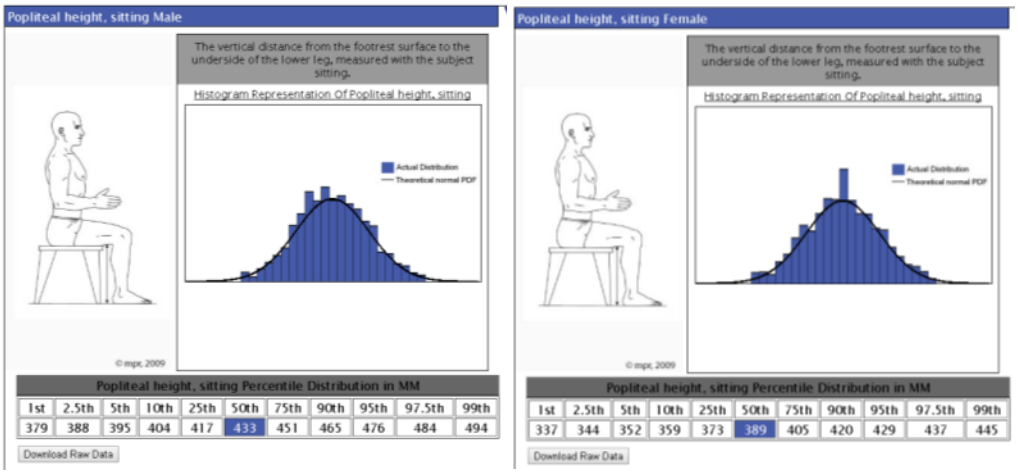


Figura 15 – Medidas antropométricas da altura popliteal, na posição sentada, para o Homem e para a Mulher.

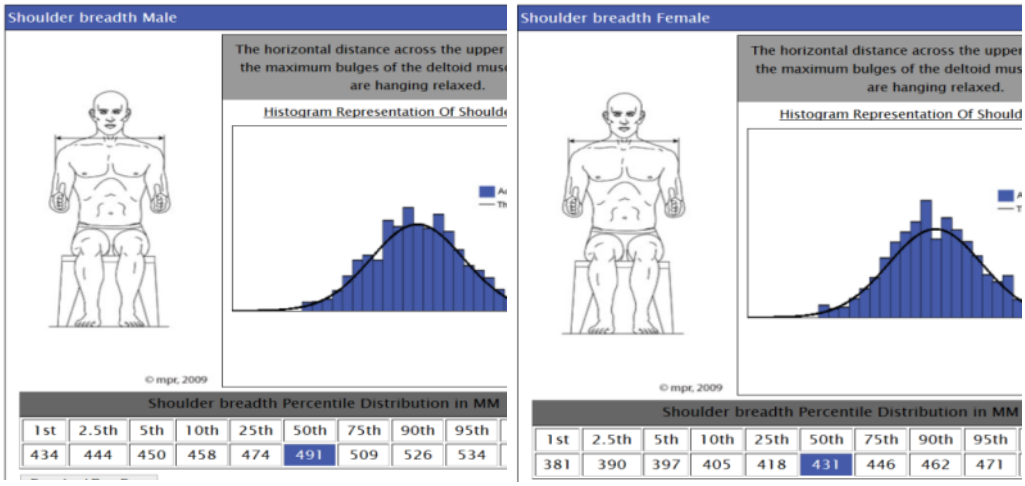


Figura 16 – Medidas antropométricas da largura dos ombros, na posição sentada, para o Homem e para a Mulher.

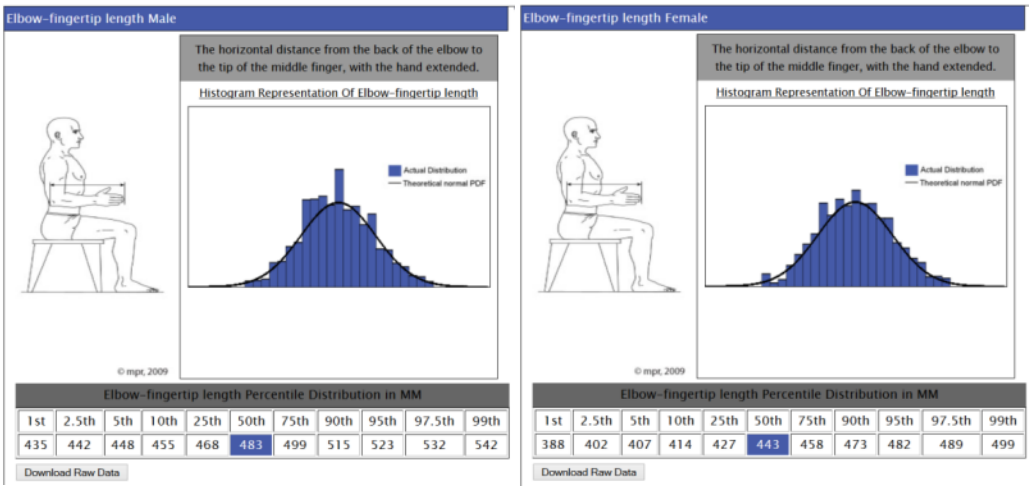


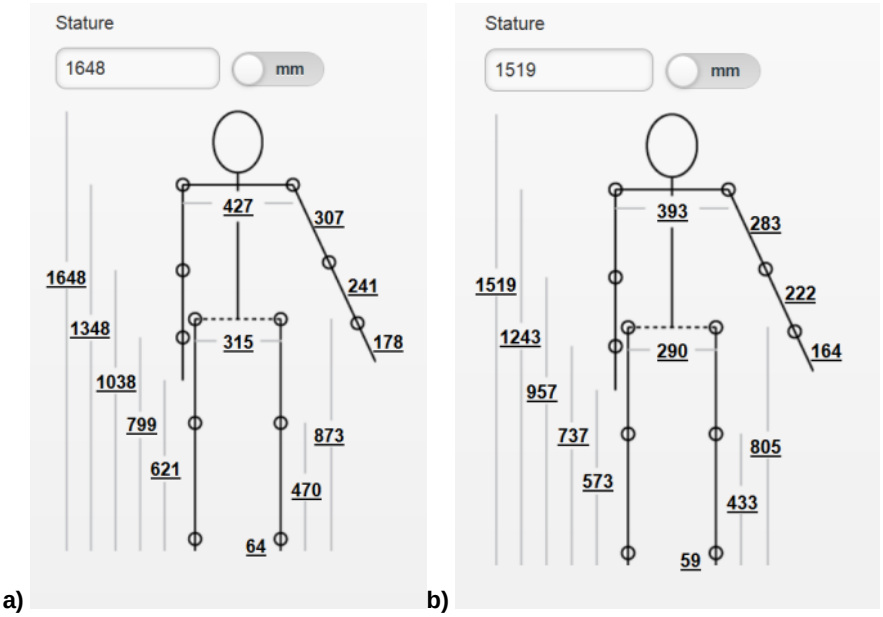
Figura 17 – Medidas antropométricas da distância horizontal entre a parte posterior do cotovelo até a ponta do dedo médio, na posição sentada, para o Homem e para a Mulher.

Quanto à NHANES, o foco dos três National Health Examination Surveys (NHES) foi a população civil do Estados Unidos da América de 1959-1970. A NHES sucedeu em 1971 pelo National Health and Nutrition Examination Survey (NHANES) executado pelos Centros para o Controlo e Prevenção de Doenças (CDC). NHANES I, II, e III foram compilados nos anos 1971-1975, 1976-1980 e 1988-1994, respetivamente. Mais tarde (1999-2006), bases de dados da NHANES foram compiladas a cada dois anos, a fim de evitar erros temporais em análises antropométricas (The Open Design Lab. 2013b).

Nas figuras 18-24 estão representadas os valores de massa, estatura, BMI e as medidas antropométricas, desta base de dados, do Homem e da Mulher para os percentis 5, 50 e 95.

Figura 18 – Valores de massa, estatura e BMI de 100% Homem para o percentil 5.

Figura 19 – Valores de massa, estatura e BMI de 100% Mulher para o percentil 5.



a) **b)**

Figura 20 – Medidas antropométricas para o percentil 5 para: a) Homem 100% e b) Mulher 100%.

Figura 21 – Valores de massa, estatura e BMI de 50% Homem/Mulher para o percentil 50.

Figura 22 – Valores de massa, estatura e BMI de 100% Homem para o percentil 95.

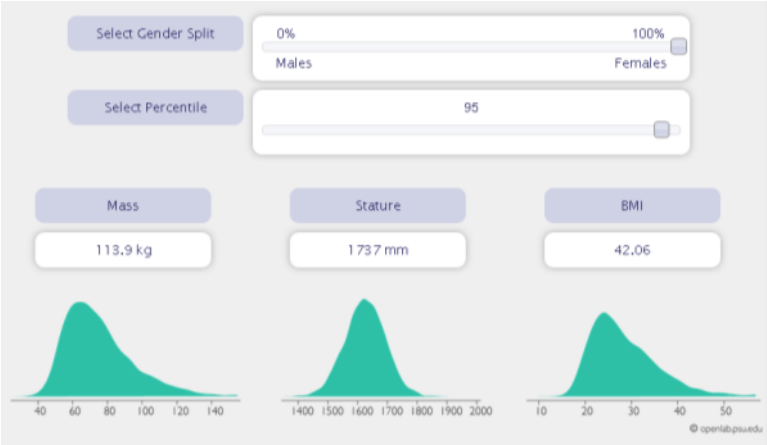
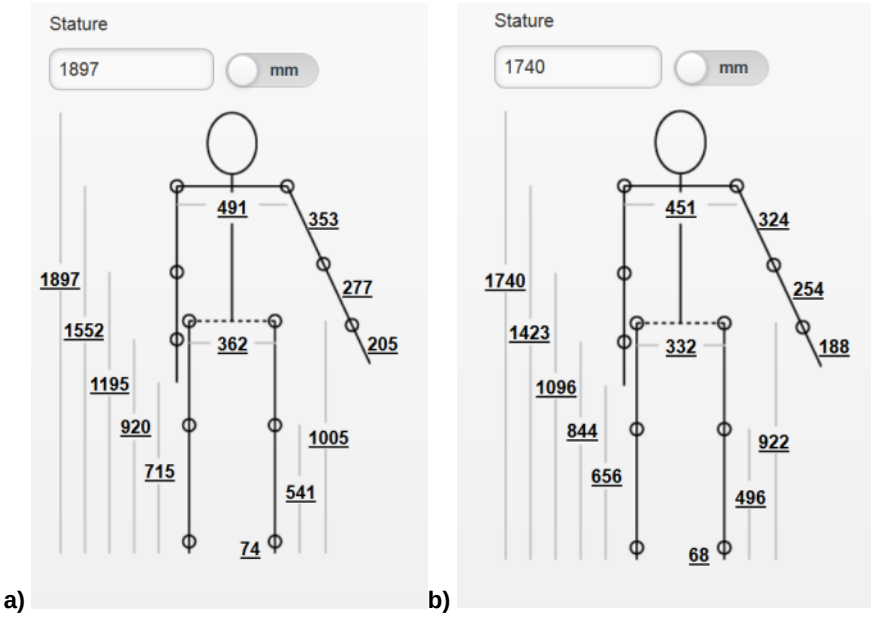


Figura 23 – Valores de massa, estatura e BMI de 100% Mulher para o percentil 95.



a) b)

Figura 24 – Medidas antropométricas para o percentil 95 para: a) Homem 100% e b) Mulher 100%.

3.2.1.5. Definição de Parâmetros

Com base na investigação realizada, a equipa de I&D definiu os parâmetros que o projecto deve ter em termos geométricos, de modularidade, de ergonomia, design, resistência mecânica, assépticos e de produção.

Funções e destinatários

A Patient Chair destina-se a utilizadores de instituições de saúde em geral e utilizadores residenciais que necessitem de apoio de cuidadores

É constituída por: costas, assento, apoio de braços e pés.

Deverá ter um sistema de reclinação das costas e assento.

Parâmetros de Trabalho

Costas

- ✓ Angulo de reclinação= 10°

Assento

- ✓ Reclinação para a frente =3° (para ajudar ao ângulo de saída da cadeira para o paciente)

Apoio de Braços

- ✓ Posição normal=0° (com o angulo do assento)
- ✓ Posição reclinada=90° (com o angulo do assento) para permitir saídas laterais dos utilizadores.

Pés

- ✓ Versão com 2 rodízios para apenas movimentar a cadeira de posição sem utilizadores
- ✓ Versão com 4 rodízios para movimentar a cadeira com utilizador (esta versão requer apoio de pés)

Massa a suportar pela cadeira

- ✓ MT=200Kg

Mecanismos de reclinação

- ✓ Costas – gas cylinder blockable ou movimento cinético do corpo
- ✓ Assento – manivela mecânica ou gas cylinder blockable.

Parâmetros Geométricos

Costas (axlxe)

- ✓ 800(acima do ponto médio do assento) x500xe (mínima para conforto de 8h)

Assento

- ✓ 500x500xe (mínima para conforto de 8h)
- ✓ Altura do chão à base do assento = 430 mm (pode-se adequar em função de dados antropométricos para a faixa de percentis abrangidos).

Pés

- ✓ Largura – em função de ser de transporte de pessoas (4 rodizios) ou apenas ter mobilidade para transporte da mesma, a largura dos pés tem que obdecer às medidas standard de larguras de portas (máx= 650mm).

Apoio de braço

- ✓ Comprimento até 425 mm do eixo de rotação do apoio de braço
- ✓ Altura =240 mm desde o plano superior do assento (parâmetro que pode ser variável em função do estudo ergonomia)
- ✓ Suportar uma carga não prevista

Parâmetros de modularidade

Costas

- ✓ Facilidade de montagem
- ✓ Ajuste da zona da nuca em função dos percentis abrangidos com a possibilidade de ser removível totalmente
- ✓ Zona de encosto de cabeça lateral.
- ✓ Possibilidade de incorporar componentes auxiliares tais como:
- ✓ Suporte para líquidos (tais como soro, etc)
- ✓ Suporte (pega) para movimentação de costas através de um utilizador auxiliar
- ✓ Suporte para iluminação.
- ✓ - Assento (base+assento)
- ✓ Facilidade de montagem e desmontagem para operações de limpeza
- ✓ Incorporação de mecanismos para as reclinações.
- ✓ Possibilidade de incorporar componentes auxiliar tais como:
- ✓ Suporte para bebidas
- ✓ Suporte para revistas ou livros
- ✓ Suporte para tablets e afins

Apoio de braços

- ✓ Facilidade de montagem
- ✓ Incorporação de dispositivos para a realização dos movimentos de reclinação das costas.
- ✓ Travamento físico nas posições dos braços.

- ✓ Incorporação de um tabuleiro (ou através da superfície do braço ou com auxilio de um componente

Pés

- ✓ Utilização de rodizios na parte traseira para movimentação em vazio da cadeira
- ✓ Possibilidade de utilização de 4 rodizios para tranporte dos utilizadores.

Parâmetros de Ergonomia

Parâmetros gerais

- ✓ Uso equitativo: o projeto deve atender a pessoas com diferentes habilidades.
- ✓ Flexibilidade no uso: o projeto atende a uma gama de indivíduos com diferentes preferências e habilidades.
- ✓ Baixo esforço físico: o projeto deve ser utilizado com eficiência, conforto e fadiga mínima.
- ✓ Tamanho e espaço adequado para acesso e uso: o projeto deve apresentar tamanho e espaços adequados para acesso, independentemente da antropometria, postura ou mobilidade do indivíduo.

Costas

- ✓ Mecanismo que vise o conforto (ausência de dor) para um período de utilização de 8h

Assento

- ✓ Mecanismo que vise o conforto (ausência de dor) para um período de utilização de 8h

Apoio de braços

- ✓ Mobilidade, estabilidade e conforto dos membros superiores.

Pés

- ✓ Facilitar a saída do utilizador assim como não obstruir tarefas do utilizador auxiliar.

Parâmetros de Design

Haver intercâmbio entre designers e ter em conta a linha Baucci (Figura 25)

Figura 25 - Linha Baucci

Parâmetros de Resistência Mecânica

Todos os componentes que incorporem a patient chair, terão que estar de acordo com as solicitações previstas nas normas europeias e americanas (ANSI/BIFMA) de testes a cadeiras.

Parâmetros Assépticos

É importante garantir materiais ou técnicas que permitam dotar o produto final com características que possam impedir que qualquer parte seja infectada permanentemente.

Os materiais devem ter resistência quando sujeitos a processos de desinfecção.

Parâmetros de produção

Facilidade em produzir o conjunto de componentes

Utilização de componentes standard quando for possível

3.2.1.6. Desenvolvimento Conceptual do Projecto

Após o estudo acerca da legislação, normas, estado de arte, e materiais, processos e tecnologias passíveis de serem utilizadas no desenvolvimento deste projeto, bem como da

definição dos parâmetros do projeto, iniciou-se a fase de desenvolvimento conceptual do projecto.

Após este desenvolvimento aferiram-se as possibilidades de realização destes conceitos em termos de materiais e processos tecnológicos. Posteriormente, os conceitos foram avaliados sendo escolhidas as soluções que melhor respondiam aos requisitos definidos para o produto.

A *Patient Chair* é uma cadeira destinada a utilizadores de instituições de saúde em geral e/ou residenciais que prestem cuidados de saúde a terceiros, como referido anteriormente. Tendo em conta o público-alvo desta cadeira foi determinado o conjunto de requisitos apresentados na Figura 26.

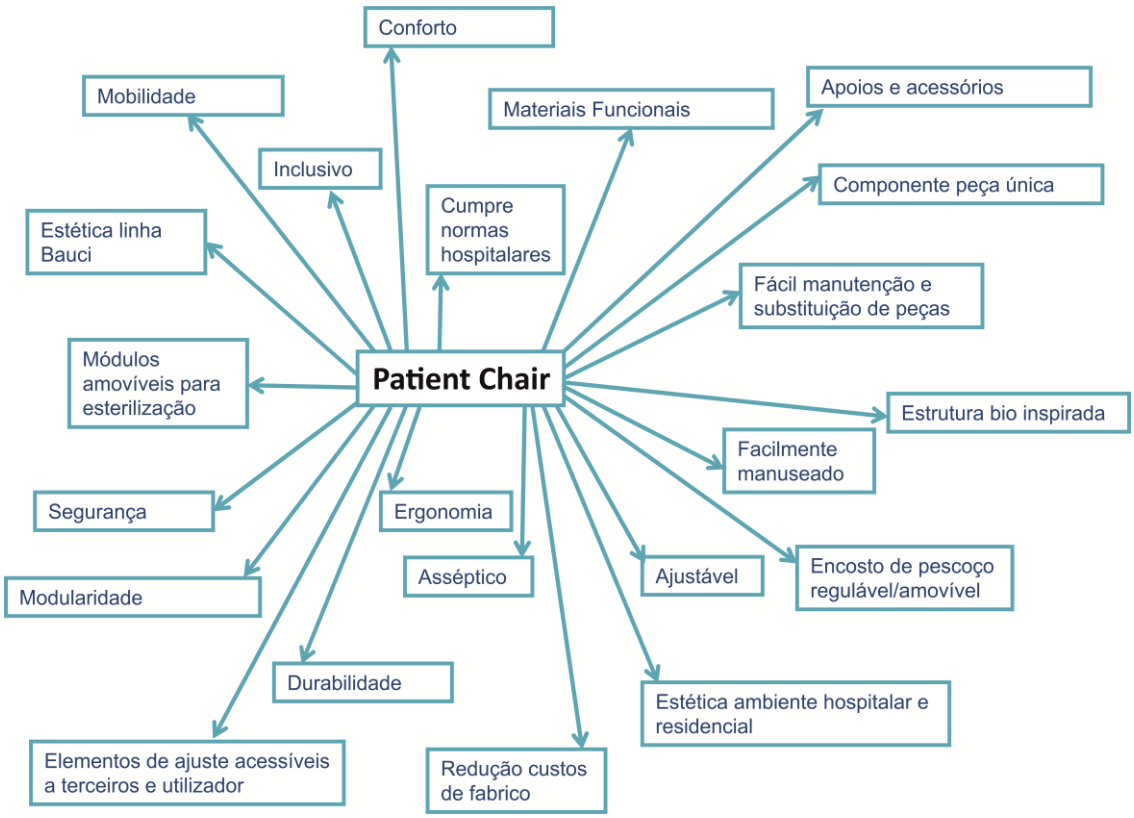


Figura 26 – Requisitos da Patient Chair.

Estes requisitos permitiram a elaboração de um conjunto de esboços iniciais, os quais foram avaliados segundo especificações tidas como as mais relevantes:

Conforto: O conforto é o requisito mais preponderante. Esta cadeira deve permitir ao utilizador uma sensação de bem-estar aquando da interação indivíduo/cadeira. Esta sensação de bem-estar pode ser alterada pelo tempo que o utilizador permanece na cadeira,

pelo não ajustamento da posição do indivíduo na cadeira, etc.. Todas estas sensações são variáveis de indivíduo para indivíduo e desencadeadas por reações fisiológicas.

Asséptico: O design, os materiais e as técnicas utilizadas na produção da cadeira são de extrema importância para o seu desenvolvimento uma vez que se pretende evitar a acumulação dos microrganismos na cadeira para que esta não seja infetada permanentemente. Em termos de design esta não deve conter muitos orifícios para que não possa haver acumulação de microrganismos nestes locais. Em termos de materiais estes devem ser lisos (sem muitas texturas) para impedir essa acumulação e devem, também, ser resistentes à temperatura e a químicos pois estes devem ser possíveis de desinfetar/esterilizar.

Ergonomia: Este é também um requisito de grande importância pois esta cadeira deve ser desenvolvida tendo em conta os dados antropométricos da população Portuguesa. Deve também ter em conta que os indivíduos possam ter diferentes capacidades, devendo a cadeira satisfazer uma elevada gama de indivíduos.

Modularidade: O facto de ser possível à cadeira ser constituída por módulos facilita a substituição de peças quando danificadas e também a sua montagem.

Fácil manutenção e substituição de peças: A cadeira deve ser de fácil manutenção e permitir uma fácil substituição de peças, devendo ser usados, para isso, componentes padrão sempre que possível.

Elementos de ajuste acessíveis a terceiros e utilizador: Os ajustes da cadeira devem ser de fácil alcance, por parte do utilizador, a partir da posição de sentado, devendo ser facilmente ajustáveis apenas com uma mão; estes ajustes devem também dar uma informação de retorno imediata. Além disso os ajustes necessários devem, também, ser de fácil execução por terceiros, em caso de incapacidade do utilizador.

No desenvolvimento conceptual foram também introduzidos alguns elementos de inspiração biológica, de adaptação ou derivação da natureza.

Figura 27 – Flor de lótus, Tecido bio inspirado

Investigadores inspiraram-se na capacidade de auto limpeza da flor de lótus para desenvolver um material têxtil que nunca fica molhado [16].

Os filamentos estão dispostos numa estrutura cheia de pontas que evita que as gotas de água cheguem até as fibras de poliéster.

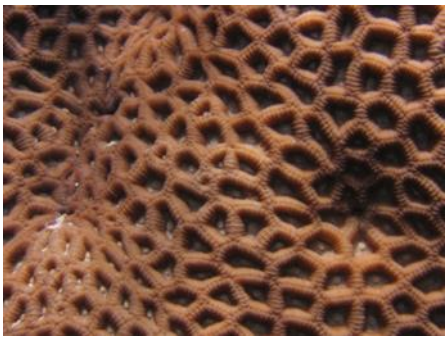


Figura 28 – Coral

A investigação de soluções orgânicas e estruturais aplicadas pela natureza aos seus elementos, como o processo de formação dos corais, permite colher dados para a solução de problemas técnicos de formas, estruturas ou objectos.

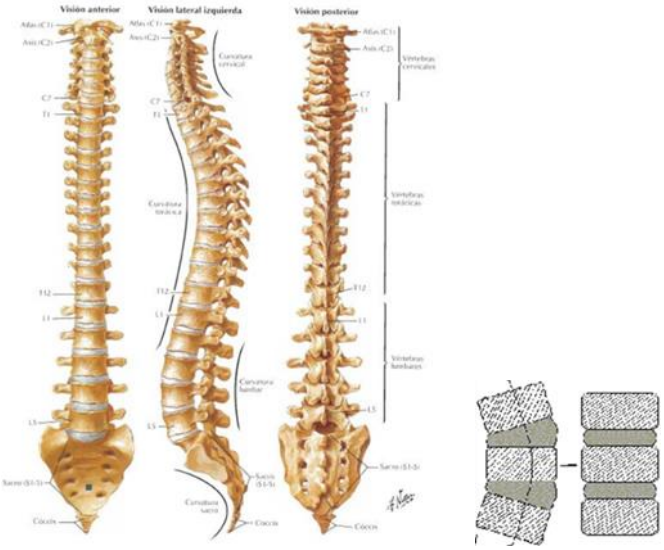


Figura 29 – Coluna vertebral e discos intervertebrais

A coluna vertebral humana, sujeita a condições de carga extremas, é um exemplo no que diz respeito a força, flexibilidade e distribuição equilibrada do peso.

Disco intervertebral é um disco de fibrocartilaginoso presente entre os corpos das vértebras, que se articulam umas com as outras de modo a conferir rigidez e flexibilidade à coluna. É descrito como um sistema hidráulico complexo que absorve choques, permite uma compressão transitórias e, devido ao deslocamento do líquido dentro do continente elástico, permite o movimento.

Foram desenvolvidos alguns desenhos bio inspirados que permitissem enriquecer esta fase conceptual, baseada no conhecimento empírico de algumas soluções já existentes na natureza.

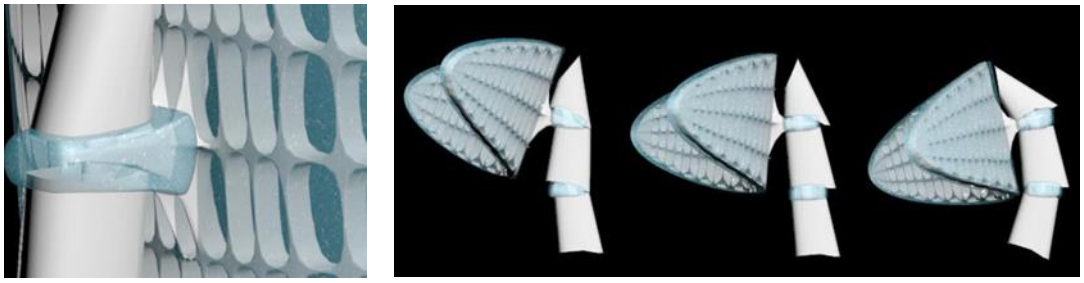


Figura 30 – Elemento modular amovível para esterilização em estrutura inspirada nos discos intervertebrais e nas costelas humanas.

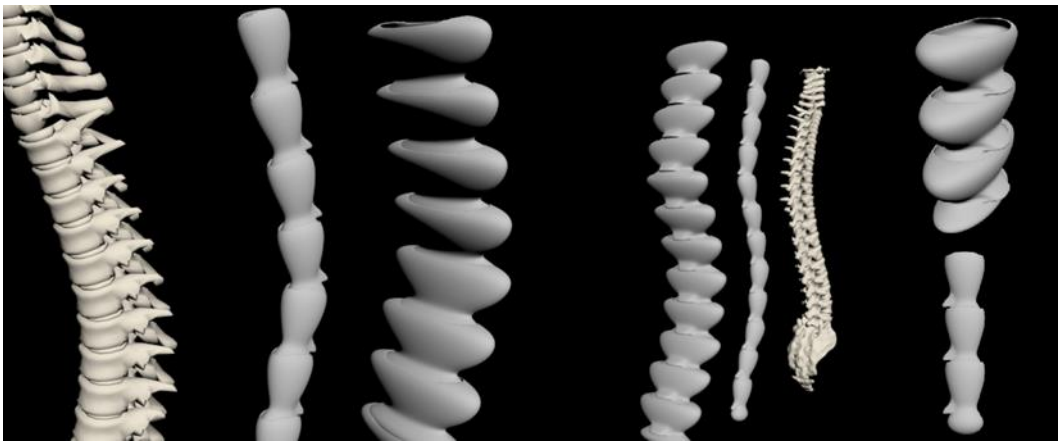


Figura 31 – Módulo integrado com inspiração nas vértebras da coluna

Figura 32 – Base inspirada na bacia humana

Partindo do intercâmbio entre a criação de um novo conceito e a linha Baucci já existente (um dos critérios propostos pela equipa), desenvolveram-se alguns esboços que apresentavam algumas soluções para os requisitos apresentados anteriormente.

- Inspiração cinética nas cadeiras de baloiço
- Módulos amovíveis para esterilização
- Integração de tabuleiro
- Apoio para o descanso de pernas e pés independentes
- Rodas opcionais para mobilidade parcial
- Movimento cinético de reclinação
- Apoio de braços que permite saída lateral

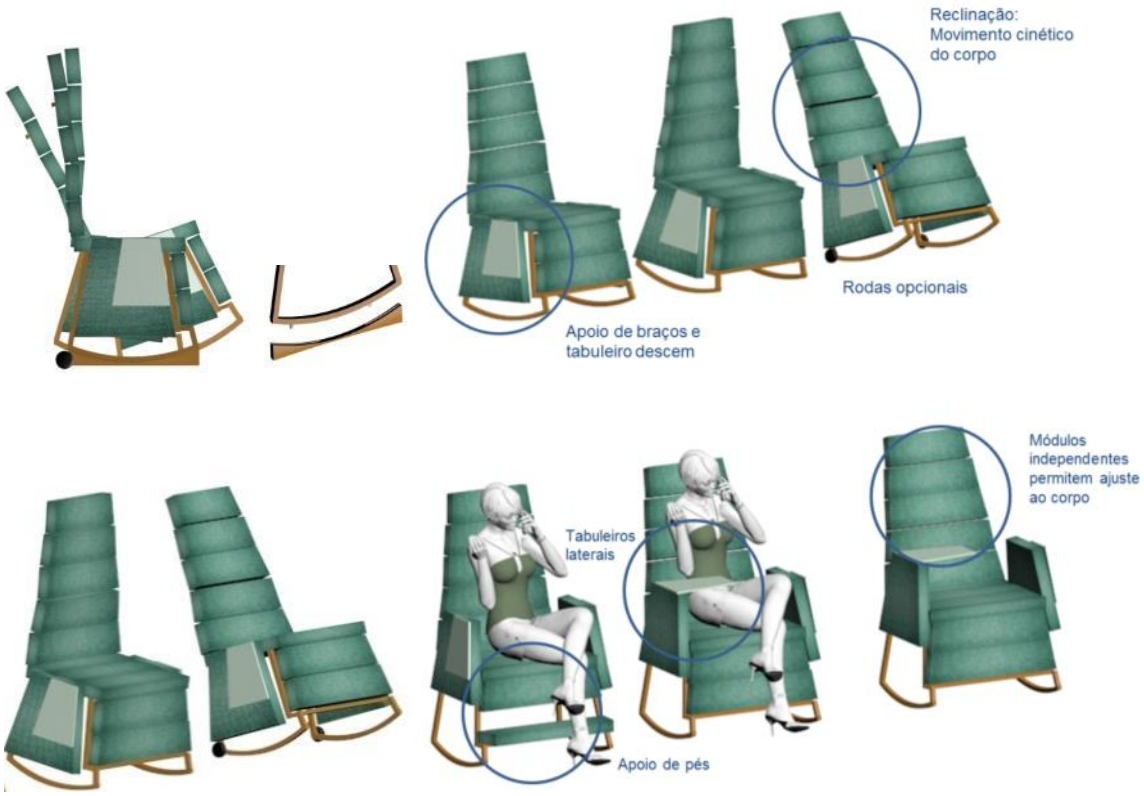


Figura 33 – Esboços para hipóteses de conceito I

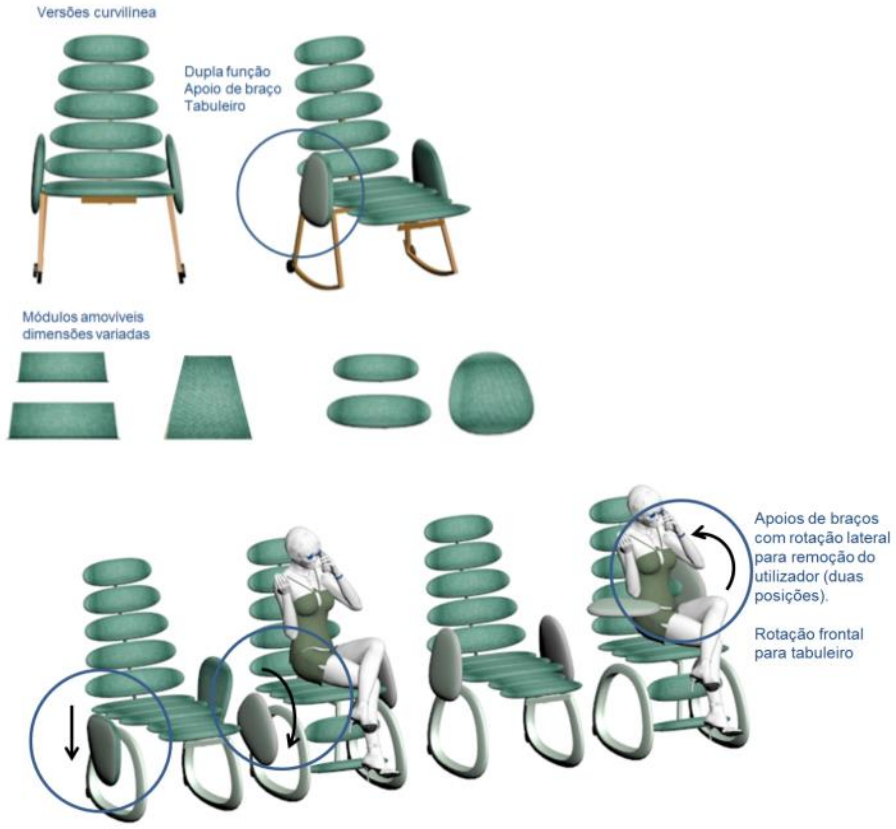


Figura 34 – Esboços para hipóteses de conceito II

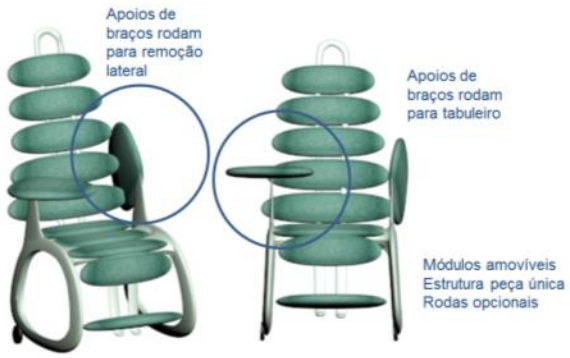


Figura 35 – Esboços para hipóteses de conceito III

Figura 36 – Esboços para hipóteses de conceito IV

Os módulos seriam processados em Polipropileno reforçado com 30 % de fibra de vidro e produzidos pelo processo de moldação por injeção. A assepticidade dos módulos poderia ser melhorada através do revestimento com tecido. Da mesma forma, o conforto para o utilizador poderia ser melhorado com a utilização de uma espuma.

Para o encaixe entre os módulos e a estrutura da cadeira é sugerida a utilização de rótulas. Estas, além de assegurarem o encaixe entre componentes, permitem que seja possível o movimento dos módulos em dois eixos, para que estes se adaptem ao utilizador de forma a conferirem o conforto necessário, de acordo com as necessidades de cada utilizador. As rótulas poderiam ser produzidas em PA ou POM, através de moldação por injeção. Pode ser necessário a utilização de insertos metálicos nas rótulas, para conferir a resistência necessária às ligações entre as rótulas e a estrutura, assim como, a sua fácil substituição.

Figura 37 – Esboços para hipóteses de conceito V

O conceito ilustrado na Figura 37 consiste em três monoblocos (assento, encosto de costas e de cabeça). Este conceito foi concebido com o objetivo de reduzir o número de componentes.

Sugere-se que estes monoblocos sejam processados usando a técnica de moldação por injeção e o material a utilizar seria o polipropileno reforçado com fibra de vidro. Para promover o conforto do utilizador aconselha-se a utilização de uma espuma de poliuretano, a qual poderá posteriormente ser revestida por um tecido para proteger a espuma de contaminações e tornar o produto esteticamente apelativo.

A ligação dos monoblocos entre si (assento, encosto de costas e cabeça) pode ser feita por um componente único ou então por ligações independentes entre cada um dos monoblocos. Dependendo da forma e do tipo de ligação, esta pode ser processado por diferentes técnicas, como é o caso da pultrusão, da extrusão e da moldação por injeção assistida por gás ou água. No que diz respeito ao tipo de material, este vai depender da forma e do modo de processamento da ligação entre os diferentes módulos.

Figura 38 – Esboços para hipóteses de conceito VI

Este conceito apresentado na Figura 38 e consiste numa peça única. Este promove a redução do número de componentes em relação aos conceitos anteriores.

A estrutura de peça única (Figura 38) pode ser produzida através de moldação por injeção usando PP reforçado com fibra de vidro. Na superfície de revestimento pode ser utilizada uma rede produzida a partir de um elastómero que se adapte ao utilizador, proporcionando assim o conforto necessário.

Após a avaliação inicial dos esboços, os requisitos mais relevantes foram analisados. Com base nestes referidos requisitos e nos critérios avaliados pela equipa, desenvolveram-se novos esboços que permitissem agregar alguns dos conceitos identificados nesta fase.

Assim, foi desenvolvido um reduzido número de esboços, com o objectivo de afunilar as alternativas apresentadas anteriormente, agregando os elementos que melhor respondiam aos requisitos definidos para o produto.

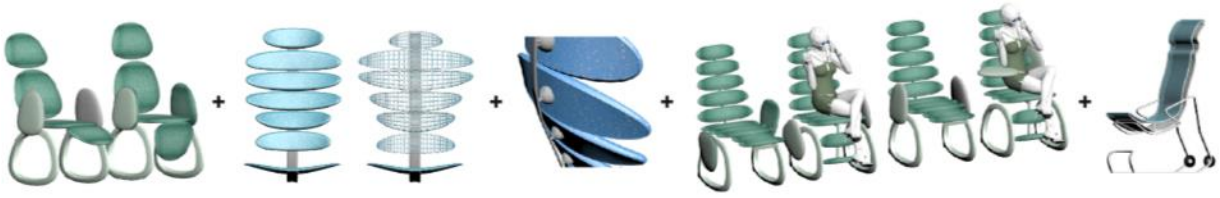


Figura 39 – Alternativas que serviram como base para novos conceitos

Os novos conceitos englobam os requisitos sugeridos pela restante equipa de desenvolvimento, nomeadamente:

• A estrutura pode ser constituída por um monobloco ou por módulos. Dependendo da solução escolhida, deve-se ter em conta a redução do número de componentes, de forma, a diminuir o número de ligações e os locais onde se possam alojar bactérias e microrganismos. No caso de a solução ser com módulos, estes não devem exceder três elementos;

• As ligações entre elementos têm de permitir uma fácil montagem do produto e facilitar a substituição e manutenção do mesmo;

• Deve-se recorrer à utilização de espumas para conferir maior conforto ao utilizador;

• O revestimento das espumas deve ser amovível para facilitar a sua limpeza e desinfeção;

• O cliente deve no máximo ter que efetuar 4 operações de montagens;

• A utilização de rótulas pode ser considerada como meio para assegurar o encaixe dos componentes e permitir o movimento dos módulos, de forma, a conferir maior conforto ao utilizador;

• Os mecanismos de ajuste da altura do assento ao chão podem ser componentes padrão;

• A reclinação das costas deve ser acompanhada pelo movimento do assento e do apoio de pés para aliviar a pressão na pele do utilizador nas zonas onde há maior acumulação de pressão;

• O produto deve ser de fácil acesso ao utilizador, bem como, permitir a sua saída facilmente, possivelmente através das zonas laterais.

A partir da análise dos conceitos apresentados na Figura 39 resultaram da sua integração duas novas hipóteses, Hipótese 1 (figura 41) e Hipótese 2 (figura 43).

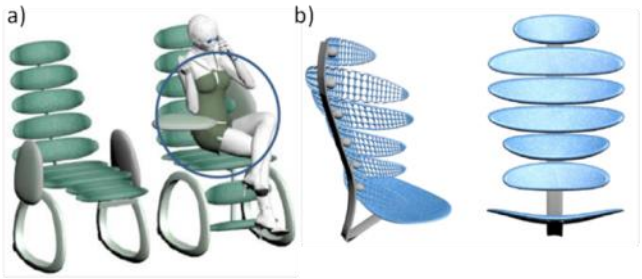


Figura 40- Conceitos que deram origem à Hipótese 1

A Hipótese 1 resultou da integração dos conceitos a) e b), representados na Figura 40, pela incorporação do assento, pés e apoios do conceito a) e a incorporação do encosto do conceito b).

Figura 41 - Hipótese 1

Após análise da Hipótese 1 foram detectados problemas com alguns dos componentes que constituem a cadeira. Os estofos, representados na Figura 41 (a), apesar de poderem conter um tecido amovível colocado sobre os módulos, possuem zonas entre módulos que serão muito susceptíveis à acumulação de microrganismos, o que desrespeita uma das especificações de maior relevância para este produto, a assepticidade. Uma possível solução consiste em aumentar o espaço entre módulos, de modo, a possibilitar uma limpeza profunda e o mais frequente possível.

Em relação aos materiais para os estofos, uma das possibilidades são as espumas de poliuretano flexível. Este material possui resistência ao crescimento de bactérias e fungos, resistência à fadiga e boa envolvência com o corpo do utilizador. Outra opção seriam as espumas viscoelásticas, uma vez que estas se moldam ao corpo, proporcionando conforto e facilitando a circulação sanguínea, o que ajuda a prevenir a ocorrência de úlceras de pressão. Em relação ao revestimento da espuma poder-se-ia utilizar uma malha em poliéster ou poliéster com algodão, pois este tecido é considerado forte, resistente ao estiramento e encolhimento, além disso, é hidrofóbico e possui baixo teor de transmissão de humidade.

Quanto aos processos de produção de espumas estas podem ser produzidas por moldação por injeção com reação, RIM. Outra solução é a compra das espumas para aplicação nas cadeiras.

Figura 41 a)Estofos e b) Estrutura da cadeira

De forma a conseguir efetuar a ligação dos estofos com a estrutura é necessário a aplicação de uma base rígida que, através de rótulas, fará a ligação com a estrutura. Este tipo de elementos de ligação, além da fácil substituição, permite que os módulos se movam de acordo com os movimentos efetuados pelo utilizador. As rótulas, como referido no relatório anterior, podem ser produzidas em PA ou POM, através da moldação por injeção.

A estrutura da cadeira apresentada na Figura 41 (b) pressupõe bastantes dificuldades na sua produção, como um componente único, devido à sua geometria. No entanto, é possível fazê-lo através da moldação por injeção, apesar de os custos de produção serem muito elevados devido à sua complexidade. Uma solução possível é a alteração da mesma pela proposta apresentada na Figura 41 (c). Esta solução é mais viável pois torna a sua produção menos complexa e com um menor custo visto não possuir zonas de difícil processamento como as que são assinaladas na Figura 41 (b). Além disso, essa solução apresenta uma estrutura frágil, na zona assinalada a azul, do ponto de vista mecânico. Durante a utilização da cadeira essa zona é sujeita a um movimento elevado, que pode comprometer o desempenho mecânico da estrutura. Por sua vez, a zona assinalada na Figura 41 (c) confere melhores propriedades mecânicas à estrutura na zona entre o encosto e o assento devido à aplicação de nervuras.

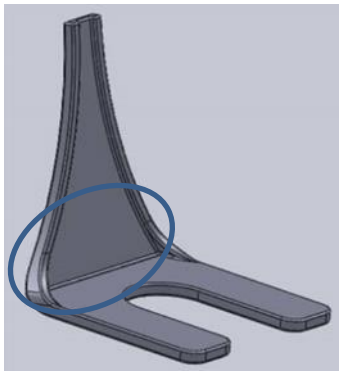


Figura 41c) Estrutura da cadeira

Sendo a estrutura da cadeira o componente que garante o suporte do utilizador, esta tem de possuir excelentes propriedades mecânicas, que podem ser conseguidas por materiais como o PP + 30 % GF ou a PA 6 + 30 % GF.

O sistema de reclinação deve permitir ao utilizador inclinar as costas num ângulo de cerca de 10 graus, como estabelecido anteriormente. Este sistema além da reclinação das costas, reclina o assento, bem como, o apoio de pés. O movimento das costas deve ser acompanhado pelo assento e apoio de pés para uma melhor distribuição da pressão aplicada sobre o utilizador. No entanto, é necessário que não cause o deslize do utilizador quando esta inclina para a frente ou para trás. Para isso é necessário acrescentar algum componente à estrutura para limitar o seu movimento. Esse componente pode ser em forma de T, para permitir o encaixe da estrutura na base e limitar os movimentos de reclinação das costas e do assento. Outra possibilidade é a utilização de rolamentos para promover o movimento de reclinação.

Figura 42 – Sistema de reclinação

A Hipótese 2 é ilustrada na Figura 40. Nesta figura não está explicito se a estrutura, que compreende as costas e as zonas laterais, é um componente único. Nesta caso haveria certas dificuldades na sua produção. Uma solução possível seria dividir a estrutura em vários componentes, costas e barras laterais. Desta forma, já poderia ser produzida por moldação por injeção. Em termos de materiais, sugerimos novamente o PP + 30% GF. Este material possui elevada resistência à temperatura, elevada resistência química, elevada resistência mecânica e boa estabilidade dimensional, a um custo competitivo. Em relação ao tecido, este pode ser constituído por uma malha de poliéster para promover a circulação de ar e a dispersão da pressão, para além das vantagens referidas anteriormente.

Além da utilização de um material com elevadas propriedades mecânicas, a estrutura, que compreende as costas e assento, pode conter nervuras para aumentar a resistência mecânica, visto ser uma zona de grandes esforços, especialmente a zona de transição

costas/assento. Convém não esquecer que toda a estrutura tem de ser dimensionada a partir dos esforços mecânicos que irá sofrer durante a sua utilização, de forma, a garantir que a estrutura vai resistir a todos os esforços que lhe são aplicados, sem risco para o utilizador.

A fixação do tecido nas barras laterais poderá, também, constituir um problema, porém podem ser utilizadas molduras para o efeito.

Nesta Hipótese 2 verifica-se a existência de apoio de braços (que deveriam, também, fazer parte da Hipótese 1), os quais podem ser em poliuretano e produzidos por moldação por injeção, visto este ser o material mais utilizado neste tipo de componentes. No entanto, pode ser estudada a possibilidade de produzir estes elementos através de um material reforçado termoformado com detalhes, como por exemplo nervuras, ou outros elementos necessários produzidos por sobreinjeção. Nesta cadeira não está representado o apoio de pés, mas admitimos que a solução para o apoio de pés da Hipótese 1 seja a mesma para a Hipótese 2.

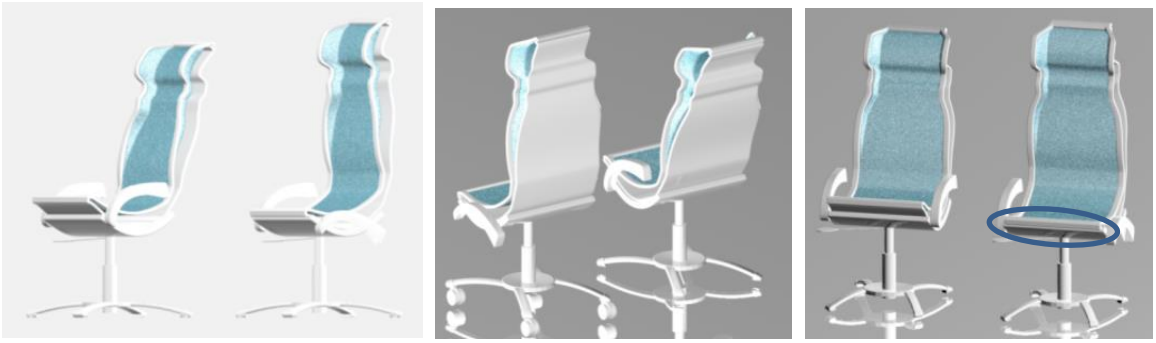


Figura 43 – Hipótese 2

Sugeriu-se que o assento contivesse espuma para não causar desconforto no utilizador, especialmente, na zona assinalada na Figura 43 com um círculo azul.

Admitindo que a base representada na Figura 44 é a mesma para a Hipótese 1 e 2. Esta tem um sistema para promover a reclinação da cadeira. Os elementos de ligação têm que permitir que a estrutura não se separe da base e que possibilite o seu movimento.

A base tem de ser capaz de suportar o peso da estrutura e do utilizador, portanto requer um material com excelentes propriedades mecânicas, como a PA + 30 % GF, o PP + 30 % CF ou a PA + 30 % aramida. Para promover uma melhoria da resistência mecânica na base será necessário incorporar nervuras.

A ligação da base aos pés da cadeira poderá ser conseguida através de elementos já existentes no mercado em produtos similares. No entanto, convém não esquecer que têm de ser totalmente processados em polímero.

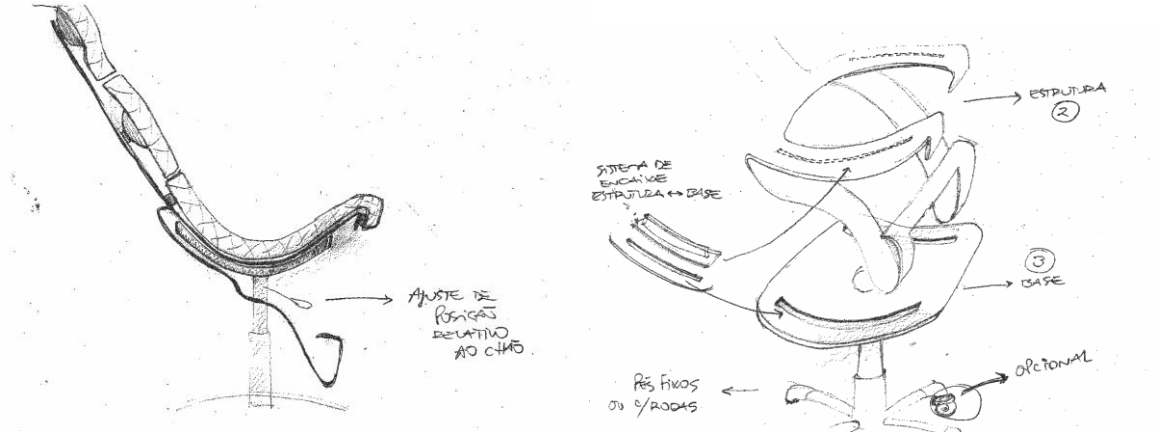


Figura 44 – Base

Foram propostos 4 tipos de suportes para aplicar em ambas as hipóteses. O primeiro tipo de apoios, Figura 11, carece de estabilidade para uma cadeira reclinável. De forma a conferir estabilidade à cadeira é necessário que a dimensão dos pés da cadeira tenha uma dimensão mínima igual à máxima reclinação da cadeira, como indicado na Figura 45.

Esta cadeira necessita de ter 5 pernas para conferir uma maior estabilidade e não haver risco de a cadeira cair quando o utilizador estiver sentado. Em termos de materiais, as pernas podem ser produzidas no mesmo material utilizado para a base e para a estrutura, para que o comportamento mecânico destas corresponda aos esforços a que vão ser sujeitas. Estes elementos podem ser produzidos através de moldação por injecção ou podem ser adquiridos no mercado com medidas padrão.

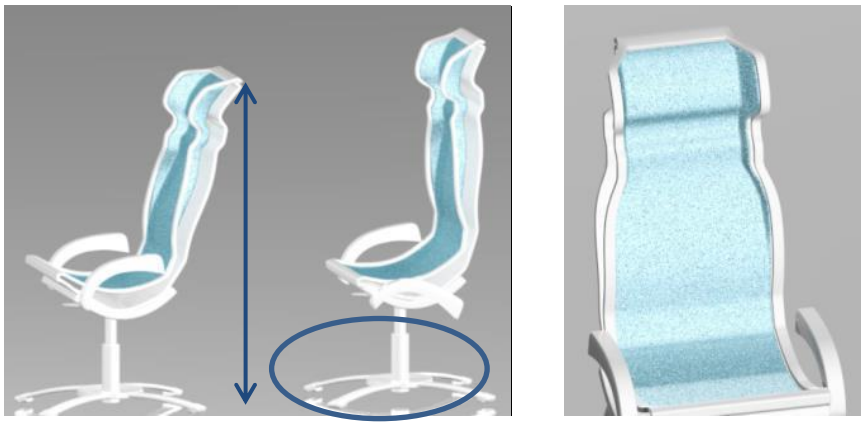


Figura 45 - Suporte da cadeira 1

Os restantes tipos de suportes, Figura 46, podem ser produzidos por RIM ou por injeção assistida por água ou gás. É de salientar que a estabilidade da cadeira na reclinação só é conseguida com o aumento da dimensão dos pés, como foi anteriormente referido para o caso da Figura 45, e com um comprimento adequado à inclinação das costas da cadeira.

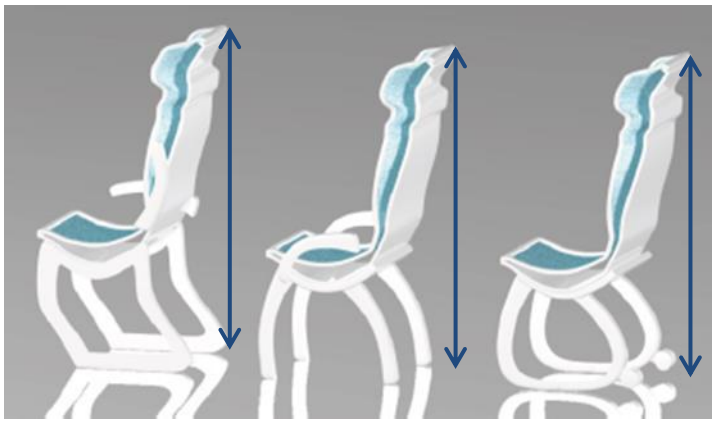


Figura 46 - Restantes tipos de suportes

Figura 47 – Solução encontrada satisfatória (em desenvolvimento)

Inserindo-se num contexto empresarial, e tratando-se de um projeto em desenvolvimento, este projeto não terminou com a entrega deste documento.

3.3. Pino Urbano Modular

Este projecto apresenta como objectivo principal o desenvolvimento de uma solução completa para a produção de produtos para o espaço urbano com grande incorporação de pneu e resíduos de plásticos indiferenciados.

Com o objectivo de apresentar soluções inovadoras para a gestão e destino sustentável dos pneus usados, internalizar conhecimento e implementar tecnologias no domínio da moldação de compostos de matriz polimérica mas com elevada incorporação de pneu e outros resíduos, desenvolveu-se um processo de estudo, experimentação e validação que se materializou no desenvolvimento de um pino urbano modular.

O conceito inicial deste projecto foi o de aliar a utilização da borracha reciclada a produtos para o espaço urbano, de forma a fazer uso das suas propriedades bem como de promover uma maior responsabilidade ambiental.

Evoluiu para um projecto de um pino rodoviário modular, respondendo à necessidade de delimitação de espaços públicos e protecção de peões a veículos motorizados. A solução de conceber um módulo surgiu com o propósito de possibilitar uma aplicação consoante a necessidade, permitindo vários tamanhos, bem como de agilizar os processos de produção inerentes.

Estes pinos podem ser instalados em parques municipais, passeios pedonais, parques de estacionamento e em qualquer lugar onde precise de ser implementada uma solução para a delimitação do espaço público.

3.3.1. Utilização de borracha reciclada

3.3.1.1. Vantagens da Utilização da borracha reciclada na delimitação urbana

Os pinos delimitadores do espaço urbano podem ser fabricados em borracha de pneus. As vantagens associadas a esta aplicação são: diminuição dos gastos de manutenção, diminuição das consequências causadas pelos pequenos acidentes de viação

no estacionamento, melhor desempenho durante o impacto dos veículos uma vez que os elementos ficam com características de estrutura semideformáveis, reduzindo os danos físicos e materiais.

Vantagens da reciclagem do pneu a nível ambiental, económico e social

A nível económico, a reciclagem contribui para a utilização mais racional dos recursos naturais e a reposição de recursos, quando passíveis de serem reaproveitados. Com a reciclagem dos pneus, aperfeiçoar-se-á o desenvolvimento das acções de articulação dos diferentes agentes da cadeia de reciclagem de pneus (recolha, triagem, pré-tratamento, transporte e destino final). A utilização da borracha aumenta consideravelmente a durabilidade dos produtos. A utilização do reaproveitamento das matérias-primas do pneu na sinalização rodoviária diminuem consideravelmente os gastos inerentes à sua manutenção e é notável a economia dos recursos energéticos gastos na fabricação da borracha, aço e fibras têxteis e economia de outros tipos de combustíveis.

A nível social, a reciclagem não só proporciona melhor qualidade de vida para as pessoas, através de melhorias ambientais, como também na geração novos empregos nas empresas recicladoras e no processo de angariação e movimentação dos pneus usados.

A nível ambiental, a reciclagem de pneus reduz substancialmente a acumulação progressiva de resíduos sólidos, minimizando-se as agressões ao solo, ao ar e à água. A responsabilidade com o meio ambiente pode ser considerada uma vantagem competitiva para as empresas. A imagem de empresa que preza um ambiente saudável, além da melhor aceitação por accionistas, consumidores, fornecedores e autoridades públicas, tem actualmente uma relevância significativa na avaliação financeira da empresa e devido às exigências da sociedade. As questões ambientais são um item muito valorizado para as fusões, aquisições e privatizações e a sua redução certamente reverterão em benefícios financeiros.

3.3.1.2. Outras vantagens

A utilização da borracha moída do pneu na aplicação dos produtos cria benefícios:

• A reciclagem do pneu devolve ao processo produtivo um consumo regenerado por menos da metade do custo da borracha natural ou sintética;

• Economia de energia;

• Optimização das propriedades de materiais feitos com borracha.

• Surgimento e fortalecimento de empresas especializadas na reciclagem dos pneus;

• Maior inibição dos focos de criação de insectos prejudiciais à saúde e até letais ao ser humano;

• Redução da poluição visual causada pelo descarte de pneus em lugares impróprios;

• Diminuição do assoreamento de rios, lagos e baías também provocados pelo descarte indevido dos pneus;

• Diminuição do número de pneus em depósitos com a consequente redução do risco de incêndios incontroláveis e a não deposição de pneus, sob qualquer formato, em aterros sanitários.

3.3.2. Caso de estudo

Este caso de estudo contempla a elaboração de um pino urbano modular constituído por material reciclado e ligante. Este produto é composto em grande percentagem por granulado de borracha reciclado, destina-se à aplicação em passeios e tem objectivo de impossibilitar o estacionamento abusivo.

3.3.2.1. Caracterização do produto

Esta solução permite não só reaproveitar um material que é na maior parte dos casos incinerado e tirar proveito das suas mais-valias, nomeadamente da característica elástica. A concepção de um pino rodoviário composto por borracha permite não danificar o automóvel em caso de impacto acidental.

Na Figura 48 são apresentadas algumas soluções desenvolvidas para o pino rodoviário, onde é possível observar o elemento de topo onde poderão ser impressas a relevo insígnias, marcas, etc., em material luminescente, à semelhança das argolas que intercalam cada módulo.

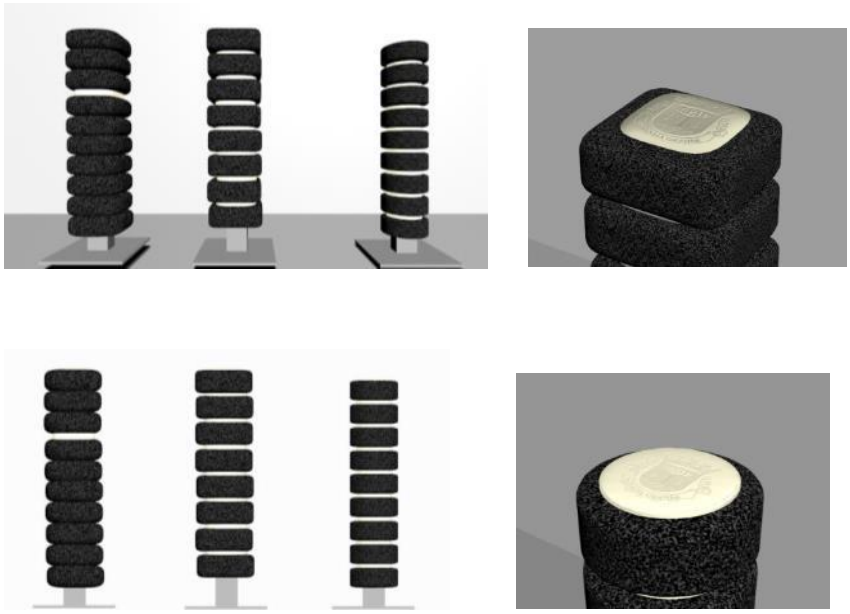


Figura 48 – Soluções para pino e elemento de topo personalizável

A Figura 48a) apresenta um fotorrealismo do pino rodoviário seleccionado para produção, assim como uma vista explodida na qual se podem identificar as várias partes.

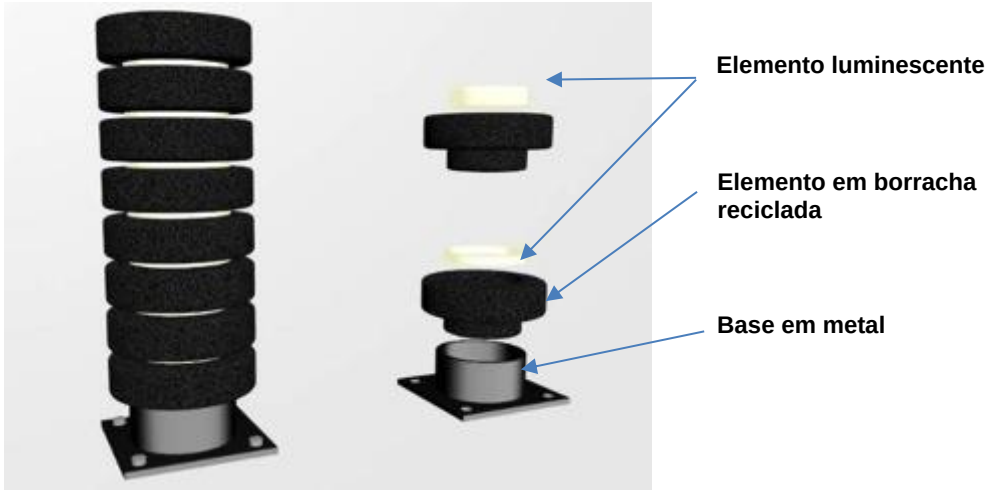


Figura 48 a) - Fotorrealismo do pino.

Este pino é composto por uma base em metal que será ligada ao passeio com parafusos, por elementos de borracha reciclada empilhados e por um anel luminescente agrupado entre cada elemento de borracha.

3.3.2.2. Caracterização do molde

Do ponto de vista técnico, pretende-se que este produto seja composto por diversos módulos com a capacidade de empilhamento consecutivo, podendo a altura de cada pino variar dependendo apenas do número de partes. Com esta solução cada pino poderá ser personalizado consoante a função ao qual se destina. O facto de serem produzidos elementos de menor dimensão permite que o tamanho do molde seja inferior e consecutivamente muito mais económico.

A Figura 49 apresenta um modelo tridimensional do respectivo molde, assim como um corte em planta com as suas dimensões principais. Estes desenhos técnicos foram necessários para a fabricação dos vários elementos do molde.

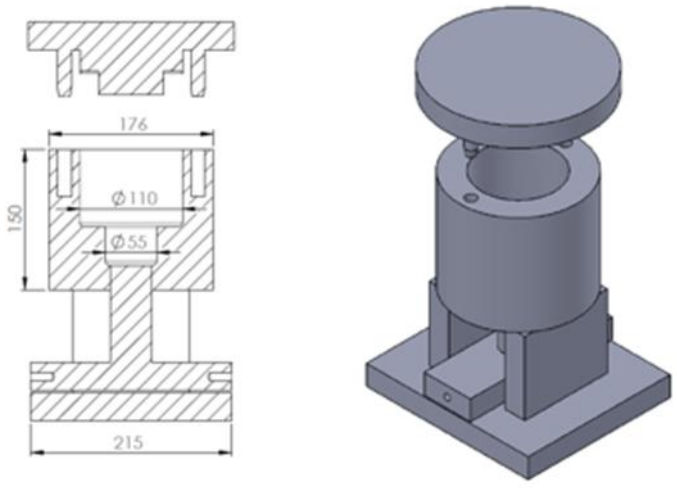


Figura 49 – Modelação do molde para elementos do pino.

A Figura 50 apresenta, no ponto a), as duas partes do molde (bucha e cavidade), o ponto b) identifica o extractor. Este elemento móvel permite extrair o provete com facilidade quando o molde aberto.

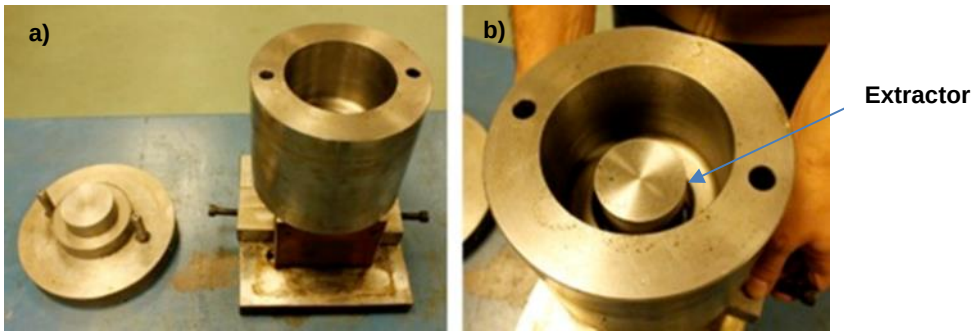


Figura 50 - Molde para elementos do pino.

3.3.2.3. Preparação da mistura

A elaboração das peças individuais do pino seguiu quatro etapas essenciais:

1. Mistura no sistema de duplo fuso da resina com as cargas (granulado de pneu)
2. Consequente enchimento do molde;
3. Fecho do molde;
4. Abertura/extracção da peça.

A mistura da resina com as cargas de pneu, primeira etapa, será a base do desenvolvimento destes produtos pois nesta fase são feitas as variações de percentagens, permitindo assim obter a melhor mistura. Testou-se as percentagens (resina/granulado) em massa com os valores de 10, 15 e 20% respectivamente.

Seguidamente relata-se a fabricação de uma unidade do respectivo pino, sendo este processo repetido para cada peça.

Após feitos os cálculos, obteve-se a quantidade (massa) de resina e de granulado de pneu para cada provete. Foi feito o cálculo para uma quantidade de material suficiente ao preenchimento do volume da cavidade do molde.

Esta quantidade destina-se apenas à produção de um elemento visto a cura da resina ser rápida e não sendo possível proceder à prensagem de mais de uma peça consecutiva. A mistura e transporte do material serão processados através do sistema de duplo fuso

apresentado na Figura 51. Este componente encontra-se aberto na figura mostrando os fusos e engrenagens de forma a compreender o seu funcionamento.

Figura 51 - Duplo-fuso de mistura e transporte.

Para garantir a mesma taxa de compactação em todos os provetes, estes foram enchidos até à face superior da cavidade do molde (Figura 52).

Figura 52 - Molde para elemento do pino preenchido com compósito.

Após esta etapa, fechou-se o molde e aguardou-se cerca de 10 minutos. Durante este tempo a resina cura o suficiente para que a peça possa ser removida mantendo a

integridade. Num processo industrial, este tempo poderia ser diminuído, utilizando vários moldes e fazendo assim um processo de produção contínua.

A Figura 53 ilustra uma peça após ser desmoldada.

Figura 53 - Elemento de pino.

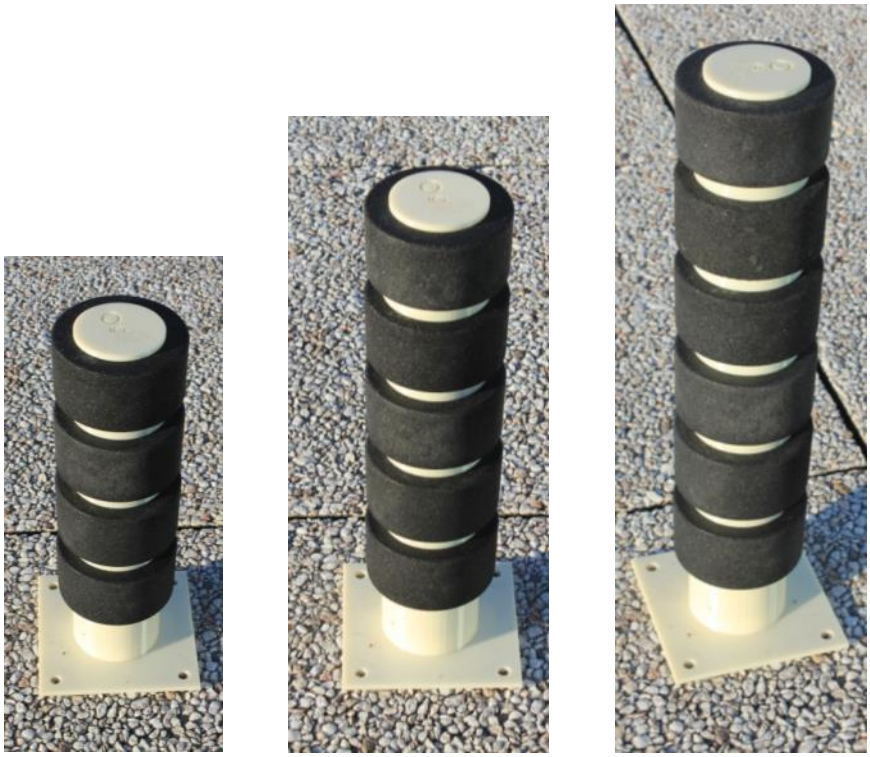


Figura 14 – Modelo do pino com diferentes configurações

Após a elaboração do número pretendido de elementos, estes empilham-se e colam-se com a mesma resina da qual são compostos, colocando entre cada elemento um anel luminescente. A Figura 55 apresenta um protótipo do pino rodoviário.

Figura 55 - Protótipo final do pino.

3.3.3. Caracterização dos materiais

Como forma de verificar a qualidade das misturas elaboradas para o caso de estudo apresentado anteriormente, fizeram-se observações ao microscópio ótico (Figura 56), assim como micro-tomografias (Figura 57). Com estes equipamentos foi possível entender a distribuição das cargas

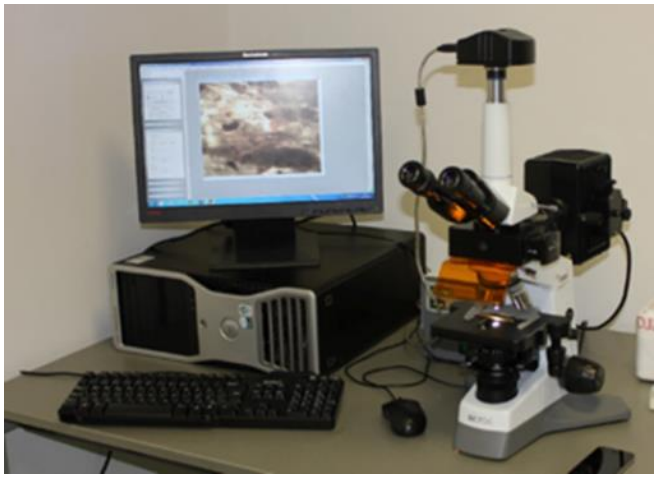


Figura 56 - Microscópio ótico.

Figura 57 - Equipamento de MicroCT (tomografia).

3.3.3.1. Compósito do pino

Foram retiradas amostras das misturas que compõem o pino e analisadas ao microscópio óptico com uma ampliação de 4x. Visto que se trata de uma análise superficial, na Figura 58 apenas se pode confirmar a boa ligação entre a borracha e a resina.

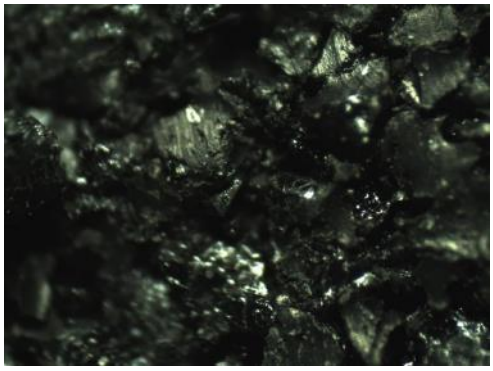


Figura 58 – Amostra do material do pino (ampliação 4x).

Cada elemento é revestido com uma pelicula estanque e protectora garantindo a sua integridade durante mais tempo. Os raios UV transmitidos pelo sol danificam a borracha, este revestimento pretende bloquear estas e outras ameaças ambientais. Na Figura 59 observa-se este revestimento com uma ampliação de 4x.

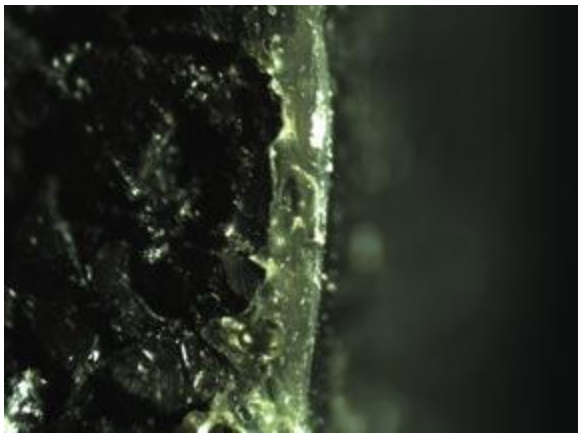


Figura 59 - Pelicula protetora (ampliação 4x).

Após parametrização das imagens obtidas através da micro-tomografia, verifica-se uma boa distribuição das cargas no compósito (Figura 60).

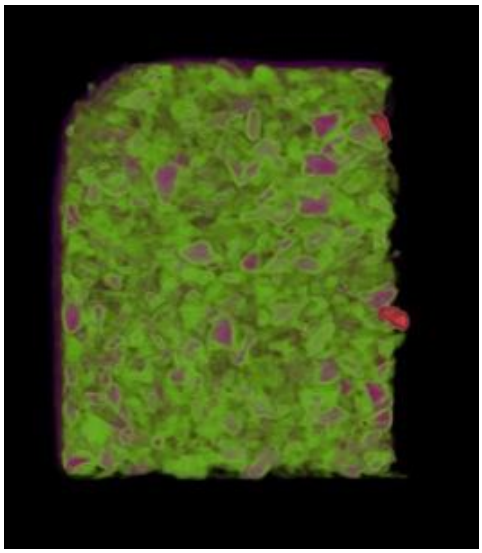


Figura 60 - Tomografia da mistura que compõe o pino.

3.3.4. Testes e ensaios

Estes produtos foram produzidos depois de intensos trabalhos experimentais. Abaixo, nas Figuras 61 a 68 apresentam-se alguns testes que permitiram o desenvolvimento de misturas e afinação de parâmetros. Nas tabelas 3 e 4 mostram-se diferentes morfologias que se foram obtendo.

Figura 61 - Molde com mistura depositada.

Após depositar o material, procedeu-se ao fecho do molde. Este encontrava-se a uma temperatura de 100 oC (Figura62).

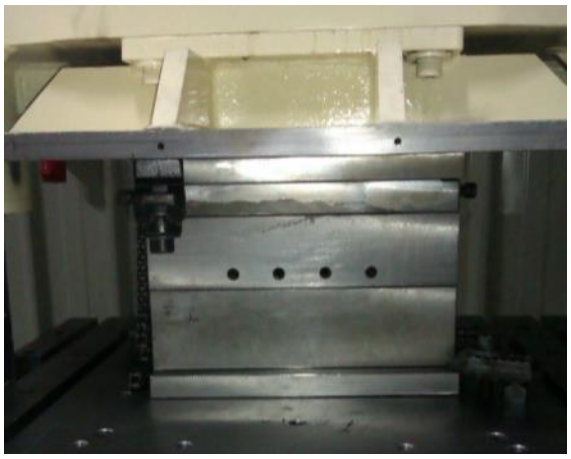


Figura 62 - Molde fechado em processo de cura do material.

Na Figura 63 encontra-se um provete curado. Como se pode verificar visualmente, a taxa de compactação é de aproximadamente 50%. Tal pode ser confirmado pela diferença de profundidade da cavidade e a altura da bucha.

Figura 63 - Molde aberto após cura.

Nas Figuras 64 e 65 pode-se observar o provete extraído do molde.

Figura 64 - Extração do provete.

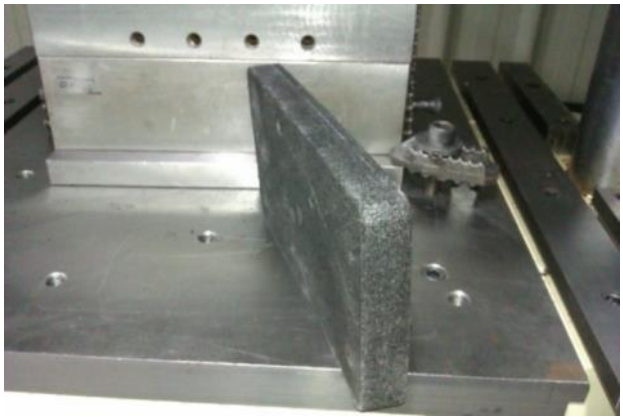


Figura 65 - Provete.

Na Figura 66 podem-se observar alguns provetes elaborados. A diferença de tonalidades deve-se única e exclusivamente ao lubrificante/desmoldante utilizado no molde.

Figura 66 - Provetes com diversas composições.

Figura 67 - Provetes.

Figura 68 – Protótipo flexível.

Cortaram-se várias fracções de diferentes zonas, dos dois protótipos (rígido e flexível), e foram atribuídas diferentes designações consoante a distância e o lado, tendo como referência o centro (Figura 68a). Foi feito também um corte transversal dos protótipos.

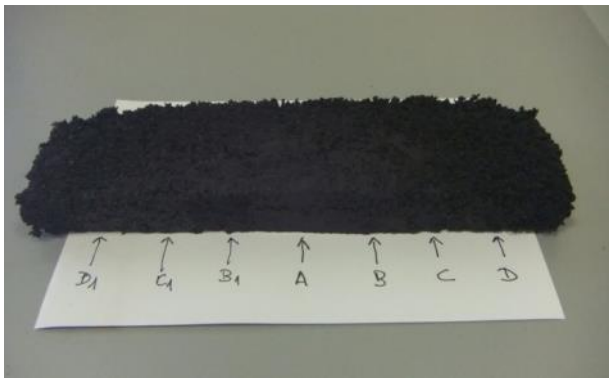
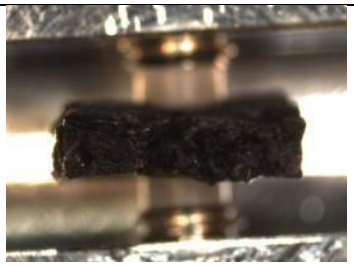
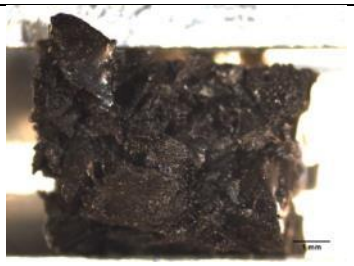
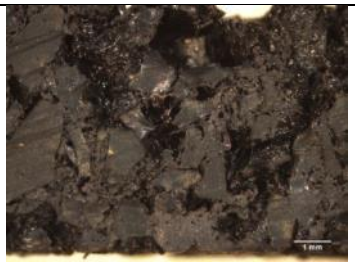


Figura 68a – Corte dos protótipos.

Apresentam-se nas tabelas 3 e 4 alguns dos resultados das misturas obtidas, do ponto de vista morfológico, onde é possível observar a dispersão e compactação da borracha na matriz termo endurecível.

Tabela 3 - Cortes e planos do protótipo flexível.

Menos denso	Corte	Plano
A		
B		

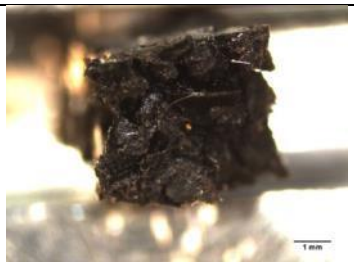
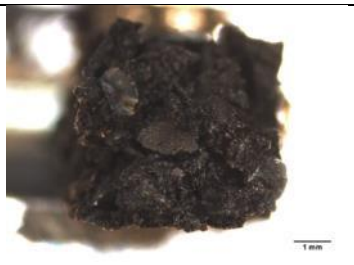
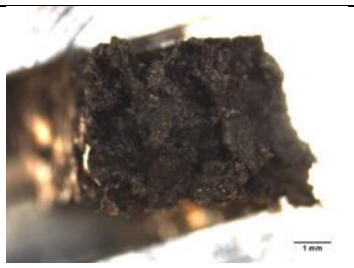
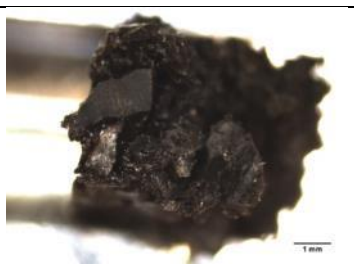
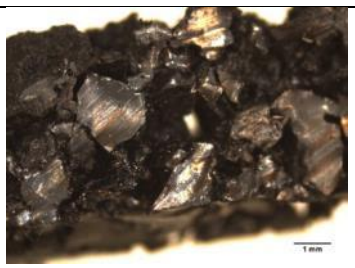
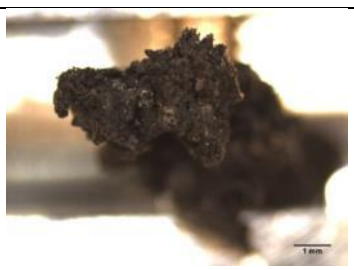
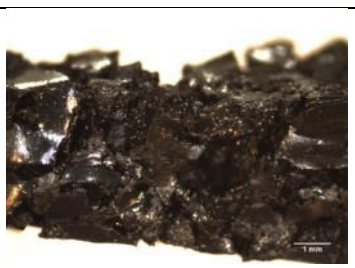
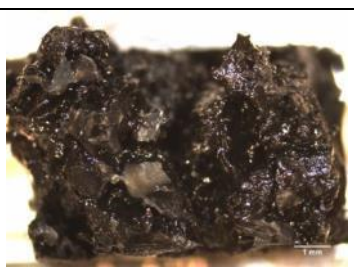
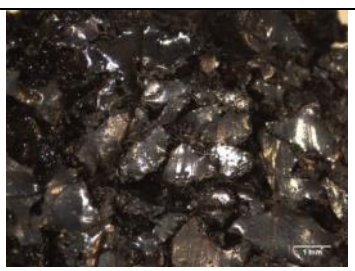
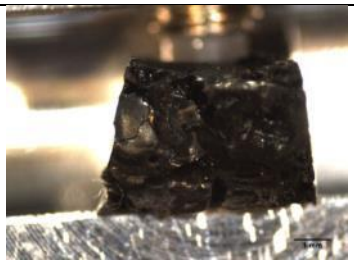
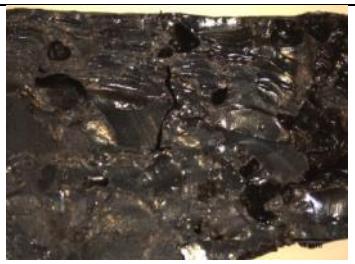
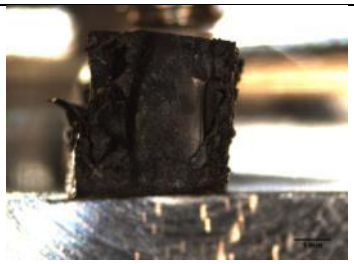
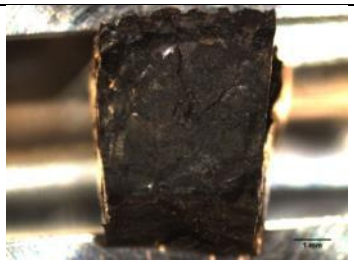
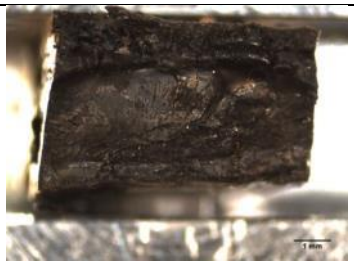
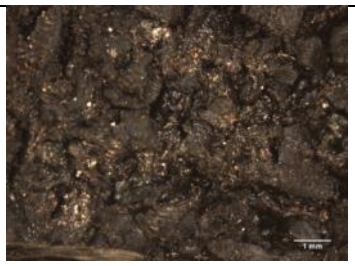
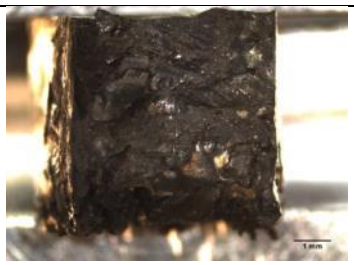
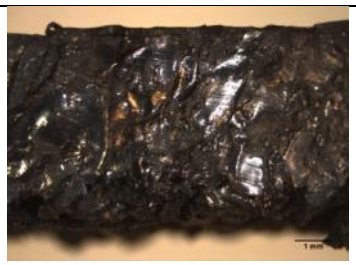
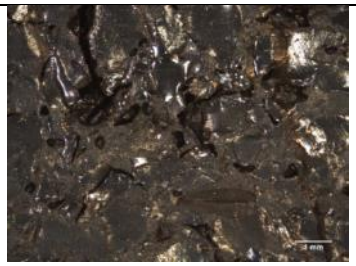
B1		
C		
C1		
D		
D1		
T		

Tabela 4 - Cortes e planos do protótipo rígido.

Mais denso	Corte	Plano
a		
b		
b1		
c		
c1		
d		

d1		
t		

3.3.5. Síntese

Exploraram-se dois tipos diferentes de termo endurecíveis.

Num dos quais tirou-se partido da reacção do isocianato com a água (adicionando calor) como forma de produzir uma matriz sólida.

No outro caso produziu-se uma matriz sólida pela reacção química de um poliol com um isocianato produzindo poliuretano. Neste último caso a reacção ocorre à temperatura ambiente.

Devido a um factor energético e económico optou-se pela produção do compósito à temperatura ambiente visto que os resultados ao nível do material eram semelhantes.

Em termos da análise do ciclo de vida fez-se um teste, que pode ser observado na tabela 3 na figura do meio da fila de cima, em que se usou o produto resultante como matriz polimérica, obtendo excelentes resultados no reaproveitamento do material o que poderá indiciar uma reutilização ad eternum onde apenas se adicionaria a resina de poliuretano.

Em termos de produção industrial deste produto este retiraria vantagens de uma massificação e utilização de material ligante em grandes quantidades, com vista a reduzir o preço. Como já foi dito, ao nível da moldação a geometria desenvolvida permite uma grande eficiência dada a modularidade do produto (Figura 69), nomeadamente:

1. Optimização do processo produtivo, utilizando sub componentes para a produção de peças de maior dimensão. Ferramentas simples e pequenas para produzir uma gama alargada de dimensões.

2. Possibilidade de conjugação de peças, constituindo conjuntos com diferentes características.

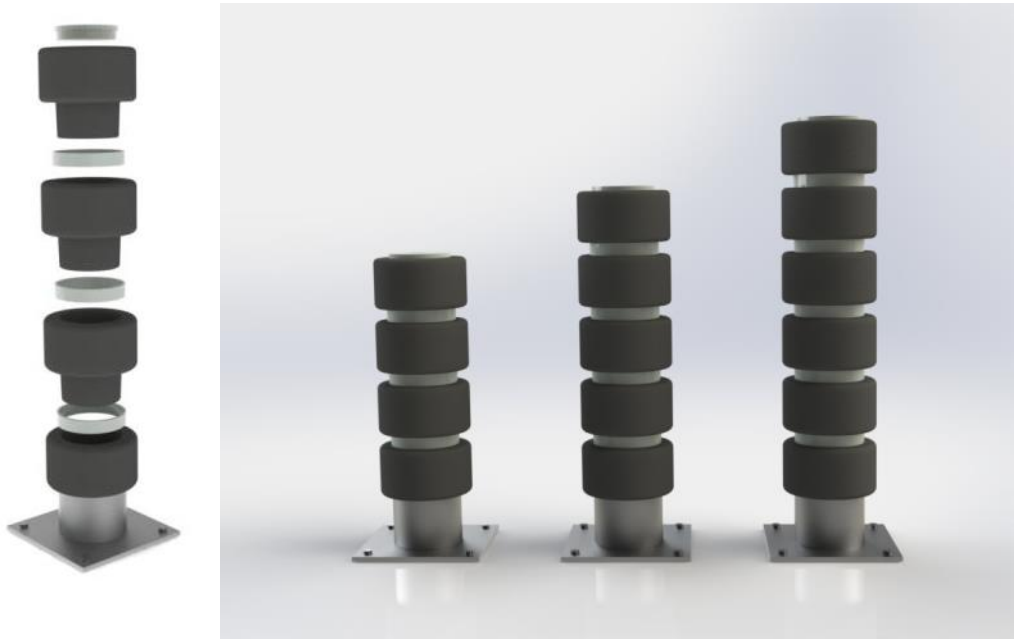


Figura 69 – Módulos e dimensões variáveis

Figura 70 – Prova de conceito

3.4. Acções de Disseminação Técnico-Científica

Organização e apoio à divulgação de projectos de investigação científico-tecnológica em áreas multidisciplinares, através de seminários, simpósios, conferências, congressos, publicações, dias abertos e outros.

Acções onde se procura dar a conhecer as actividades do CDRsp, apresentar alguns projectos de investigação e divulgar o que de relevante se vai passando em termos de ciência & tecnologia.

3.4.1. Seminários CDRsp

Responsável pela dinamização, organização, apoio técnico, logístico e administrativo.

Este evento tem como principal objectivo a apresentação do trabalho desenvolvido por um orador convidado com reconhecido mérito, nas áreas de marketing, sustentabilidade, saúde e/ou engenharias, dos quais destaco três.

Figura 71 – Banner da página de internet referente ao evento

3.4.1.1. *Physics and its Boundaries - in Imaging and Display Technologies*

"*Physics and its Boundaries - in Imaging and Display Technologies – Personal Experience*", a apresentar pelo Professor Doutor David Ezra da *DE Technologies Ltd* e do *Centre for Advanced Microscopy*, da Universidade de Reading, Reino Unido.

Figura 72 – David Ezra no auditório do CDRsp

3.4.1.2. *Reliability designs of suspension bar roofs in stadiums*

"*Reliability designs of suspension bar roofs in stadiums*", cujo orador convidado é foi o Doutorado Iurii Priadko pela D*onbas National Academy of Civil Engineering and Architecture*, na Ucrânia.

Figura 73 – Iurii Priadko no auditório do CDRsp

3.4.1.3. A Termografia e as suas aplicações para a saúde: Experiência no uso deste recurso para investigação

"A Termografia e as suas aplicações para a saúde: Experiência no uso deste recurso para investigação" com o orador convidado, Prof. Luis Miguel Costa Carrão, Docente da

Escola Superior de Saúde do Instituto Politécnico de Leiria no Curso de Licenciatura em Fisioterapia.

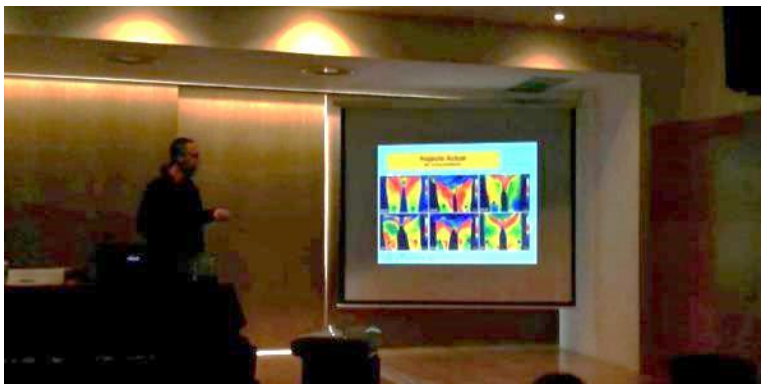


Figura 74 – Luís Carrão no auditório do CDRsp

3.4.2. Conferência Design Center

O *Design Center* - Semana do Design da Marinha Grande é um evento orientado para a promoção da comunicação e interação entre profissionais, empresários e estudantes da área do design.

Figura 75 – Cartaz do *Design Center* - Semana do Design da Marinha Grande

Com o intuito de divulgar o design como importante factor de competitividade e de desenvolvimento económico, gerador de riqueza e valor acrescentado, o *Design Center* - Semana do Design da Marinha Grande apresenta-se como instrumento de promoção do empreendedorismo. Objectivo: estimular a inovação, a criatividade, a tecnologia, a competitividade e o desenvolvimento de produto.

Figura 76 – Identidade agregadora do território

A Câmara Municipal da Marinha Grande ao pretender afirmar o concelho como "Marinha Grande – Centro da Engenharia & Design" criou uma nova identidade agregadora do território (Figura 76).

Na sequência da experiência adquirida com a realização das "Conferências Internacionais de Design" de 2O11, o evento pretende cativar toda a comunidade de forma a reunir a indústria, a cultura, a história e as suas gentes num ambiente decisivo na identificação e caracterização do potencial económico da Marinha Grande.

3.4.2.1. Simpósio Design Thinking

O evento *2nd Design Thinking Symposium*, teve lugar na Marinha Grande, a 10 de Outubro de 2014, englobado na Semana do Design da Marinha Grande que incluía conferências e exposições, promovidas por instituições académicas e a indústria.

Figura 77 – *Banner* do Simpósio

Na sequência da experiência adquirida com a realização evento *Design Thinking Symposium* de 2013, o CDRsp pretende estimular e promover a criatividade aliada à inovação, à tecnologia e aos princípios de sustentabilidade, esperando desenvolver colaborações entre os participantes de modo a promover o conhecimento e identificar as principais tendências do campo disciplinar.

Figura 78 – Auditório do Edifício da Resinagem, Marinha Grande

3.5. Outras actividades

Em qualquer estágio, a intervenção passa por uma transversalidade em termos de funções. Todas as tarefas desenvolvidas promovem uma aprendizagem constante, têm um carácter formativo, de construção de um profissional completo e com todas as competências fundamentais para o mercado de trabalho, Saber-Ser e Saber-Fazer.

3.5.1. Comunicação CDRsp

No decorrer dos trabalhos desenvolvidos no CDRsp é sempre necessário criar elementos gráficos e novos suportes de comunicação, que dizem respeito aos vários projectos, artigos, conferências, seminários, e outros, que paralelamente foram desenvolvidos durante o período vigente do estágio.

3.5.1.1.1. Página de Internet

A dinamização da página de internet do CDRsp e a necessidade da sua actualização permanente, visa a promoção e a divulgação daquilo em que o centro está envolvido junto de toda a comunidade e respectivos parceiros.

Tanto a página de internet como a página do facebook do CDRsp, permitem uma interacção com o público nacional e internacional, sendo este um meio de comunicação além-fronteiras.

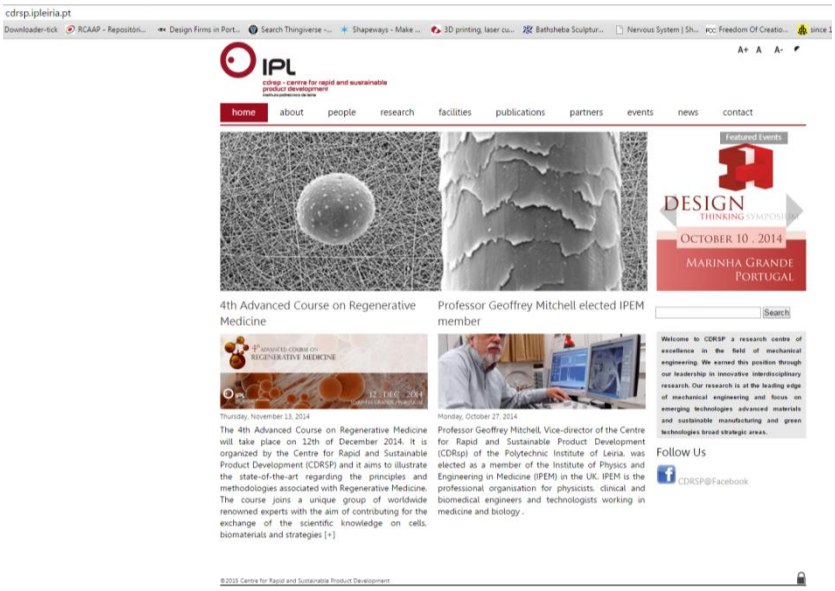


Figura 79 – Página de internet do CDRsp

3.5.1.2. Elementos gráficos

No decorrer da actividade do CDRsp surgiu a necessidade do desenvolvimento de logótipos, posters, figuras e outros elementos gráficos referentes a artigos, seminários, conferências, projectos, e outros, em que o centro se encontre envolvido.

São elementos que facilitam uma leitura e a disseminação do que se pretende comunicar, variando na forma e no suporte em que são inseridos.

Abaixo apresentam-se alguns exemplos dos elementos anteriormente referidos (Fig.80-82).

Figura 80 – Exemplos de elementos gráficos para artigos científicos

Figura 81 – Exemplos de posters de apresentação

Figura 82 – Exemplos de logótipos para projectos

3.5.2. Responsabilidades Internas

O trabalho desenvolvido no CDRsp passou pela integração na equipa do Laboratório de Engenharia Inversa e Realidade Aumentada e pela logística audiovisual do auditório do edifício.

3.5.2.1. Laboratório de Engenharia Inversa e Realidade Aumentada

No laboratório de engenharia inversa o trabalho desenvolvido centrou-se na digitalização tridimensional com recurso a equipamentos como a Comet e a Tscan da Steinbichler , a 3D Sense e Structure da 3D Systems

A digitalização 3D é a designação pela qual se classificam um conjunto alargado de tecnologias que permitem a captação das coordenadas tridimensionais de pontos sobre um objeto real e desta forma permitir a sua reprodução virtual.

O desenvolvimento das tecnologias de visão computacional, permitem actualmente a digitalização dos objectos com maior flexibilidade através de sistemas de não contato, quer pela utilização de luz estruturada ou de laser, conforme figura abaixo.

Figura 83 – Sistemas de digitalização 3D

O trabalho desenvolvido no laboratório de realidade aumentada passou pelo desenvolvimento de um caderno de apoio à análise matemática no domínio da educação, e à aplicação desta tecnologia nos mais diversos âmbitos como é o caso do turístico, museológico e biológico.

A Realidade Aumentada representa a integração de conteúdos virtuais no mundo real. Esta integração é efetuada através da utilização das tecnologias de informação e comunicação (TIC). Basta ter um dispositivo com uma câmara para que qualquer um de nós possa ter acesso a conteúdos disponibilizados com Realidade Aumentada, conforme figura abaixo.

Figura 84 – Sistemas de realidade aumentada

3.5.2.2. Auditório CDRsp

As responsabilidades inerentes à logística audiovisual do auditório do CDRsp dizem respeito à disponibilização de som e imagem para que os eventos possam ocorrer da melhor forma possível, com todos os equipamentos disponíveis e operacionais.

Figura 85 – Vista do auditório do CDRsp

4. Conclusão

O conhecimento científico adquirido através da Ciência aliado às técnicas avançadas para a produção de produtos, facilita a elaboração de projectos e a sua optimização. Estes quando apoiados em soluções científicas e tecnologias sustentáveis poderão melhorar a qualidade de vida dos utilizadores desses produtos.

De acordo com os objectivos definidos no início deste relatório procurei recolher a informação disponível e necessária ao desenvolvimento dos produtos, tendo em vista a sustentabilidade de cada um, seja nos métodos produtivos, nos materiais, como na relação com o utilizador e outros. Para o efeito recorri ao conhecimento multidisciplinar e às tecnologias emergentes, procurando uma melhor compreensão e aplicação de conceitos abertos e em evolução.

No desenvolvimento da ortótese cervical foi fundamental perceber as mais-valias do trabalho numa equipa multidisciplinar, desde a génese do desenvolvimento do produto até à sua implementação/aplicação. O resultado final poder ser substancialmente optimizado ao longo de todo o processo.

O trabalho desenvolvido para a Patient Chair permitiu partir para o desenvolvimento com as bases bem estruturadas no sentido de desenvolver um produto com requisitos muito específicos e que têm que responder a um determinado número de normas.

Existiu no entanto espaço para a criatividade, pois tratando-se de uma fase de desenvolvimento conceptual, foram apresentadas várias propostas de desenho, que levaram à escolha final da opção mais adequada, do ponto de vista de todos os parceiros inseridos no projecto.

Sendo este um projecto de âmbito empresarial e em desenvolvimento, não terminou com a entrega deste documento.

No desenvolvimento de soluções de borracha de pneu reciclado, mais especificamente um pino para delimitação urbana, este permitiu criar um produto inovador e de reconhecimento pelos pares, no que diz respeito ao processo de design e de produção que para além de optimizado, se revela mais económico e personalizável.

O trabalho desenvolvido em todas as actividades deste estágio possibilitou o acesso a todos os conhecimentos cientifico-tecnológicos e multidisciplinares já descritos

anteriormente, contribuindo para o enriquecimento do meu percurso profissional presente e futuro. As ferramentas e os diversos tipos de abordagens e metodologias que foram daí discorridas permitir-me-ão desenvolver trabalhos no futuro, com conhecimento prévio de materiais, tecnologias e processos emergentes no desenvolvimento de produto.

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Patentes

[18]**Failor R. A. et al**. (1990), "Patient's chair", patente nº Des. 311,509.

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Anexos

Anexo 1 - Patentes

US D654713 S1 – Patient chair

US 7069608 B2 – Multi-purpose patient chair

US 4729598 A – Patient chair system

US D311509 S – Patient's chair

US 20020000745 A1 – Patient chair with quaternary spring motion

US 20120292877 A1 – Mobile rocking patient chair and method of use

US 20060220429 A1 – Patient chair with a vertically movable seat

US D654713 S1 – Patient chair

US00D654713S

(12) **United States Design Patent**
Lloyd et al.

(10) **Patent No.: US D654,713 S**
(45) **Date of Patent: ** Feb. 28, 2012**

(54) **PATIENT CHAIR**

(76) Inventors: **Thomas Zachery Lloyd**, London (GB); **Luke Neil Pearson**, London (GB); **Nicholas Stanley Borg Carpenter**, London (GB); **Sandra Angela Chung**, London (GB); **Clark Jon Bardsley**, London (GB); **Samuel Duncan Wilkinson**, London (GB); **Martin Howard Battye**, Suffolk (GB); **David Hugh Wickett**, Suffolk (GB)

(**) Term: **14 Years**

(21) Appl. No.: **29/376,833**

(22) Filed: **Oct. 13, 2010**

(30) **Foreign Application Priority Data**

Apr. 13, 2010 (EM) 001694969-002

(51) **LOC (9) Cl.** **06-01**
(52) **U.S. Cl.** **D6/366**; D6/500
(58) **Field of Classification Search** D6/334–336, D6/360–369, 373–374, 379–380, 498, 500–502, D6/601; 297/284.4–284.5, 291, 297, 411.2, 297/411.27–411.29, 452.13, 452.19, 452.21, 297/452.29, 452.3, 452.56, 452.64
See application file for complete search history.

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D597,770	S *	8/2009	Tamara	D6/501

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Primary Examiner — Ricky Pham

(57) **CLAIM**

The ornamental design for a patient chair, as shown and described.

DESCRIPTION

FIG. **1** is a front three quarter view of the patient chair showing our new design:
FIG. **2** is a side view of the patient chair design:
FIG. **3** is a front view of the patient chair design;
FIG. **4** is a rear view of the patient chair design;
FIG. **5** is a rear three quarter view of the patient chair design; and,
FIG. **6** is an exploded view of the patient chair design.

1 Claim, 6 Drawing Sheets

FIG. 1

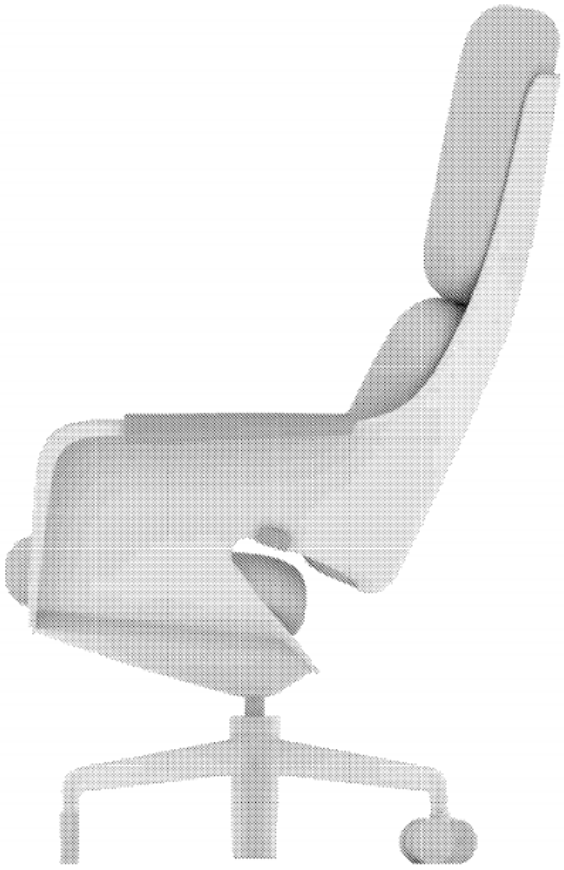

FIG. 2

FIG. 3

FIG. 4

FIG. 5

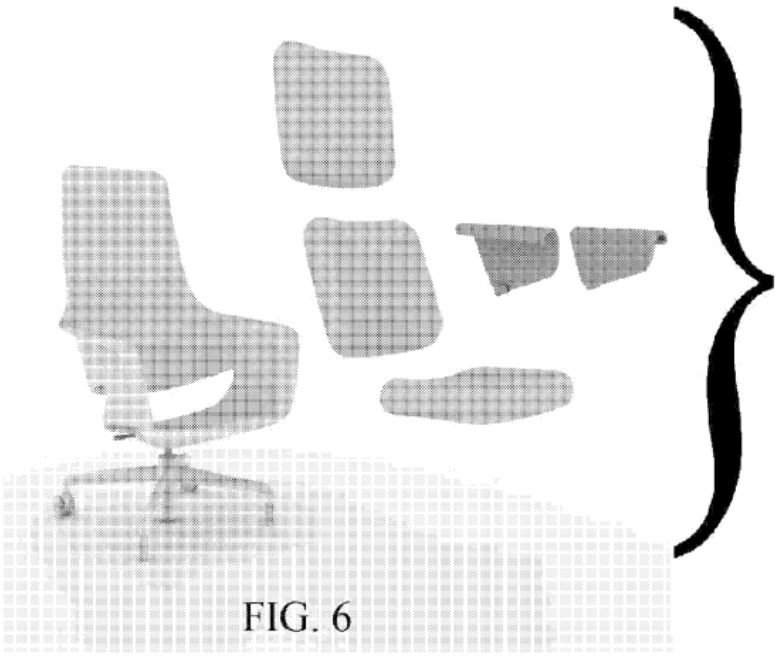

FIG. 6

US 7069608 B2 – Multi-purpose patient chair

US007069608B2

(12) **United States Patent**
Failor et al.

(10) **Patent No.: US 7,069,608 B2**
(45) **Date of Patent: Jul. 4, 2006**

(54) **MULTI-PURPOSE PATIENT CHAIR**

(75) Inventors: **Raymond A. Failor**, Seville, OH (US); **Michael D. Fox**, Rittman, OH (US)

(73) Assignee: **TransMotion Medical, Inc.**, Sharon Center, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/750,442**

(22) Filed: **Dec. 31, 2003**

(65) **Prior Publication Data**

US 2005/0138731 A1 Jun. 30, 2005

(51) **Int. Cl.**
A61G 7/015 (2006.01)
A61G 7/05 (2006.01)
A61G 7/14 (2006.01)
A61G 7/16 (2006.01)

(52) **U.S. Cl.** **5/618**; 5/601; 5/86.1; 280/650; 280/655.1; 297/423.35

(58) **Field of Classification Search** 5/86.1, 5/618, 601; 280/647, 650, 655.1; 16/900, 16/438; 297/423.35
See application file for complete search history.

(56) **References Cited**

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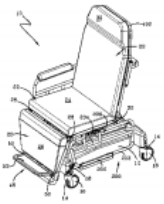
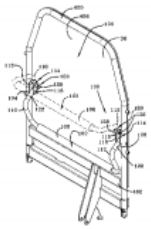
Primary Examiner—Alexander Grosz
(74) *Attorney, Agent, or Firm*—Renner, Kenner, Greive, Bobak, Taylor & Weber

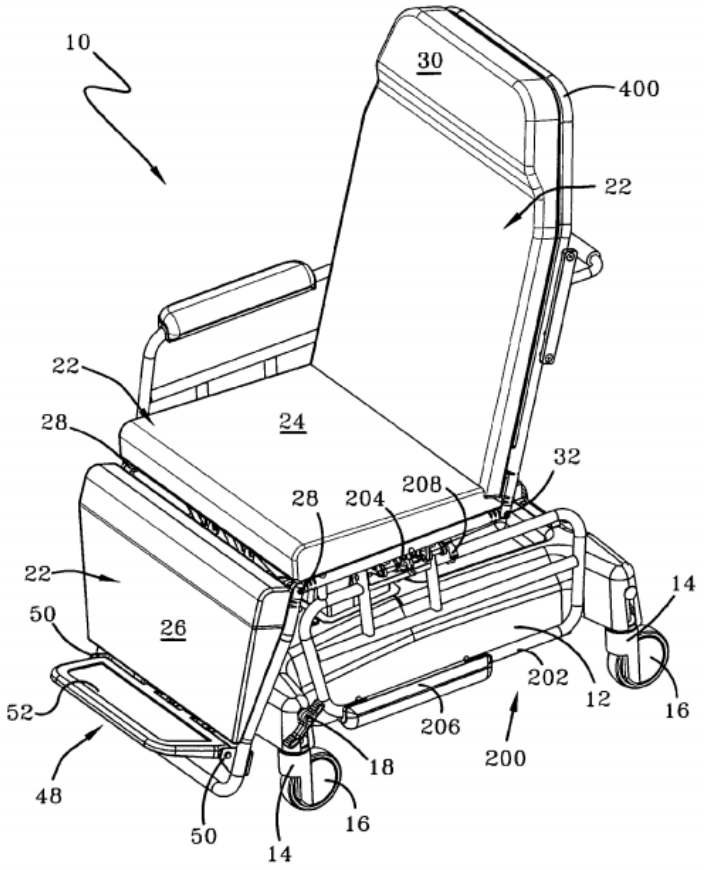
(57) **ABSTRACT**

A medical chair provides a radiolucent backrest pivotally secured to a seat section. A pivoting push bar on the backrest pivots between an operative position, where it can be used to maneuver the chair, and a storage position where it does not compromise the radiolucent property of the backrest. The chair includes a leg support section, and the backrest and leg support section pivot between a chair structure and a stretcher structure. The pivoting of the backrest and legs support section are controlled by actuators that are positioned so as not to interfere with the radiolucent property of the backrest. A foot platform on the leg support section is connected to remain substantially parallel to the seat section as the leg support section is pivoted. A remote control allows for adjusting the configuration of the chair from points distant from the medical chair.

2 Claims, 10 Drawing Sheets



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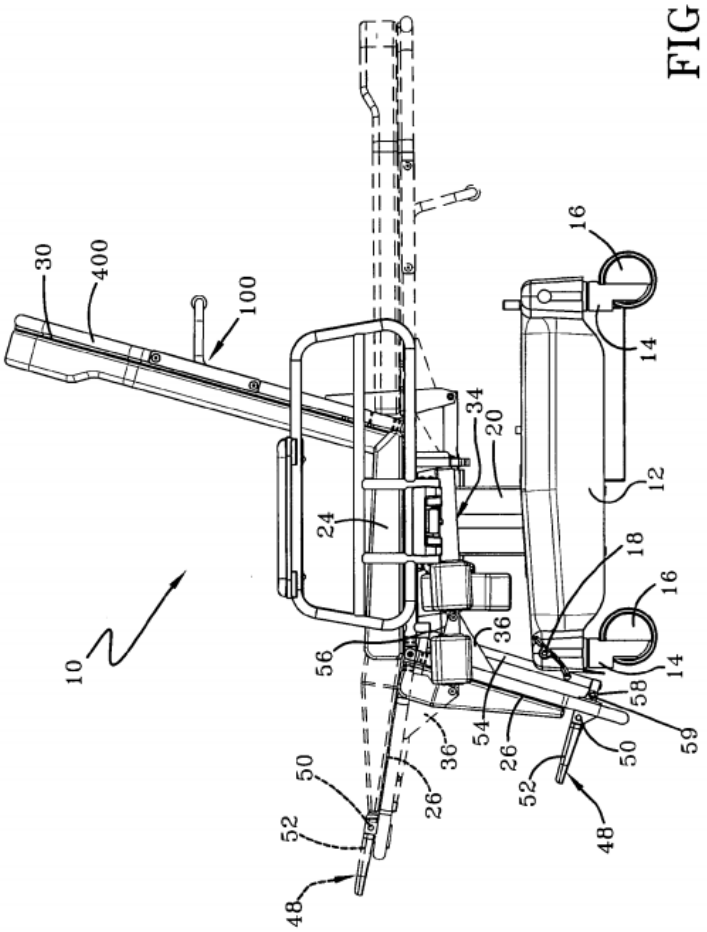
FIG−1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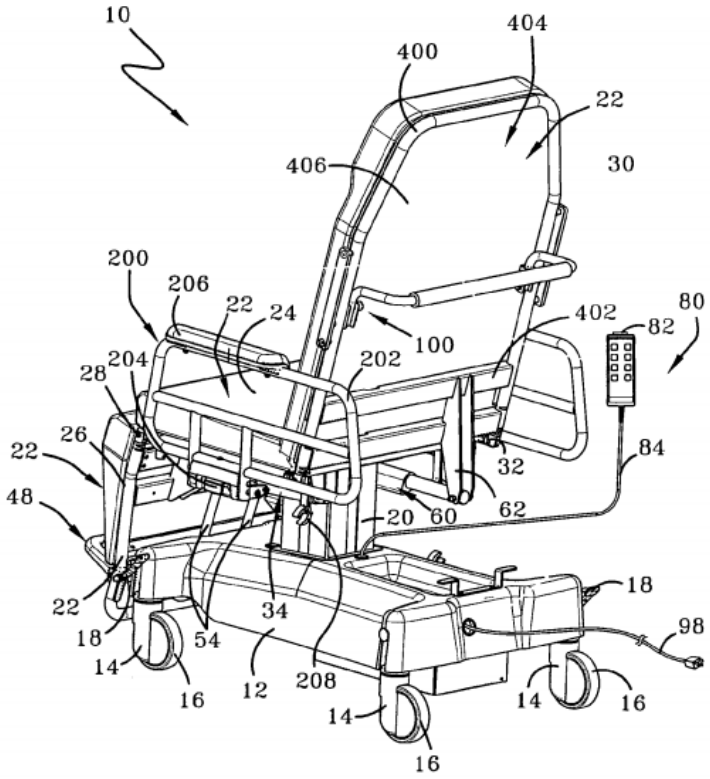
FIG–2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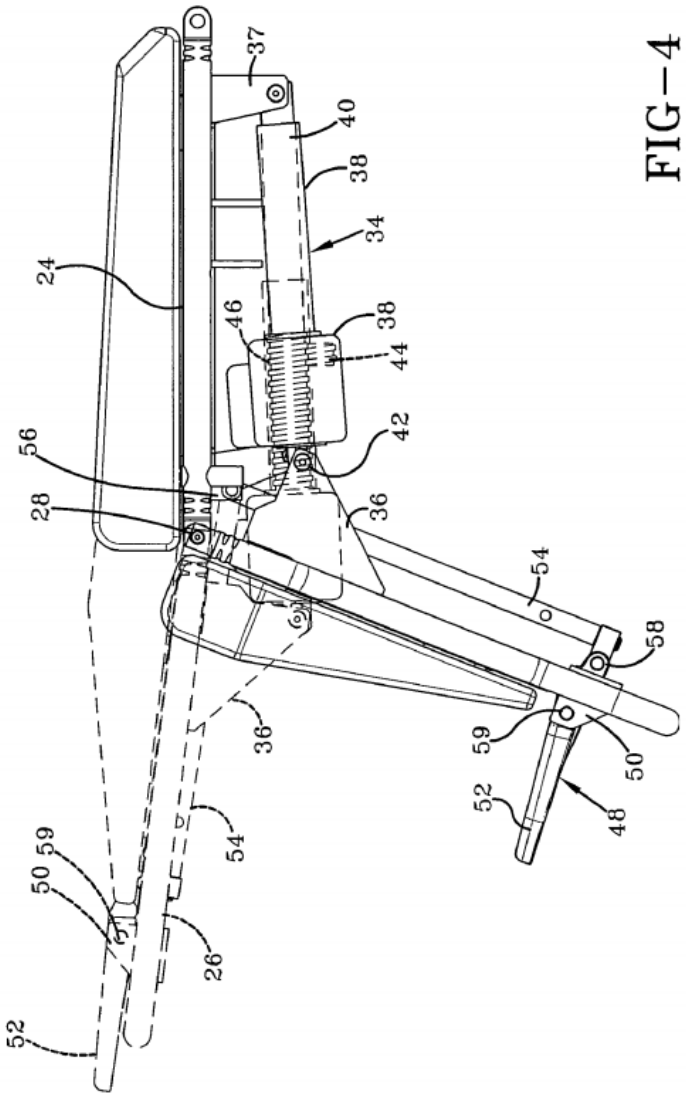
FIG−3



FIG–4

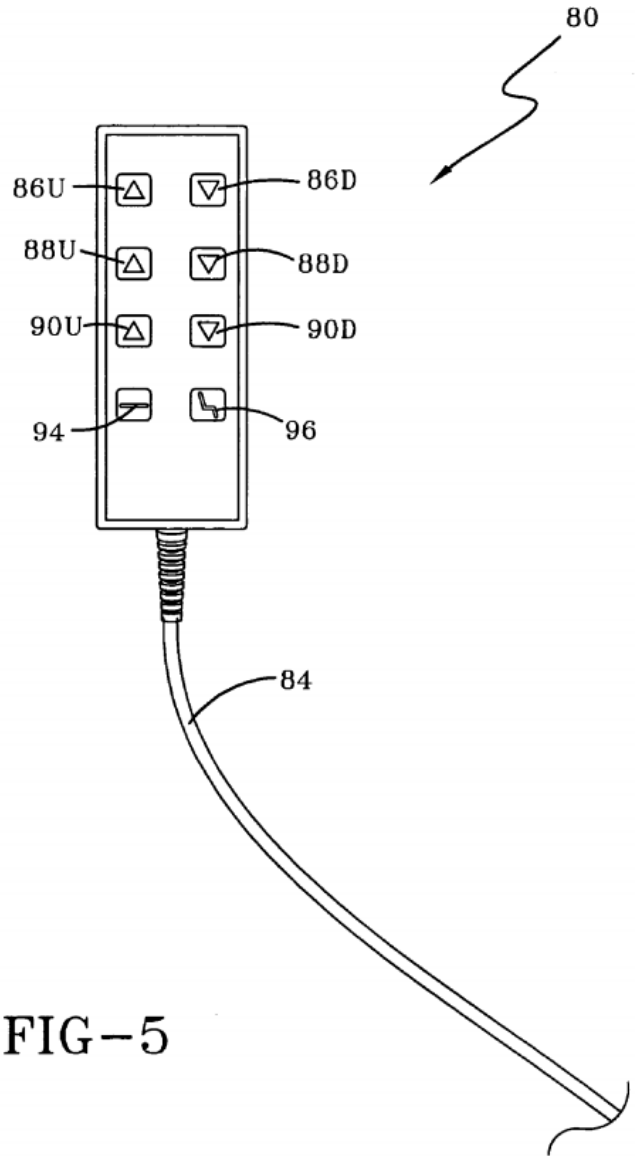
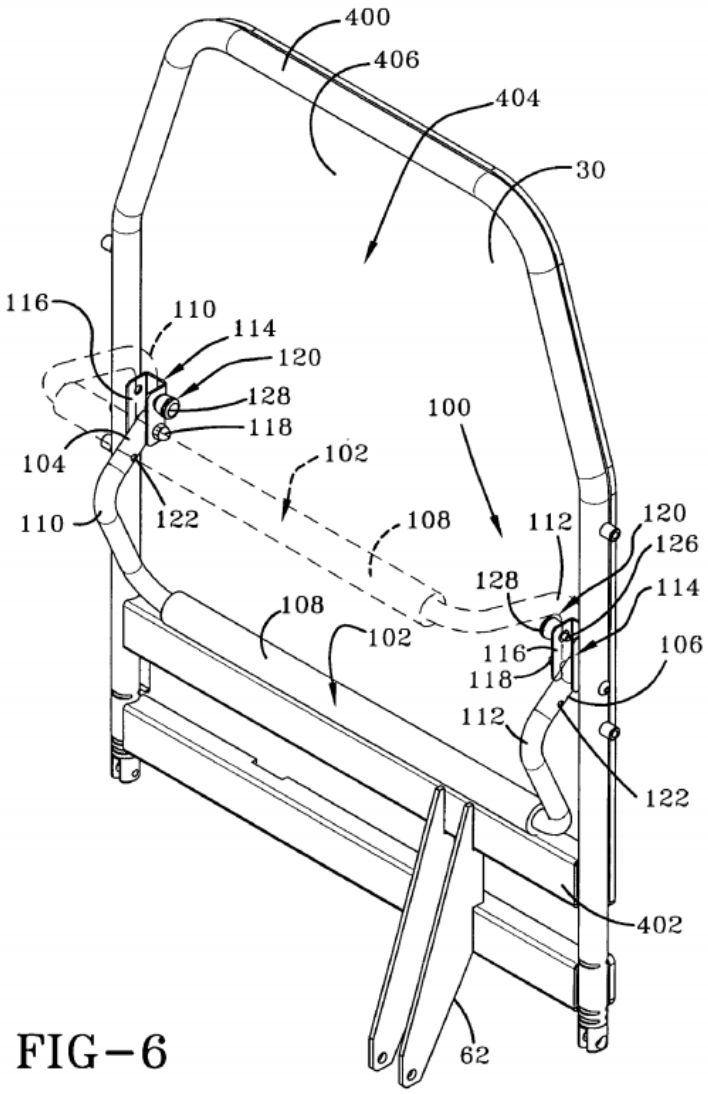


FIG-5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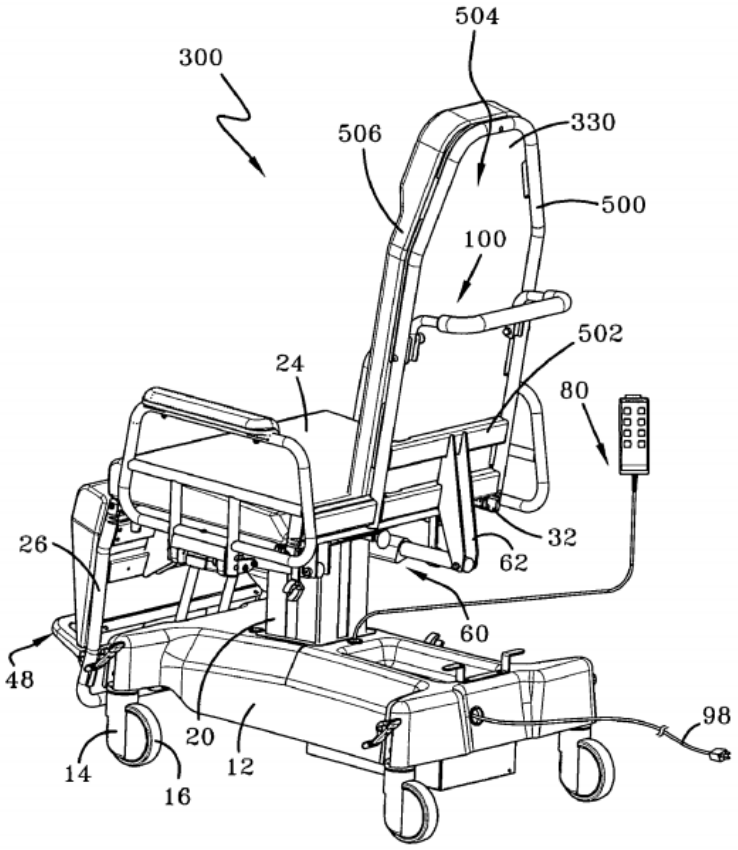
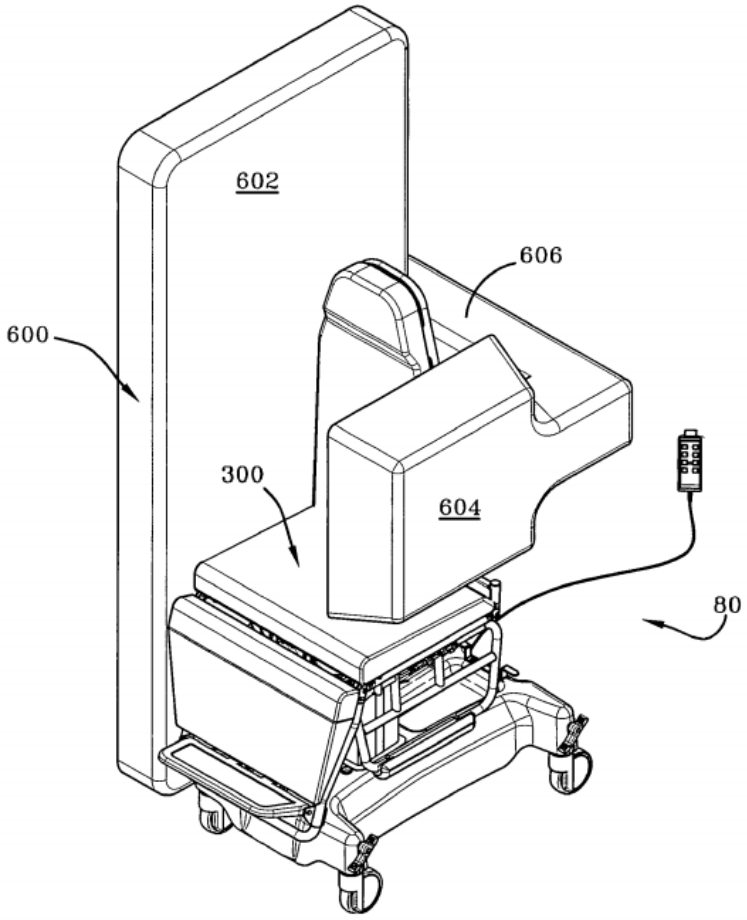
FIG−6



FIG−7



FIG−8

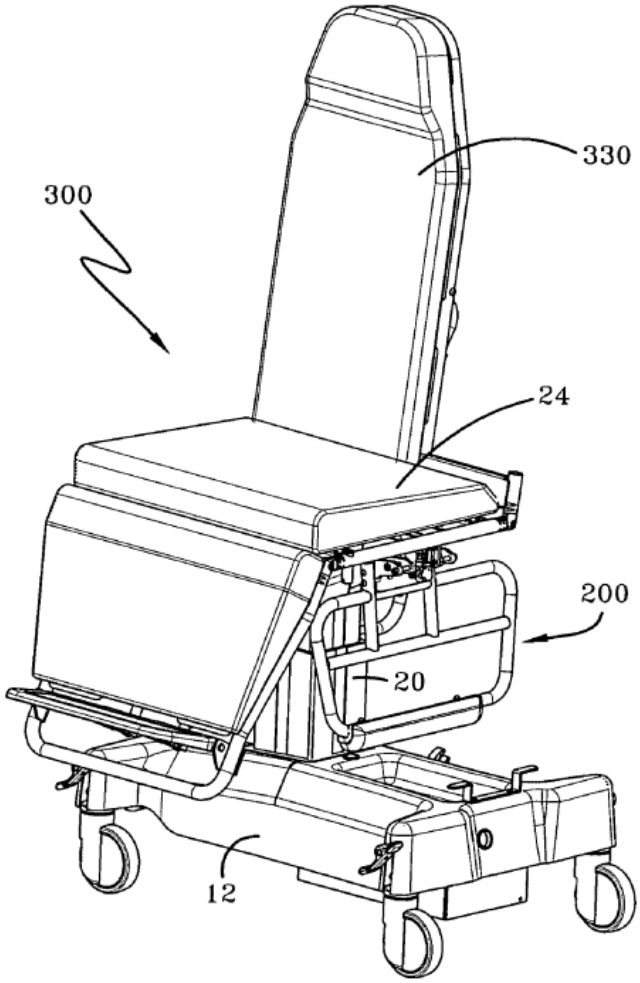
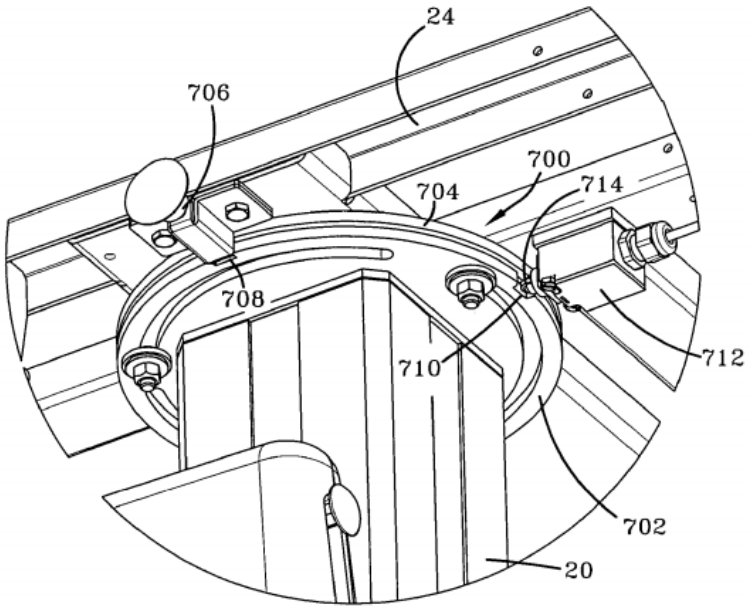


FIG-9



FIG−10

MULTI-PURPOSE PATIENT CHAIR

TECHNICAL FIELD

The present invention generally resides in the art of patient chairs and, more particularly, relates to a patient chair having features that make the chair particularly useful for radiographic and fluoroscopic procedures.

BACKGROUND ART

Mobile patient chairs are generally known in the art, and are used for patient transfer and transport, and, in some instances treatment and recovery, at medical facilities. They typically include a patient support structure that includes a seat section, a back rest, and a leg support section, wherein the back rest and leg support sections may be positioned relative to the seat section to provide a chair structure or stretcher structure, as needed. The support structure is generally carried on a base that rides on caster assemblies, which allow for transport of the patient chair. In these chairs, a patient can be quickly and safely moved from a sitting position to supine positions and vice versa.

Certain medical chairs in the prior art have been particularly useful in radiographic and fluoroscopic procedures wherein the patient is allowed to remain in the medical chair during such procedures. More particularly, some medical chairs are dimensioned to be received in radiographic and fluoroscopic machines (RF machines) at positions that allow a patient in the chair to be subjected to radiographic or fluoroscopic procedures. However, chairs in the prior art do not provide for manipulation of the support structure, particularly the back rest, once the medical chair is positioned in the RF machines. Thus, if it is determined that the patient is not properly oriented relative to the machine, or if the patient becomes uncomfortable, or, if for any other reason, the positioning of the support structure must be changed, the chair must be removed from its receipt in the RF machine.

Medical chairs used in conjunction with RF machines as generally disclosed above also typically include radiolucent back rests. With radiolucent back rests, radiographic or fluoroscopic procedures may be carried out to view medical conditions relating to the patient, from approximately the waist up to the top of the skull. However, the back rests of the prior art also typically provide push bars for transporting the medical chair on its caster assemblies. To preserve the radiolucent property of the back rest, these push bars are made to be removable from connection to the back rest. Because the push bar must be removed for a radiographic or fluoroscopic procedure, it presents a part that is separable from the remainder of the medical chair, and undesirably tedious to properly employ.

In some medical chairs, a foot rest portion may extend from the leg support section substantially perpendicular thereto to provide, as the name implies, a rest for the patient's feet. When the leg support section is raised to provide the medical chair with a stretcher structure, the foot rest must be folded down or else it will provide an obstruction to the patient when he or she attempts to lay down on the stretcher. In the prior art chairs, the foot rest must be manually manipulated to pivot upwardly against the leg support section in the stretcher structure, and must be manually manipulated to pivot downwardly in relation to the leg support section in the chair structure. This is another tedious and undesired exercise.

Thus there exists a need in the art for a medical chair that has a back rest that may be positioned even when the chair is placed within RF machinery. There also exists a need for a medical chair having a radiolucent back and a push bar for transporting the medical chair, wherein the push bar does not have to be removed to prevent obstruction of the radiolucent back. A need also exists for a medical chair having a foot rest portion that does not require constant tedious repositioning when the support structure of the chair is moved between a stretcher structure and a chair structure.

BRIEF DISCLOSURE OF THE INVENTION

In one embodiment, this invention provides a medical chair comprising a seat section; a radiolucent back rest pivotally secured to said seat section such that it may selectively extend from said seat section at desired positions in relation thereto; and a back rest actuator to selectively position said radiolucent back rest in relation to said seat section, wherein said back rest actuator does not compromise the radiolucent property of said radiolucent back rest. In medical chairs of the prior art, the mechanisms controlling the positioning of the back rest interfered to some degree with the radiolucent window of the back rests.

The prior art has also provided medical chairs having transport push bars that are removable to provide a radiolucent back rest, but the removal of the push bar is an added burden, and misplacing the push bar is common. Thus, in another embodiment, this invention provides a medical chair comprising a radiolucent back rest; and a push bar pivotally attached to said radiolucent back rest to move between an operative position, wherein said push bar is used to maneuver the medical chair, and a storage position, wherein said push bar does not compromise the radiolucent property of said radiolucent back rest.

The prior art has also failed to provide an efficiently functioning foot platform at the end of leg support sections. This invention provides such a medical chair comprising a seat section; a leg support section pivotally secured to said seat section such that it may selectively extend from said seat section at desired positions in relation thereto; and a leg support actuator that functions to adjust the position of said leg support section in relation to said seat section, wherein the position of said leg support section may range from substantially perpendicular to the plane of said seat section, in a chair configuration, to substantially parallel to the plane of said seat section, in a stretcher configuration; a foot rest section pivotally secured to said leg support section about an axis and providing a foot platform that remains substantially parallel to the plane of said seat section as said leg support actuator functions to adjust the position of said leg support section in relation to the plane of said seat section.

Each embodiment above, alone or in any combination, lends itself to an improved means for positioning a patient in radiographic and fluoroscopic machines (RF machines). More broadly, this invention provides a method for performing radiographic and fluoroscopic procedures on a patient, the method comprising the steps of supporting the patient in a medical chair comprising a seat section, a radiolucent back rest pivotally secured to said seat section such that it may selectively extend from said seat section at desired positions in relation thereto; and a remote control that controls the positioning of said radiolucent back rest relative to said seat section so that said radiolucent back rest is positionable from points distant from the medical chair; provisionally positioning the medical chair in a radiographic or fluoroscopic machine so as to provisionally position the patient supported thereon for a radiographic or fluoroscopic procedure; and adjusting the positioning of the medical chair and patient

supported thereon with said remote control after said step of provisionally positioning the medical chair.

BRIEF DESCRIPTION OF THE DRAWINGS

For a complete understanding of the objects, techniques and structure of the invention reference should be made to the following detailed description and accompanying drawings wherein:

FIG. **1** is a perspective view of a medical chair in accordance with this invention;

FIG. **2** is a side plan view showing the medical chair in a chair configuration and a stretcher configuration, the stretcher configuration being shown in phantom;

FIG. **3** is a rear perspective view of the medical chair;

FIG. **4** is a detailed view of the general configuration of the actuators employed to alter the configuration of the medical chair;

FIG. **5** is a closeup of the remote control that is used to alter the configuration of the medical chair;

FIG. **6** is a perspective view of the backside of the backrest of the medical chair, showing the attachment of a push bar thereto, in an operative position (in phantom) and a storage position (non-phantom);

FIG. **7** is a perspective view of another embodiment of a medical chair, wherein the backrest portion of the chair is not sized as wide as the seat section of the chair, such that the medical chair shown therein is particularly useful in fluoroscopic procedures, as is generally known;

FIG. **8** is a perspective view of the use of the medical chair of FIG. **7** in a radiographic and fluoroscopic machine;

FIG. **9** is a perspective view of the medical chair of FIG. **7**, shown with the patient support structure rotated on the telescoping support column 90 degrees relative to the base; and

FIG. **10** is an exploded view of the underside of the seat section, showing connection between the seat section and the telescoping column.

PREFERRED EMBODIMENT FOR CARRYING OUT THE INVENTION

Referring now to FIGS. **1** and **2**, a medical chair in accordance with this invention is designated generally by the numeral **10**. Base **12** provides support for medical chair **10** and rides on a plurality of caster assemblies **14** and associated wheels **16** so that chair **10** is mobile. Central brake system **18** selectively controls the ability of the caster assemblies **14** to swivel and the ability of the wheels **16** to rotate and lock. Preferably, a four wheel brake and steer caster system is employed, such systems being generally known in the art.

Telescoping support column **20** extends upwardly from base **12** to support a patient support structure that is generally designated by the numeral **22**. Patient support structure **22** includes various sections that may be positioned to provide a chair structure or stretcher structure or any compromise between these positions, as is generally known. Particularly, support column **20** supports seat section **24** generally parallel to the ground, and leg support section **26** is pivotally mounted to seat section **24** as at leg hinges **28**. Similarly, back rest **30** is pivotally mounted to seat section **24** as at back hinges **32**.

Leg support actuator **34** is mounted to the underside of seat section **24**, and communicates with leg support section **26** through mounting bracket **36**. In FIG. **4**, it is seen that sleeve **38**, which pivotally attaches to bracket **36** at pivot pin **42**, houses shaft **40**, which pivotally attaches to mounting bracket **37** outside of sleeve **38**. Sleeve **38** also houses a motor (not shown) that advances lead screw **44**, which communicates with threaded portion **46** of shaft **40**. By rotating lead screw **44** by means of the motor, sleeve **38** may be advanced to the left or to the right on shaft **40**, thus regulating the angle at which leg support section **26** extends from seat section **24**. At full retraction, leg support section **26** is substantially perpendicular to seat section **24** and, at full extension, is substantially parallel and on plane with seat section **24** (drawn in phantom in FIG. **2**). It will be appreciated that medical chairs are sometimes constructed to provide true right angles between a seat section and a leg support section, and the term "substantially perpendicular" thus covers an actual perpendicular relationship, as well as those close to perpendicular. The same applies to "substantially parallel."

Although a specific physical structure has been defined for advancing leg support section **26**, the functioning of leg support actuator **34** might be accomplished with other mechanisms, with the main concern here being the provision of an adjustable leg support section **26** at a position that does not interfere with the backrest of the chair. This will be disclosed more fully below.

Footrest **48** is pivotally secured to leg support section **26** at mounting brackets **50**. Footrest **48** provides foot platform **52** substantially parallel to seat section **24**. It is particularly preferred that foot platform **52** remain substantially parallel to seat section **24**, even as leg support section **26** is moved from full retraction (i.e., in a chair structure positioning) to full extension (i.e., a stretcher structure positioning). Thus, at least one footrest link **54** is pivotally secured between seat section **24**, at mounting bracket **56**, and footrest bracket **58**, which, it will be appreciated, is on the opposite side of the axis of rotation for footrest **48**, as defined by the pivotal securement at pivot pins **59** in mounting brackets **50**. As can be seen in FIG. **2**, as leg support section **26** is raised to its full extension, foot platform **52** is maintained substantially parallel to seat section **24** during the raising of leg support section **26**. This beneficial functioning of the foot platform might be accomplished with other mechanisms.

Backrest actuator **60** is also mounted to the underside of seat section **24**, and pivotally communicates with mounting bracket **62** attached to backrest **30**. Backrest actuator **60** operates through a sleeve, shaft, lead screw, and mounting bracket assembly, as does leg support section **26**; however, at full extension, backrest **30** is substantially perpendicular to seat section **24** and, at full retraction, is substantially parallel and on plane with seat section **24** (FIG. **2**).

Remote control **80** is provided to operate lead screw **44** of the leg support actuator **34** and the similar lead screw of backrest actuator **60**, either individually or in tandem. Control **80** extends from connection with appropriate electronics in base **12** and, in addition to controlling lead screws, also controls the height at which telescoping support column **20** maintains seat section **24**. With reference to FIGS. **3** and **5**, control **80** includes control pad **82**, electrically coupled by means of cord **84** to operate actuators **34** and **60** and adjust the height of telescoping column **20**. Control pad **82** includes back adjustment up button **86**U, and back adjustment down button **86**D, which respectively serve to advance backrest **30** up towards the chair structure and down toward the stretcher structure. Similarly, control pad **82** includes leg adjustment up button **88**U and leg adjustment down button **88**D, which respectively serve to adjust leg support section **26** upward toward the stretcher structure and downward toward the chair structure. Telescoping support column **20** is adjusted

by means of height adjustment up button **90**U and height adjustment down button **90**D. Finally, tandem stretcher button **94** serves to both raise leg support section **26** and lower backrest **30** so as to advance sections of patient support structure **22** toward the stretcher structure, and tandem chair button **96** serves to advance both leg support section **26** and back support section **30** toward their respective chair structure positions. Any appropriate electronics may be employed, and it is desired that control **80** be capable of being manipulated from a location remote from chair **10**.

The power for electronic manipulation of the positioning of chair **10** may be supplied by battery or by common communication with a wall outlet, as indicted at cord **98**. Preferably both means for supplying power are provided.

Referring now to FIGS. **3** and **6**, it can be seen that push bar assembly **100** is provided on the back of backrest **30** to allow an attendant to maneuver chair **10**. Push bar assembly **100** includes push bar **102** having first and second locking end portions **104**, **106** that extend to grip portion **108** at bends **110**, **112**. First and second locking end portions **104**, **106** are pivotally mounted to backrest **30** by associated locking mechanisms **114**. Locking mechanisms **114** include mounting brackets **116**, which pivotally secure first and second locking end portions **104**, **106** as at pivot pins **118**, so they can pivot between an operative position (in phantom in FIG. **6**) and storage position (non-phantom).

In the operative position, locking plunger **120** extends into recesses **122** provided in end portions **104**, **106**, to lock push bar **100** in place. Locking plunger **120** is spring biased in a conventional manner to extend into recess **122** when push bar **102** is moved to its operative position, and plunger **120** is provided with beveled tip **126** to ramp over ends **104**, **106** and "snap" into recess **122**. Plunger grip **128** may be gripped and pulled to counter the bias on locking plunger **120** and remove it from engagement with recess **122**, allowing push bar **102** to be pivoted to the storage position. The folding/storing position of the push bar is important in that it folds out of the way, thus permitting an unobstructed radiolucent clear backrest area, and, being attached at all times, it can not be lost or used as a weapon.

Preferred embodiments of medical chair **10** further include opposed side rail assemblies **200** that are pivotally mounted to seat section **24** to move from a support position, as shown in FIGS. **2** and **3**, to a storage position, as shown in FIG. **1**. Side rail assembly **200** includes rail weldment **202**, affixed to rail hinge **204**, which pivotally connects side rail assembly **200** to seat section **24** to pivot between a use position and a storage position. Arm pad **206** is secured to the top of rail weldment **202** to provide a comfortable armrest for a patient, in the use position. Clip **208**, under seat section **24**, clamps to a portion of rail weldment **202** to secure side rail assembly **200** in the storage position.

In the embodiments of FIGS. **1**–**3**, seat section **24** and backrest **30** have substantially identical widths. In another embodiment of this invention, as shown in FIG. **7**, an alternative medical chair **300** is shown having backrest **330**. The focus here is on the alternative backrest **330**, and other elements of chair **300** are substantially identical to chair **10** and have received like numerals to the extent necessary to disclose the particulars of backrest **330**. Backrest **330** is pivotally mounted to seat section **24**, as in the full-width backrest embodiment, at back hinges **32**, and can be advanced toward a chair structure or stretcher structure by backrest actuator **60**.

Backrests in accordance with this invention, whether full (as backrest **30**) or narrow (as backrest **330**), are preferably radiolucent. Thus, in particularly preferred embodiments, backrests **30**, **330** are substantially defined by frame members **400**, **500** and at least one bracket support **402**, **502** that provide a window **404**, **504** that is devoid of any material that would compromise the radiolucent property of the backrest. More particularly, radiographic backboards **406**, **506** are provided in these respective embodiments, supported by frame members **400**, **500**. Radiographic backboards **406**, **506** are formed from radiolucent materials, and may include, without limitation, phenolic materials, lexane materials and carbon fiber materials. It should be appreciated that, due to the existence of the at least one bracket support **402**, **502**, backrests **30**, **300** may technically be described as not being 100 percent radiolucent. However, it is appreciated in the art that backrests of the type shown, like backrests **30** and **330**, are "radiolucent" for all practical purposes inasmuch as the main torso area of a patient may be examined through radiographic or fluoroscopic procedures, even while the patient is resting in medical chair **10** or **300**. In accordance with these embodiments, backrests may range in size, having widths of from about 12 inches to about 24 inches and heights from about 25 to 35 inches. Of this height, the bottom 6 to 8 inches might have its radiolucent property compromised by mounting bracket **62** and at least one bracket support **402**, **502**, but, again, such backrests are still considered to be radiolucent backrests.

Referring now to FIG. **8**, as is known, chairs shaped substantially as those shown here are desired for use in performing radiographic and fluoroscopic procedures on a patient. In FIG. **8**, medical chair **300** is shown in a radiographic and fluoroscopic machine (RF machine) **600**, positioned in the caliper opening between the table **602** and the image intensifier **604**. Arm **606** connects between table **602** and image intensifier **604**. In FIG. **8** backrest **330** is positioned substantially parallel to arm **606**, although, as known in the art, medical chairs might be positioned in RF machine **600** with their backrest positioned perpendicularly to arm **606**. In the latter case, it is particularly important that backrest be radiolucent, as there should be no obstruction between image intensifier **604** and table **602**. In both situations, it might be necessary to further position the backrest or leg support section after provisionally positioning the medical chair between table **602** and image intensifier **604**. Remote control **80** provides this beneficial ability to further position the chair from a position remote from RF machine **600**. Intimate access to the medical chair, particularly the backside of the backrest is not required, as in the prior art.

To position a medical chair with its backrest perpendicular to arm **606**, the seat section of the medical chair is fixed to the telescoping column so as to selectively pivot 90 degrees thereon. This is shown in FIGS. **9** and **10**, with reference to medical chair **300**. This position is provided only for use during specific RF procedures when the length of the base of the chair prevents the chair from fitting in the RF machine. In FIG. **9**, seat section **24** has been rotated 90 degrees on telescoping column **20**, as compared to the position of seat section **24** in FIGS. **7** and **8**. In FIG. **10**, seat section **24** is in the position shown in FIGS. **7** and **8**, and the underside of seat section **24** and its interaction with telescoping column **20** is shown.

With reference to FIG. **10** it can be seen that the rotation of seat section **24** is accomplished by swivel assembly **700**. Swivel assembly **700** includes a stationary disk **702**, mounted on top of telescoping column **20**, and a rotating disk **704** mounted to seat section **24**. Rotating disk **704** and seat section **24** can thus rotate on stationary disk **702**. Rotation is limited by the interaction of a plunger **706** with first and second notches **708** and **710**, which are offset at 90

degrees along the 360 degree circle defined by disks **702**, **704**. By pulling on plunger **706** to remove it from notch **708**, seat section **24** may be rotated until plunger **706** engages notch **710**. When plunger **706** is engaged with notch **708**, chair **300** is positioned as in FIGS. **7** and **8**, and, when plunger **706** is engaged with notch **710**, chair **300** is positioned as in FIG. **9**.

In the position of FIGS. **7** and **8**, it will be appreciated that side rails **20**, whether up or down, extend outside of the boundaries of base **12**, such that telescoping column **20** may be adjusted up or down in relation to base **12**, without interference from side rails **200**. In the position of FIG. **9**, however, when side rails **200** are down, they rest directly above base **12**, and lowering seat section **24** too far on telescoping column may cause side rails **200** to either crush base **12** or be crushed by thereby. Therefore, a cut-off switch **712** is provided offset 90 degrees from plunger **706** to engage notch **710** when plunger **706** engages notch **708**, and serves to prevent the lowering of seat section **24** when positioned as in FIG. **9**. Switch **712** includes a biased roller **714** that has an extended position, wherein it engages notch **710**, as shown, and a retracted position, wherein biased roller **714** is pressed radially outward in relation to the center of stationary disk **702**. The retracted position is reached when seat section **24** is rotated on stationary disk **702** such that biased roller **714** is pressed inward as it is forced out of notch **710**. In the extended position, switch **712** is effectively off, and allows for the telescoping of seat section either up or down via telescoping column **20**. In the retracted position, which is reached when seat section **24** is rotated to the position of FIG. **9**, switch **712** is effectively on, and prevents the downward telescoping of seat section **24**. Thus, when seat section **24** is positioned on telescoping column **20** in a position where side rails **200**, if down, could be crushed by adjusting the height of seat section **24**, switch **712** ensures that the downward adjustment means (e.g., height adjustment down button **90**D of remote control **80**) is switched off.

Thus, medical chairs of the type disclosed herein allow for improved radiographic and fluoroscopic methods. A patient may be first supported in the medical chair and provisionally positioned in the RE machine. Thereafter, the positioning of the medical chair may be adjusted to fine tune the positioning of the patient within the RE machine.

Thus it can be seen that the objects of the invention have been satisfied by the structure presented above. While in accordance with the patent statutes only the best mode and preferred embodiment of the invention has been presented and described in detail, the invention is not limited thereto by thereby. Accordingly, for an appreciation of the true scope and breadth of the invention reference should be made to the following claims.

The invention claimed is:

1. A mobile medical chair comprising:

a seat section;

a radiolucent back rest;

a push bar pivotally attached to said radiolucent back rest to move between an operative position, wherein said push bar is used to maneuver the medical chair, and a storage position, wherein said push bar does not compromise the radiolucent property of said radiolucent back rest;

a locking mechanism that selectively locks said push bar in its operative position, said push bar being pivotally attached to said radiolucent back rest by said locking mechanism;

a leg support section, said leg support section and said radiolucent back rest being pivotally secured to said seat section such that they may selectively extend from said seat section at desired angles in relation to the plane of said seat section;

a leg support actuator that functions to adjust the angle of extension of said leg support section in relation to the plane of said seat section, wherein the angle of extension may range from substantially perpendicular to the plane of said seat section in a chair configuration of the medical chair to substantially parallel to the plane of said seat section in a stretcher configuration of the medical chair; and

a back rest actuator that functions to adjust the angle of extension of said radiolucent back rest in relation to the plane of said seat section, wherein the angle of extension of said radiolucent back rest may range from substantially perpendicular to the plane of said seat section in said chair configuration to substantially parallel to the plane of said seat section in said stretcher configuration, and wherein said leg support actuator and said back rest actuator are located beneath said seat section and do not compromise the radiolucent property of said radiolucent back rest.

2. The medical chair of claim **1**, wherein said push bar, in said storage position, does not obstruct the proper positioning of said medical chair in radiographic and fluoroscopic machines.

* * * * *

US 4729598 A – Patient chair system

United States Patent [19]

Hess

[11] **Patent Number: 4,729,598**

[45] **Date of Patent: Mar. 8, 1988**

[54] **PATIENT CHAIR SYSTEM**

[76] Inventor: **Jack H. Hess**, 15455 Ella Blvd., #75, Houston, Tex. 77090

[21] Appl. No.: **28,657**

[22] Filed: **Mar. 20, 1987**

[51] **Int. Cl.**[4] **A47C 7/72**

[52] **U.S. Cl.** **297/180;** 297/453; 297/439; 5/453

[58] **Field of Search** ..... 297/180, 453, DIG. 10; 5/453, 455, 469

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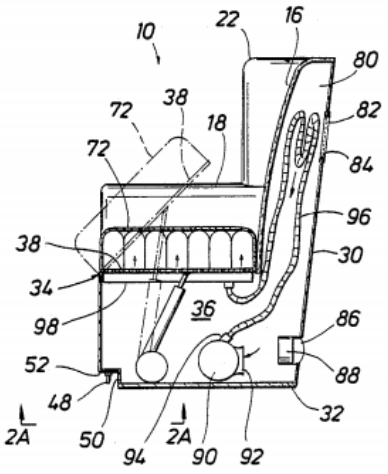
Primary Examiner—Francis K. Zugel

[57] **ABSTRACT**

A convalescent chair for hospital and nursing home patients and the like including a chair structure forming a back rest, arm rests and shoulder and head support for patients. A seat support structure is pivotally connected to the forward portion of the chair structure and is elevated by a motorized jack from a substantially horizontal position to an inclined position to assist in raising a patient from the seated position to the standing position. A plurality of air sacs and a therapy pad are supported by the seat support structure and are supplied filtered and cooled air to provide sufficient air flow for inflation of the air sacs and for effective discharge of air from the upper portion of the air sacs. An air distribution conduit extending from a blower to an air supply manifold in assembly with the seat support structure forms a heat exchanger portion so that air being drawn through an internal chamber of the chair by an exhaust fan imparts cooling to air flowing through the air distribution conduit.

18 Claims, 8 Drawing Figures



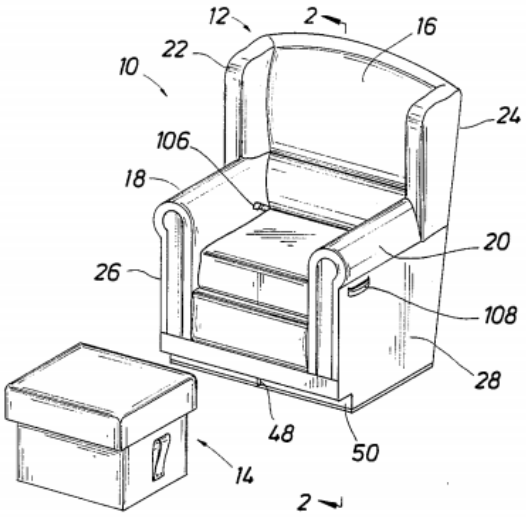


FIG. 1

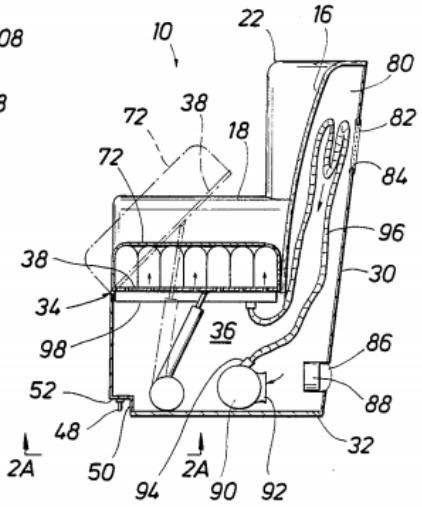
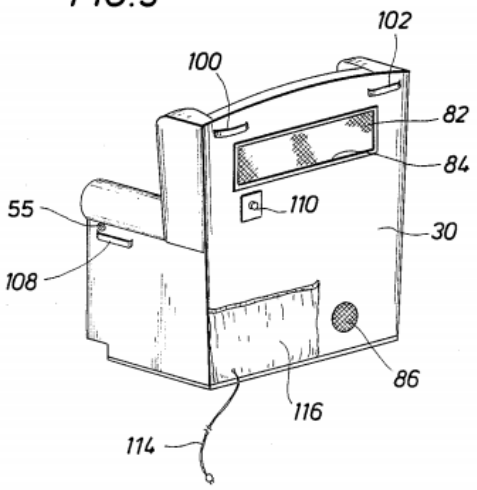


FIG. 2

FIG. 3



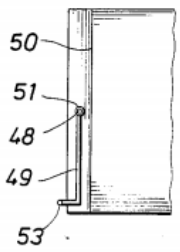


FIG. 2A

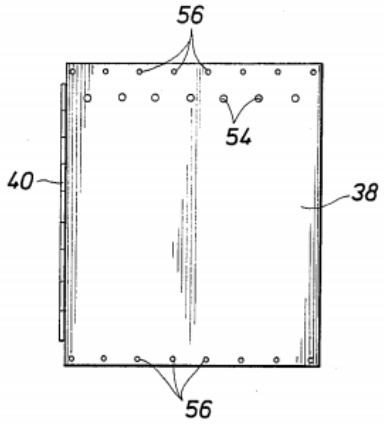


FIG. 4

FIG. 5

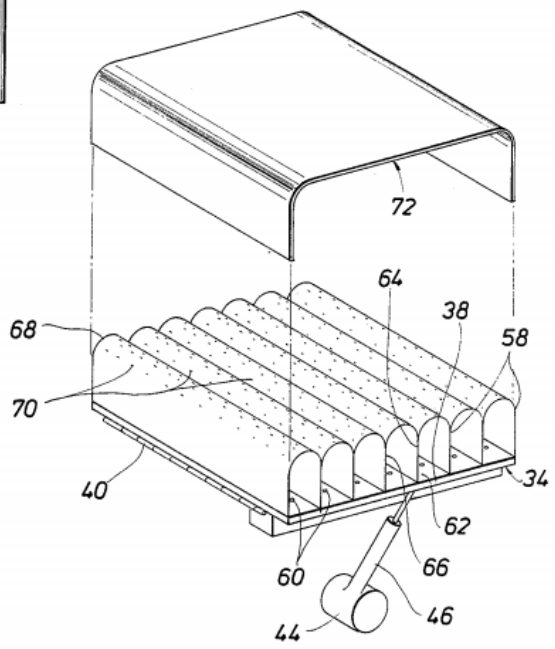


FIG. 7

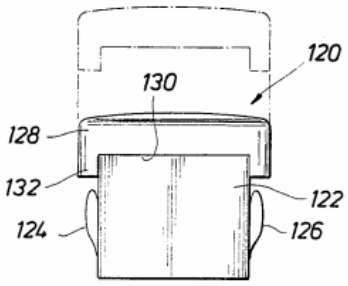
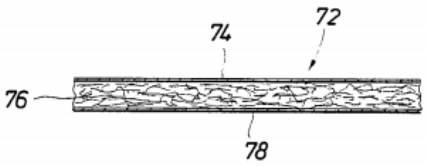


FIG. 6



PATIENT CHAIR SYSTEM

FIELD OF THE INVENTION

This invention is directed generally for chairs for use in and about various patient care facilities such as hospitals, nursing homes and also for use in the domestic environment such as by convalescing persons, elderly persons and the like. More specifically, the present invention is directed to a patient chair system forming a seat or bottom portion having a plurality of air sacs for efficient patient weight distribution to minimize the development of pressure induced lesions and to provide for efficient temperature control and moisture removal for patient comfort to enhance the convalescing progress of the patient toward a more healthy condition.

BACKGROUND OF THE INVENTION

It is well known that a convalescing patient will spend a great majority of time in bed. Many different types of hospital beds have been developed to enhance the care and comfort of the patient during convalescent activities. For example, the bed structures disclosed in U.S. Pat. Nos. 3,822,425, 3,909,858, 4,488,322 and 4,638,159 are specifically designed to protect patients from the development of pressure induced lesions or bed sores during protracted patient convalesce. At times however, it is quite beneficial for patients to assume a comfortable sitting position and to move about. For this reason, many hospitals, nursing homes and other convalescent centers are provided with chairs for use by patients. In most cases, the chairs are simply large, stuffed chairs which provide for patient comfort. In many cases these chairs are covered with a water resistant material such as any one of a number of commercially available polymer materials which will not remove moisture from the patient and which will not provide for cooling of the patient. In fact, a great majority of the materials utilized for chair covers will retain heat and moisture rather than permit removal or dissipation of heat and moisture from the skin tissue of the patient. In virtually all cases hospital chairs are provided with seats which only provide for patient support and comfort and do not protect the patient against the development of pressure induced lesions.

Convalescing patients must frequently sit in chairs for extremely long periods of time without changing positions. Since in the sitting position majority of the patient's weight is applied to the seat portion of the chair the mechanical pressure between the patient's skin and the seat portion of the chair is frequently great enough for the development of pressure lesions. The skin and sub skin tissues of the patient contain a multitude of capillaries for circulating blood to the skin. If the mechanical pressure of the skin against the surface of a bed, chair is sufficiently great that the capillaries are collapsed or restricted, there is insufficient blood supply to portions of the skin tissue. This condition of poor blood supply causes the skin and sub skin tissue to deteriorate, thus developing pressure induced lesion or bed sores. The blood supply at the skin of the patient also provides for effective transmission of moisture from the patient in the form of perspiration. It is desirable therefore that the chair system provide effectively for removal of moisture from the patient and to also provide for cooling of the patient. Obviously under circumstances where ineffective cooling takes place certain areas of

the patient's skin tissue is subjected to excessive heat which is a contributing factor to the development of pressure induced lesions. Further, moisture continuously present at the skin of the patient also enhances the development of pressure induced lesions and prevents efficient healing of the skin tissue after pressure lesions have developed. In the case of patients sitting in chairs, the skin tissue about the buttocks and thighs of the patient is frequently subjected to excessive mechanical pressure conditions which enhance the development of pressure lesions. It is desirable therefore to provide for efficient, even distribution of the weight of a patient over a substantial area of the seat portion of the chair to thus minimize the mechanical pressure induced to any portion of the patient's skin surface. It is also desirable to provide for efficient moisture removal and cooling from the bottom or seat portion of the chair to thus provide efficiently for patient comfort and to enhance therapeutic activity when the patient is in a seated position.

In many cases hospital chairs are merely plain stuffed, comfortable chairs. When elderly or physically unsound patients are sitting in these chairs the patient can slump to one side and become uncomfortable without possibility of being shifted to a comfortable position unless nursing personnel provides such assistance. It is desirable therefore to provide a chair system incorporating means for efficient support of the patient to prevent undesirable slumping. In many cases patients are connected to other therapeutic apparatus during the times they are seated in hospital chairs. For example intervenous fluid equipment may be utilized or the patient my be intubated such as with a trachea tube, food supply tubes, etc. It is desirable therefore to provide a chair system which will effectively prevent the patient from inadvertently dislodging other hospital apparatus while seated in a convalescent chair.

SUMMARY OF THE INVENTION

It is therfore a primary feature of the present invention to provide a noval convalescent chair which effectively minimizes mechanical pressure to the skin of the patient while the patient is seated.

It is another feature of the present invention to provide a novel convalescent chair which provides for effective moisture removal and heating or cooling of the patient as in appropriate for enhancing comfort and therapeutic activity.

It is another feature of this invention to provide a novel convalescent chair which may be utilized for long periods of time by patients without any significant risk of developing pressure induced lesions.

It is another important feature of this invention to provide a novel convalescent chair having restraining apparatus to permit effective control of the position of the patient even though the position may not have the capability of personal support in a seated position.

It is another feature of this invention to provide a novel convalescent chair which may be effectively activated by nursing personnel to enhance lifting of a patient from the seated position to the standing position without requiring nursing personnel to lift the entire weight of the patient.

Another important feature of this invention includes the provision of a novel convalescent chair having a plurality of air sacs for patient support and wherein the air sacs and air supply system therefor are designed to

provide efficient patient support regardless of the weight or physic of the patient.

It is another feature of this invention to provide for efficient support of the feet of a patient depending upon needs selected by nursing personnel, which is provided in the form of a multi-position ottoman that may be positioned for efficient support of the feet and legs of the patient.

Briefly, the present invention is accomplished through the provision of a patient convalescent chair which includes a chair frame having a back rest, arm rests and lateral shoulder supports for the patient. The convalescent chair mechanism also includes a bottom or seat support having a plurality of air sacs each having an inlet receiving pressurized and filtered air from an air supply system. The air sacs are provided with multiple pin holes in spaced relation about the upper surface thereof such that air continuously escapes from the air sacs through the pin holes and is directed upwardly toward the patient. The air sacs are covered with a removable therapy pad having an internal layer of soft fiberous material such as Dacron TM which is sandwiched between upper and lower panels of sheet material. The upper panel of sheet material is impervious to water, solids and air and is pervious to water vapor. This upper panel may be in the form of a Nylon ® Taffeta panel having a monolithic coating. The lower layer of material may be formed by a suitable fabric such as uncoated Nylon ® fabric which permits air circulation therethrough from the pin holes of the air sacs to thereby provide a condition of turbo charged osmosis to remove moisture from the patient which is attracted through the upper panel by osmosis or capillary attraction.

The seat portion of the chair is pivoted at the front portion of the chair and is activated mechanically by a motorized screwjack or by any other suitable lifting mechanism to enhance lifting of the patient from the seated position to a standing position. An appropriate foot activated switch is located at the lower portion of the chair and is operable by the foot of nursing personnel to control lifting movement of the seat while steadying or partially supporting the patient during lifting of the patient to the standing position. The patient may also be steadied by a nurse during seating activity while the pivotal seat lowers the patient to the seated position.

Air being circulated through the air sacs is filtered at an air inlet to prevent the inside of the chair and air sacs from being contaminated by dust and other particulates. Thus filtered air is provided by a blower to inflate the air sacs and provide a sufficient volume of air to compensate for air discharged from the pin holes of the air sacs. To compensate for the increased heat of air compression by the air blower a long air distribution conduit supplying the air sacs forms a heat exchanger portion. External air is then drawn through a filter and across the heat exchanger portion by an exhaust fan. The flowing air of the air distribution conduit is cooled so that the patient is supplied with air at an appropriate temperature for comfort.

To enhance the comfort of the patient in the seated position a nove ottoman device is provided which is basically in the form of a support pedestal having a removable cap portion. The pedestal may be employed without the cap to establish an intermediate leg position of the patient. The cap may be positioned on the support pedestal for a more elevated position of the legs of the patient. The cap portion may be removed and used independently to support the feet or legs of the patient in a lowered position.

For auxiliary support of the patient while sitting in the chair, strapped loops are provided on the back and adjacent the arm rest portions of the chair. To support the upper body portion of the patient a pair of support straps may be connected to the back portion of the chair and may be crossed over the chest of the patient to thus provide efficient support to prevent the patient from slumping forwardly or sidewardly in the chair. Strap loops adjacent the arm rest portions of the chair enable straps to be utilized to secure the lap or upper leg portions of the patient and perhaps the arms of the patient to prevent inadvertent removal of tubes from a patient undergoing therapeutic activity.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the manner in which the above recited features, advantages and objects of the present invention are attained and can be understood in detail, more particular description of the invention, briefly summarized above, may be had by reference to the specific embodiments thereof which are illustrated in the appended drawings, which drawings form a part of this specification.

It is to be understood, however, that the appended drawings illustrate only a typical embodiment of this invention and therefore are not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments. In the Drawings

FIG. **1** is an isometric illustration of a patient convalescent chair and ottoman constructed in accordance with the present invention.

FIG. **2** is a sectional view of the convalescent chair of FIG. **1** showing the normal position of the chair seat in full line and the pivotally elevated position of the chair seat in broken lines.

FIG. **3** is an isometric illustration of the convalescent chair of FIG. **1** shown from the rear and side portions thereof.

FIG. **4** is a plan view of the seat support platform of the convalescent chair of FIGS. **1–3** with the air sacs removed therefrom.

FIG. **5** is an isometric illustration of the seat platform with the air sacs attached thereto.

FIG. **6** is a fragmentary sectional view of the therapeutic pad system of the convalescent chair hereof.

FIG. **7** is a sectional view of the ottoman of FIG. **1** illustrating the cap structure thereof in assembly with the support pedestal.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings and first to FIG. **1** a patient convalescent chair system constructed in accordance with the present invention is illustrated generally at **10** and incorporates a basic chair assembly shown generally at **12** and an ottoman assembly illustrated generally at **14**. The chair assembly **12** incorporates a back rest portion **16**, arm rests **18** and **20** and transverse shoulder and head support portions **22** and **24**. The chair construction also defines side walls **26** and **28** and a rear wall **30** which, in addition to providing basic chair structure, also cooperate with a bottom wall **32** and a seat support panel **34** to form an enclosure or compartment **36** within which various power energized components of the chair system are located.

The seat support structure **34** which is shown in FIGS. **1**, **4** and **5** comprises a generally rectangular support plate **38** which may be composed of any one of a number of suitable strong and lightweight material. For example, the support plate **38** may be composed of ¾" plywood having a layer of fiberglas which forms the upper surface of the support plate. As shown in the plan view of FIG. **4** the support plate **38** is secured by an elongated hinge **40** to the front portion of the chair structure and is therefore pivotal forwardly to raise the seat portion of the convalescent chair and thus accomplish elevating movement of the patient in the chair toward the standing position. During patient raising activity of this nature, nursing personnel can stabilize the patient and provide a patient guiding function with very little lifting being necessitated. A motor **44** which may be electrically energized or energized in any other suitable fashion operates a jack mechanism **46** to raise and lower the support plate **38**. The jack mechanism **46** may conveniently take the form of a screw jack or any other suitable linear actuator capable of providing sufficient mechanical energy to raise and lower the support plate **38** with a patient seated thereon. The motor **44** is energized by means of a power and control circuit including a switch actuator rod **48** which is engaged by the foot of nursing personnel to accomplish controlled raising or lowering of the support panel **38** without necessitating the use of the hands to do so. The switch rod **48** is connected to a suitable switch assembly for controlling activation of the motor **44** in the desired manner for extension or contraction of the jack mechanism **46**. The switch rod **48** is located within an angular recess in the lower front portion of the chair assembly, which recess is defined by chair surfaces **50** and **52**. The angular recess permits a nurse to stand close to the patient so that nurse will be in a better position for applying lifting or stabilizing force to the patient as necessary. The switch **48** depends downwardly from the surface **52** and thus is located at an out of the way position to prevent it from being activated by the patient or inadvertently activated by cleaning personnel. The switch **48** is located centrally of the front portion of the chair thereby enabling nursing personnel to stand in front of the patient and activate the swtich **48** with a foot in the appropriate direction for raising or lowering the support panel **38**. Thus, the arms of the nursing personnel are free to stabilize and guide the patient as the patient is lifted by the chair apparatus to a standing position. Conversely, with the seat structure of the chair elevated in the manner shown in broken lines in FIG. **2**, a patient is enabled to lean against the seat portion and be gradually lowered to the seated position by nursing personnel while being steadied by a nurse controlling the switch **48** by foot engagement therewith.

As shown in the plan view the support plate **38** is provided with a plurality of spaced air inlet opening fittings **54** which are each located between pairs of snap elements **56** which are affixed to opposed edge portions of the support panel. A plurality of air sacs **58** are provided which are disposed in side-by-side relation on the upper surface portion of the support panel **38**. The air sacs are composed of a flexible material which is impervious to air and water. For example, the air sacs may be composed of heat sealed Nylon ®. Each of the air sacs **58** includes an air inlet fitting **60** which is receivable within respective ones of the air inlet opening fittings **54**. Each of the air sacs incorporate mating snap elements which are receivable by snap elements **56** of the support panel **38**. Thus, the air sacs are secured to the support plate by the respective snap elements **56** and air communication is established with the interior of the air sacs by means of the air inlet openings formed by interrelated fittings **54** and **60**. The air sacs cooperatively form a support for the buttocks and thigh portions of the patient and function to establish a large surface area of contact with the patient in order that mechanical force to any specific portions of the patient's skin is minimized so that capillary blood supply can function effectively to maintain skin tissue healthy. Each of the air sacs defines a bottom wall **62** and a pair of opposed sidewalls **64** and **66**. The air sacs also form a curved elongated upper wall **68** having multiple pin holes **70** formed therein. The pin holes **70** provide for discharge of air along the upper surface portions of the air sacs. This air discharge is utilized for efficient cooling of the patient and for removal of moisture such as is developed by perspiration.

A therapy pad illustrated generally at **72** is connected to each corner of the support panel **38** or to the front portion of the chair assembly adjacent the support panel by means of snaps or other suitable connector devices. The therapy pad is utilized by folding it over the air sacs **58** such that it overlies the upper perforated surface portions **68** of the air sacs with the free end thereof being secured between one of the air sacs and the back rest portion of the chair. As shown in the partial sectional view of FIG. **6** the therapy pad **72** includes an upper layer or panel of material **74** which is pervious to water vapor and impervious to air. The layer or panel **74** is composed of a fabric material such as Nylon ® Taffeta for example which is provided with a monolithic coating of a composition rendering it pervious to water vapor and impervious to air. As a patient perspires the moisture is conducted away from the patient by osmosis or capillary attraction and passes through the monolithic coating and into the panel **74**. Immediately below the panel **74** is provided a suitable thickness of fiberous material **76** such as Dacron TM fibers which form a pad of suitable thickness. The loose Dacron TM forming the pad permit air to circulate through the fiberous pad and to attract any moisture accumulation from the panel **74**. The lower panel **78** of the therapy pad **72** is in the form of a suitable fabric material which permits passage of air from the pin holes of the air sacs upwardly into the fiberous pad formed by the fibers **76**. For example, the lower panel **78** may conveniently take the form of an uncoated Nylon ® fabric material.

As shown particularly in FIG. **2** the back rest portion of the chair assembly shown at **16** forms an internal compartment **80** which is in communication with compartment **36**. The back portion of the chair construction is provided with a filter **82** which is received within a filter opening **84**. At the lower portion of the back panel **30** of the chair is provided an exhaust fan **86** which is energized by an electric motor **88** or by any other suitable fan drive system. The exhaust fan **86** exhausts air from the chamber **36** and the chamber **80** and thus draws air through the filter **82**. Air drawn into the chambers **80** and **36** is therefore substantially free of dust and other contaminants which are excluded by the filter.

Within the compartment **36** is provided an air blower **90** which is also energized by an electric motor and includes an air intake **92** in communication with the chamber **36**. The air blower **90** includes an exhaust **94** to which is coupled a cooling and air delivery holes **96**. As

the air of the chamber **36** is compressed by the blower **90** its temperature is increased by virtue of compression. For cooling of the air exiting from the discharge **94** of the blower the hose **96** has considerable length with a portion of it extending upwardly into the chamber **80** defined by the back rest portion of the chair. This upwardly extending portion of the hose **96** is disposed in serpentine configuration and provides considerable surface area which is contacted by cool air being drawn through the filter **82** and into the chamber **80** by the suction of the exhaust fan **86**. Thus, the hose **96** functions as a heat exchanger to remove the heat of compression from the air exiting the discharge of the blower. The hose **96** is formed of thin, convoluted material which permits it to have significantly large surface area for good heat exchange quality. The hose **96** is coupled with an air distribution manifold **98** which is secured to the lower portion of the support panel **38**. The air distribution manifold is provided with a number of spaced openings which are in communication with respective ones of the openings **54** of the support panel.

As shown in FIG. **3** the rear panel of the chair is provided with a plurality of strap connector elements **100**, **102**, **104** and **106**. Each of the side portions of the chair is provided with at least one strap connector element such as shown at **108**. To prevent a patient from slumping in the chair such as when the patient might fall asleep or when the patient becomes otherwise unable to sit upright, it is appropriate to provide for patient support. Accordingly, chest straps may be appropriately secured such as between strap connectors **100** and **106** and between strap connectors **102** and **104**, thus providing support straps that cross across the chest of the patient. These straps will effectively support the patient and provide for patient safety and security even under circumstances where the patient might have fallen asleep. In the event the patient is intubated or connected to interveneous treatment apparatus the patient support apparatus will stabilize the patient and prevent the tubes or catheters from being inadvertently withdrawn from the patient. The strap connectors **108** on the side portions of the chair enable the patient also to be secured by means of a strap that extends across the lap of the patient or which forms a seat belt to prevent the patient from sliding as the seat is tilted. Also, arm restraint straps may also be secured to the strap connectors **108** in the event such is deemed appropriate by nursing personnel.

Also on the back panel **30** of the chair is provided an electrical control switch **110** which may be activated by nursing personnel to energize the exhaust fan and air blower systems of the chair. An electrical cord **112** extends from the back portion of the chair and is provided with a suitable electrical connector **114** to enable operation of the chair by means of conventional 115 volt electrical power. At the lower rear portion of the chair is provided a flexible pocket **116** into which the electric cord **112** may be placed when the chair is not in service. The pouch or pocket **116** is also of sufficient dimension to contain any other suitable equipment which is utilized in conjunction with the patient chair system.

For support of the feet and legs of the patient in proper position for efficient therapy and comfort, the patient chair system is provided with a two piece ottoman shown generally at **120**. The ottoman includes a support pedestal **122** which is shown to be of generally rectangular form but which may take any other suitable configuration within the spirit and scope of the present invention. A pair of lift loops **124** and **126** are secured to opposed side portions of the support pedestal **122** to provide for lifting of the ottoman when its movement is desired. The ottoman is also provided with a removable cap structure **128** having a recess **130** which receives the upper portion of the support panel. Thus, side portions **132** of the cap structure **128** extend downwardly over the top portion of the support pedestal and maintain the cap **128** in proper assembled relation with the support pedestal. In the condition shown in FIG. **7** the feet or lower legs of the patient will be supported in their most elevated position by the two piece ottoman assembly. If the legs of the patient are intended to be lowered slightly, the cap element **128** is removed and the legs and feet of the patient are then supported by the upper portion of the support pedestal. If the patient's legs and feet should be even further lower but yet supported, the support pedestal is set aside and the cap member **128** is used to provide support for the feet and legs of the patient. This feature enables the positions of the patient's feet to be changed from time to time simply by adjusting the character of the ottoman as is desired to enhance patient comfort or therapy.

In order to utilize the patient chair system of this invention, nursing personnel will simply connect the power cord **112** to an appropriate electrical outlet and move the switch **110** to the on or operate position. The exhaust fan **86** and the air blower **90** will become immediately energized thereby introducing pressurized air from the blower through the hose **96** and into the air distribution manifold **98** where it enters and inflates the various air sacs **58**. If the patient is able to move from the standing position to the seated position, the support platform **38** and its air sac assembly is allowed to remain in the position shown in full lines in FIG. **2**. In the event the patient needs assistance to move from the standing position to the sitting position the nurse will engage the switch control rod **48** with the nurses foot and move it to the appropriate position for raising the seat portion of the chair toward the broken line position shown in FIG. **2**. The patient can then lean against the elevated inflated air sacs covered by the therapy pad **72**. Thereafter the nurse will reverse the position of the switch rod **48** thus causing the jack motor to reverse for lowering the inflated seat assembly with the patient to the full line position shown in FIG. **2**. Nursing personnel will not be required to support any significant weight of the patient during this seating activity. During operation of the mechanism the heat induced to the air by compression activity of the blower **90** will be effectively removed by the heat exchange capability of the elongated, serpentine hose **96** with filtered air flowing across it from the filter **82**. Thus, filtered and cooled air will be forced by the blower through the hose **96** and into the air distribution chamber **98** for injection into the various air sacs **58**. The air will be discharged from the air sacs through the pin hole perforations in the upper curved portions thereof and will flow into the therapy pad to provide the lower portion of the patient with effective cooling and moisture removal. The air sacs will evenly distribute the weight of the patient over a significantly large area to maintain mechanical compression of the skin tissues of the patient at a minimum level efficient for maintaining efficient blood flow through the capillaries of the skin tissue. Thus, there will be no tendency for the development of pressure induced lesions.

The patient may be strapped to the chair system by straps extending across the chest of the patient, by arm or lap straps in the manner discussed above. Thus, infirm patients may be effectively secured within the chair system and there will be no tendency for patients to inadvertently pull away tubes and catheters etc.

When it is desired to remove the patient from the chair, nursing personnel will stand in front of the chair and steady the patient such as by grasping the shoulders. The foot switch rod **48** will then be activated appropriately to raise the seat portion of the chair to the broken line position shown in FIG. **2**. Thus, the patient will be raised from a seated position to a substantially standing position without any necessity for the nurse to provide significant lifting or force. After the patient has been removed from the chair the foot switch may again be manipulated to lower the seat portion of the chair to the full line position shown in FIG. **2**. Thereafter, the electrical system of the chair may be deengergized simply by shifting the switch **110** to its off position.

The therapy pad which has protected the upper portion of the air sacs from direct contact with the patient may be removed from the chair for cleaning. This feature effectively prevents any significant cross contamination of patients from any moisture that might have accumulated within the therapy pad.

In view of the foregoing it is seen that the present invention is one well adapted to attain all of the objects and features hereinabove set forth together with other features which are inherent in a description of the apparatus itself. It will be understood that certain combinations and subcombinations are of utility and may be employed without reference to other features and subcombinations. The scope of this invention is intended to be limited only by the scope of the intended claims and is not limited by the specific embodiment shown and described herein.

I claim:

1. A convalescent chair for hospital and nursing home patients and the like, comprising:

(a) a chair structure forming a back rest, arm rests and shoulder and head supports for patients, said chair further forming seat support means and forming an enclosure therein and an air inlet opening for said enclosure communicating said enclosure with environmental air;

(b) a plurality of air sacs being secured in side by side relation to said seat support means and having multiple air vent holes formed in the upper surfaces thereof;

(c) means communicating pressurized air into said air sacs to inflate the same and to provide a sufficient flow of air into said air sacs to compensate for discharge of air from said multiple holes;

(d) means for exhausting air from said enclosure and stimulating air flow through said air inlet opening of said enclosure;

(e) electrically energized air blower means located within said enclosure and forming air intake and discharge openings; and

(f) an elongated heat exchanger conduit interconnecting said discharge opening of said electrically energized air blower means with said plurality of air sacs for supply of pressurized air to said air sacs, said elongated heat exchanger conduit being so located within said enclosure that air being drawn through said air inlet opening of said enclosure by said air exhausting means and said electrically energized air blower means is passed over said elongated heat exchanger conduit for cooling air being being discharged from said air blower.

2. A convalescent chair as recited in claim **1** wherein:

(a) said seat support means is pivotally connected to the front portion of said chair structure; and

(b) seat elevation means is incorporated within said chair structure and is interconnected with said seat support means, said seat elevation mechanism being controllably energized for pivoting said seat support means from a substantially horizontal position to an inclined position.

3. A convalescent chair as recited in claim **2** wherein said seat elevating means comprises an electrically energized screw jack.

4. A convalescent chair as recited in claim **1** wherein said seat support means comprises:

(a) a generally rectangular seat support panel having a plurality of air inlet openings formed therein;

(b) said air sacs having air inlet openings, fittings mating with said air inlet openings of said seat support panel;

(c) an air distribution manifold being in communication with each of said air inlet openings; and

(d) said elongated heat exchanger conduit conducting pressurized air from said electrically energized air blower means to said air distribution manifold.

5. A convalescent chair recited in claim **1** wherein:

(a) a portion of said elongated heat exchanger conduit forms a serpentine heat exchanger configuration; and

(b) said electrically energized air blower means and said air exhausting means induce flow of environmental cooling air across said elongated heat exchanger conduit for removing heat therefrom for cooling of air flowing therethrough.

6. A convalescent chair as recited in claim **5** wherein said means for inducing air flow comprises:

(a) a filter being disposed within said air inlet opening into said enclosure to filter air drawn therein; and

(b) an air exhausting means comprising an exhaust fan being disposed within said enclosure and exhausting air therefrom, said exhaust fan developing a suction condition within said enclosure thus drawing air through said filter and across said elongated heat exchanger conduit.

7. A convalescent chair as recited in claim **1** including a plurality of strap connectors being secured to back and side portions of said chair structure and adapted to receive straps for supporting a patient seated within said convalescent chair.

8. A convalescent chair as recited in claim **1** wherein:

(a) said chair structure defines an internal enclosure defined beneath said seat support means and within said back rest;

(b) said electrically energized air blower means has an intake thereof located within said enclosure and a discharge coupled with said elongated heat exchanger conduit;

(c) said elongated heat exchanger conduit having a portion of serpentine configuration located within said enclosure of said back rest.

9. A convalescent chair as recited in claim **8** wherein said air distribution hose is of convoluted configuration establishing a large air contact area to enhance the air cooling capability thereof.

10. A convalescent chair as recited in claim **1**, including:

(a) a support pedestal adapted to be positioned in front of said chair structure; and

(b) a cap member being received by the upper portion of said support pedestal and providing a support surface for supporting the feet and legs of a patient seated in said chair structure.

11. A convalescent chair as recited in claim **10** wherein said cap member forms a recess receiving the upper portion of said support pedestal, said cap member being restrained against transverse movement relative to said support pedestal.

12. A convalescent chair for hospital and nursing home patients and the like, comprising:

(a) a chair structure forming a back rest, arm rests and shoulder supports for patients and forming an enclosure therein and an air inlet opening for said enclosure communicating said enclosure with environmental air;

(b) a seat support structure being pivotally connected to the front portion of said chair structure;

(c) a motorized jack mechanism being located within said chair structure and being operative to impart pivotal movement to said seat support from a substantially horizontal position to an inclined position;

(d) a plurality of air sacs being mounted in side-by-side relation on said seat support, said air sacs each forming curved perforate upper surfaces for air distribution beneath a patient;

(e) means for exhausting air from said enclosure and stimulating air flow through said air inlet opening of said enclosure;

(f) electrically energized air blower means located within said enclosure and forming air intake and discharge openings; and

(g) an elongated heat exchanger conduit interconnecting said discharge opening of said electrically energized air blower means with said plurality of air sacs for supply of pressurized air to said air sacs, said elongated heat exchanger conduit being so located within said enclosure that air being drawn through said air inlet opening of said enclosure by said air exhausting means and said electrically energized air blower means is passed over said elongated heat exchanger conduit for cooling air being discharged from said air blower.

13. A convalescent chair as recited in claim **12** wherein:

said elongated heat exchanger conduit forms a serpentine portion being disposed for contact by air being drawn through said air inlet opening by said air exhausting means.

14. A convalescent chair as recited in claim **13**, including:

(a) an air distribution manifold being secured to the lower portion of said seat support means; and

(b) said elongated heat exchanger conduit being in communication with said air distribution manifold.

15. A convalescent chair as recited in claim **14**, wherein seat support means comprises:

(a) a generally rectangular seat support panel forming a plurality of spaced air inlet openings therein, said air distribution manifold being in communication with said plurality of air inlet openings; and

(b) each of said air sacs forming an air inlet opening fitting which is receivable within respective ones of said air inlet openings.

16. A convalescent chair as recited in claim **15**, including a therapy pad being releasably secured to the front portion of said chair structure and forming a cover for said upper surface portions of said air sacs.

17. A convalescent chair as recited in claim **16** wherein said therapy pad comprises:

(a) an upper layer of fabric material;

(b) an intermediate pad of fiberous material capable of permitting air circulation therethrough; and

(c) a lower layer of fabric material permitting substantially free circulation of air from said perforate upper portions of said air sac therethrough and into said fiberous layer for efficient removal of moisture.

18. A convalescent chair as recited in claim **17**, including:

(a) a support pedestal to be positioned in front of said chair structure for support of the feet and legs of a patient seated therein; and

(b) a removable cap element being received by the upper portion of said support pedestal and providing an upper surface for contact by the feet and legs of said patient.

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US D311509 S – Patient's chair

United States Patent [19]

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[54] **PATIENT'S CHAIR**

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[52] **U.S. Cl.** **D12/131**; D6/365

[58] **Field of Search** D6/334, 360, 361, 364, D6/365, 366; D24/1.1; D12/129, 128

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Assistant Examiner—J. H. Musgrove
Attorney, Agent, or Firm—Hoffmann & Baron

[57] **CLAIM**

The ornamental design for a patient's chair, as shown and described.

DESCRIPTION

FIG. **1** is a front perspective view of a patient's chair showing our new design on a reduced scale;
FIG. **2** is a side elevation view thereof, the opposite side being a mirror image thereof;
FIG. **3** is a front elevation view thereof;
FIG. **4** is a rear elevation view thereof;
FIG. **5** is a top plan view thereof; and
FIG. **6** is a bottom plan view thereof;

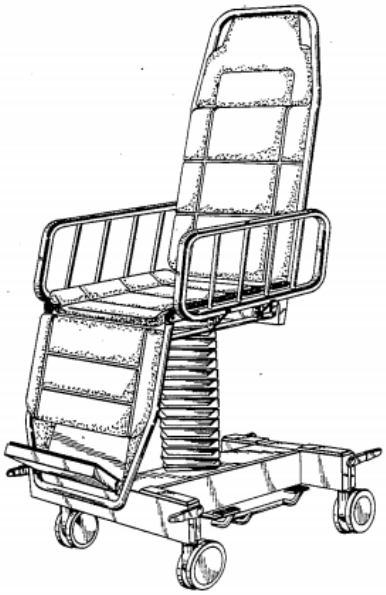


FIG. 1

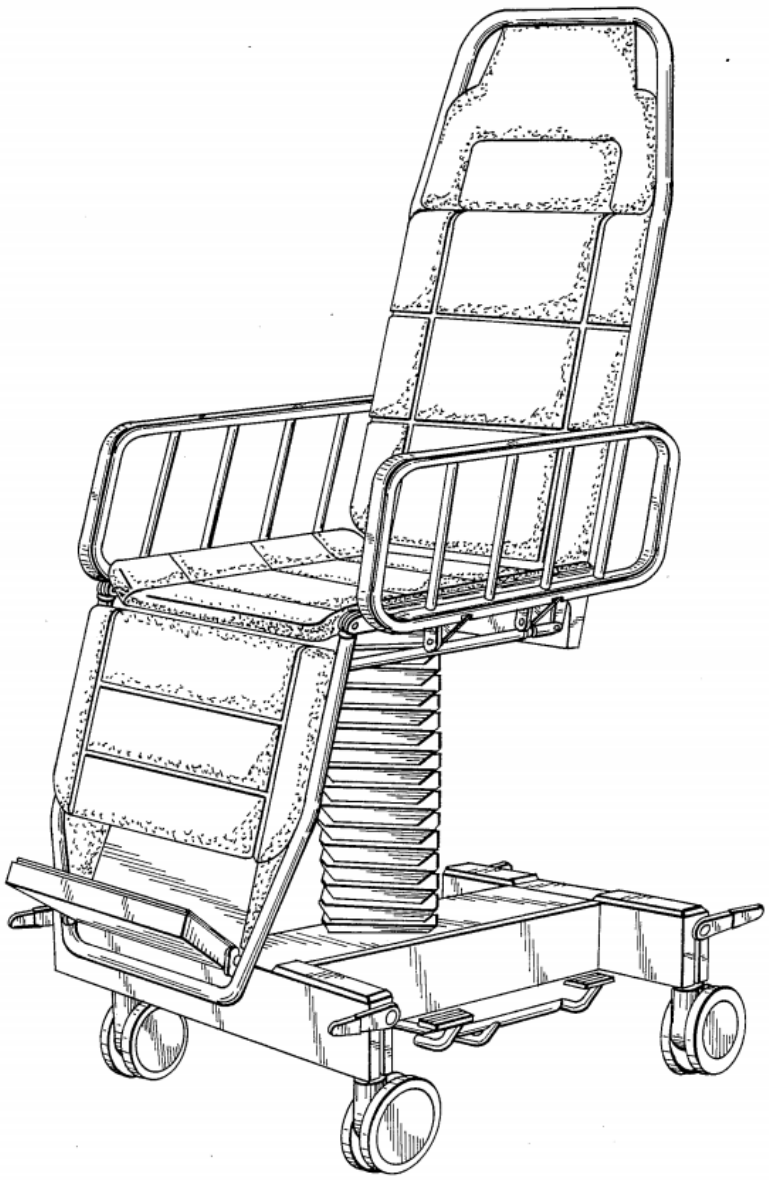


FIG. 2

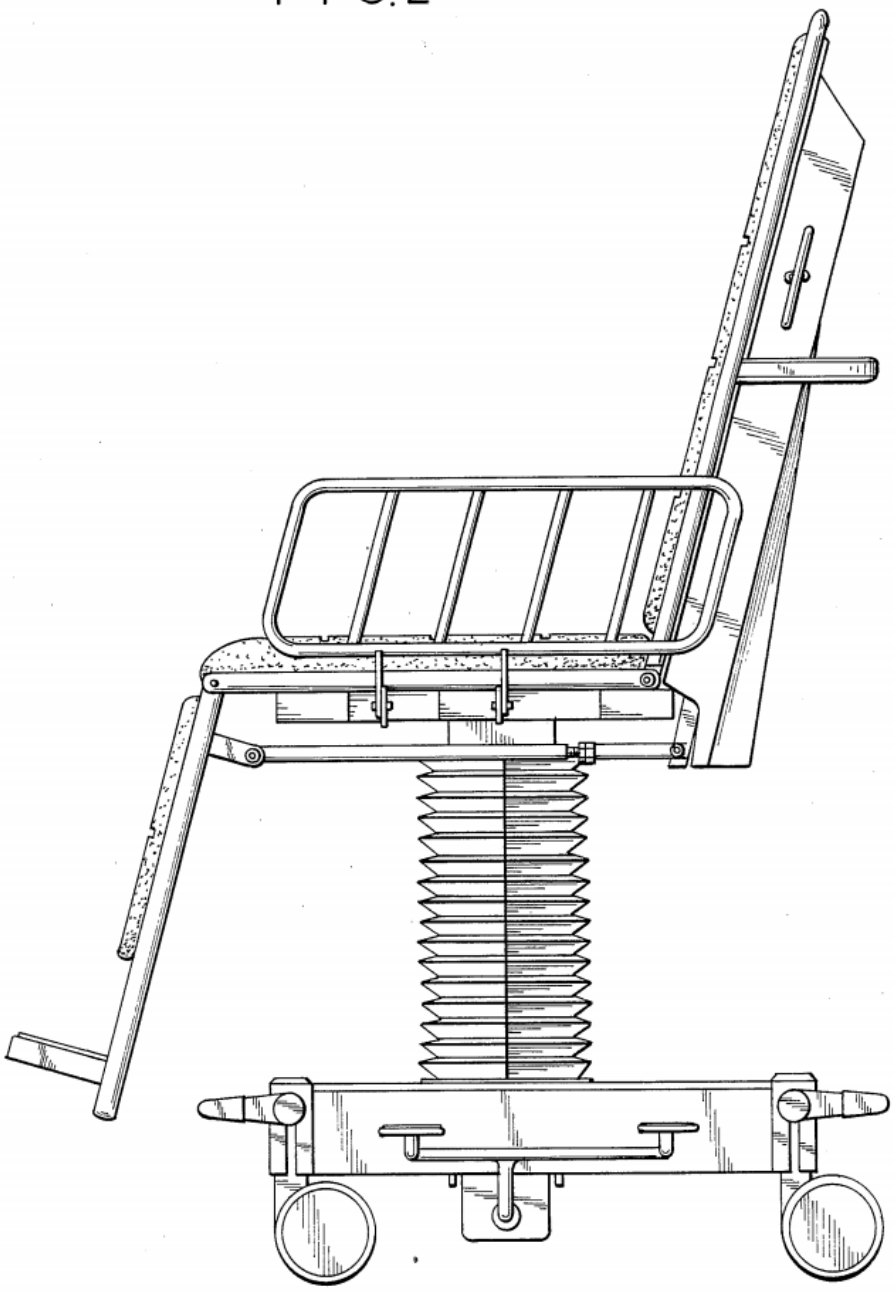


FIG. 3

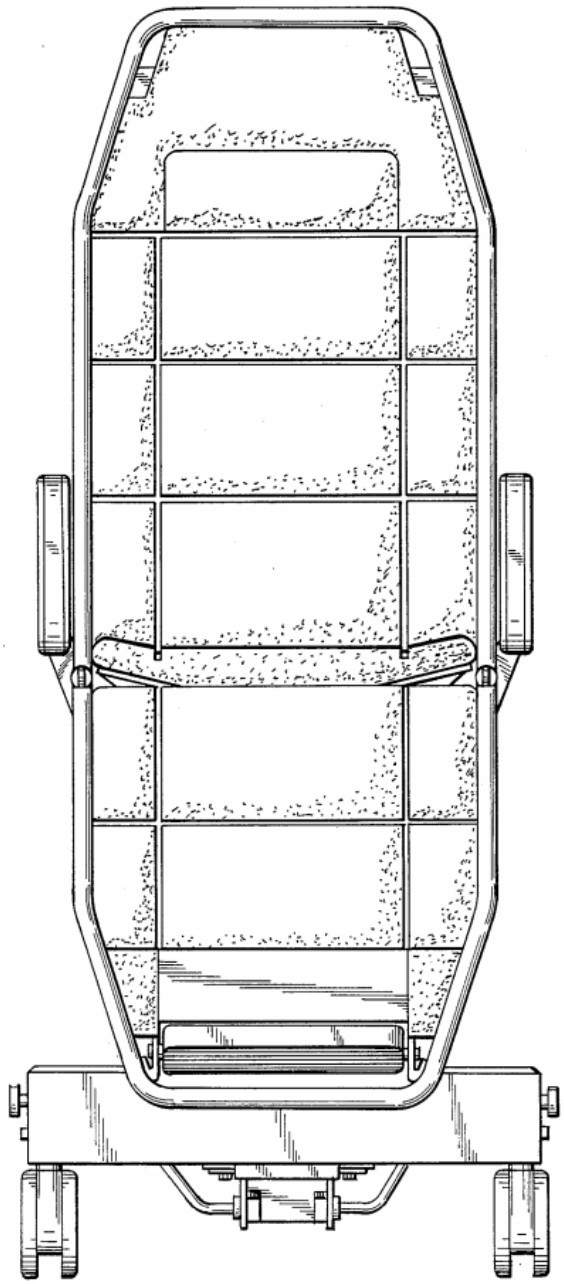


FIG. 4

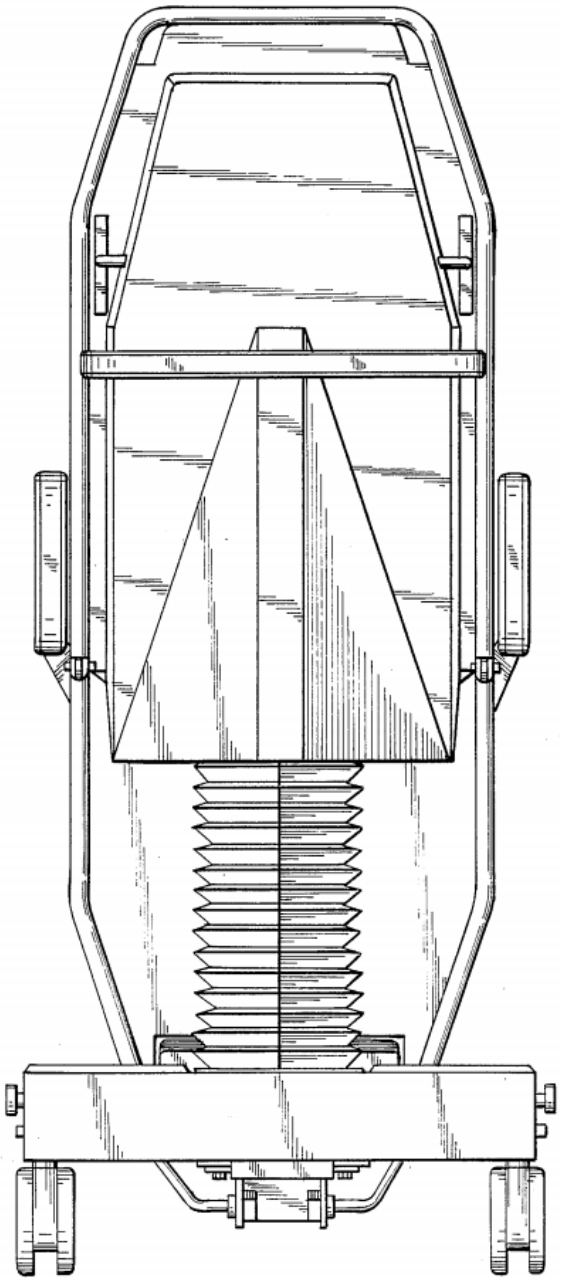


FIG. 5

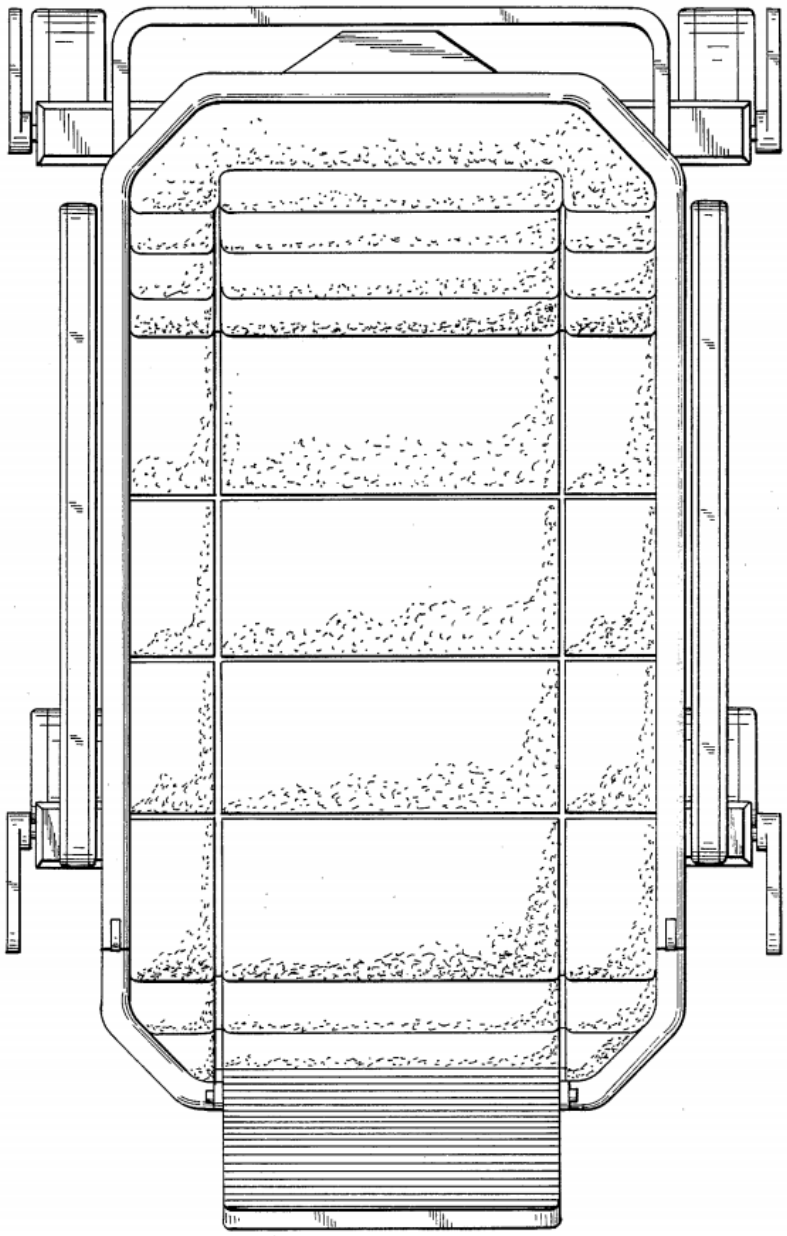
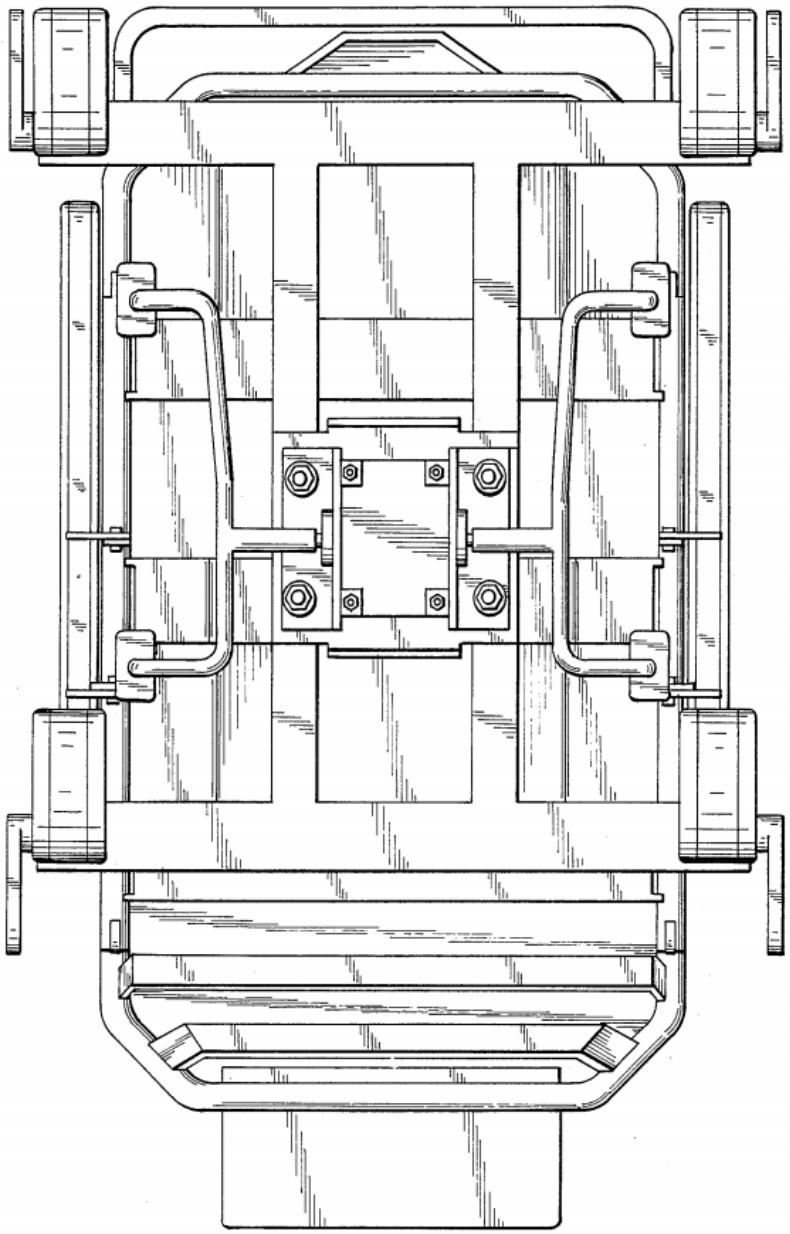


FIG. 6



US 20020000745 A1 – Patient chair with quaternary spring motion

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(19) **United States**

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Conte (43) **Pub. Date: Jan. 3, 2002**

(54) **PATIENT CHAIR WITH QUATERNARY SPRING MOTION**

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Related U.S. Application Data

(63) Non-provisional of provisional application No. 60/212,326, filed on Jun. 16, 2000.

Publication Classification

(51) **Int. Cl.**[7] **A47C 1/024**

(52) **U.S. Cl.** **297/302.3**

(57) **ABSTRACT**

A patient chair has a support pedestal with a pair of front legs, a pair of rear legs, a pair of side members, a rear frame member connecting the two rear legs and a cross member connecting the side members at a location between the front and rear legs. A pair of leaf springs is attached to the underside of the cross member with portions thereof extending forwardly and rearwardly therefrom in a substantially horizontal manner. Each leaf spring includes a U-shaped bight or loop portion at the forwardmost extremity of the leaf spring coupling the forwardly extending portion with a horizontal overlying portion which passes over the cross member and extends rearwardly therefrom terminating in an orthogonally generally upwardly extending back support portion. A seat is fastened to the horizontal overlying portion of each leaf spring for receiving and supporting a chair occupant. Each leaf spring is provided with two spaced apart resilient members which are fixed to the chair and engage the horizontal overlying portion when the seat is supporting a load. The resilient members contribute to the spring action opposing closing of the U, but not to the spring effect opposing opening of the U.

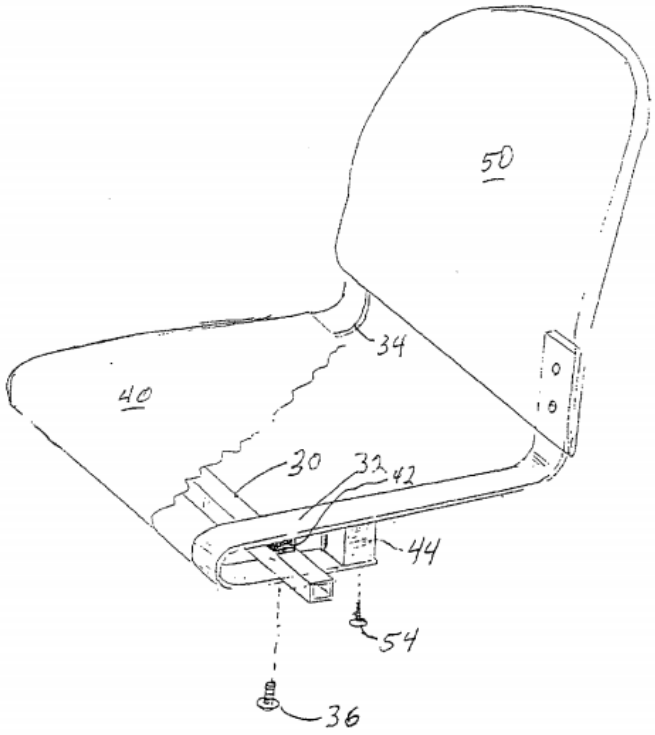


FIG. 1

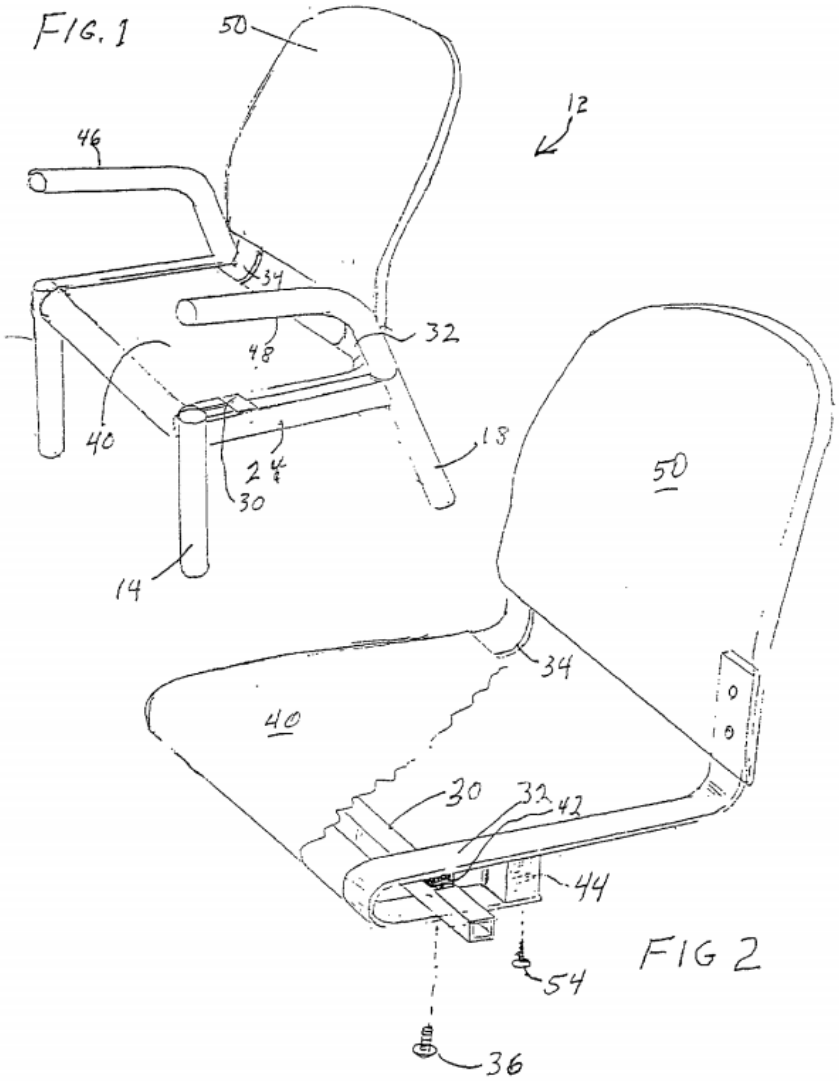


FIG 2

FIG. 3a

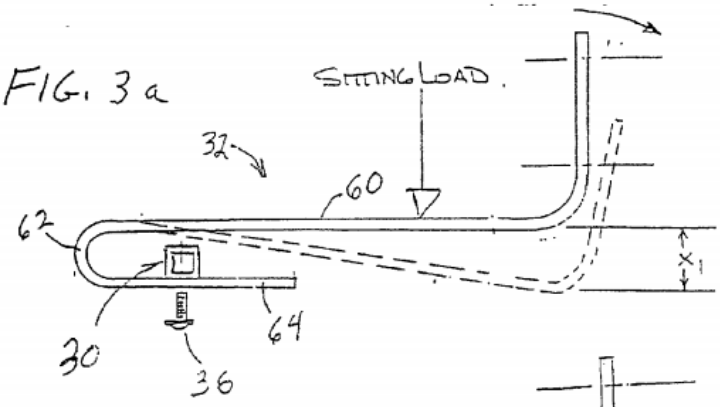


FIG. 3b

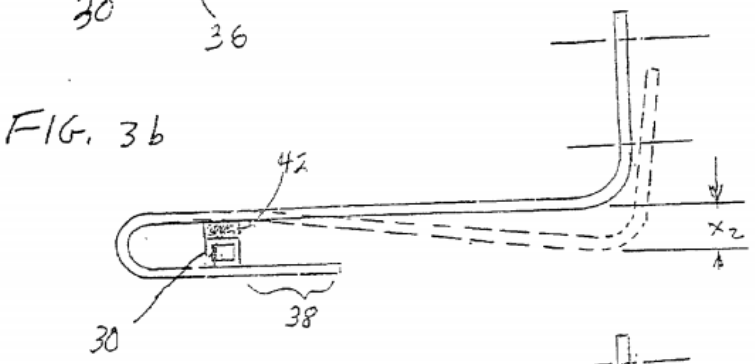


FIG. 3c

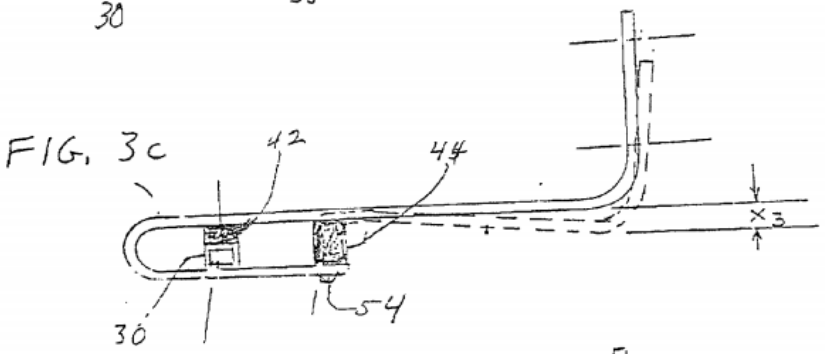
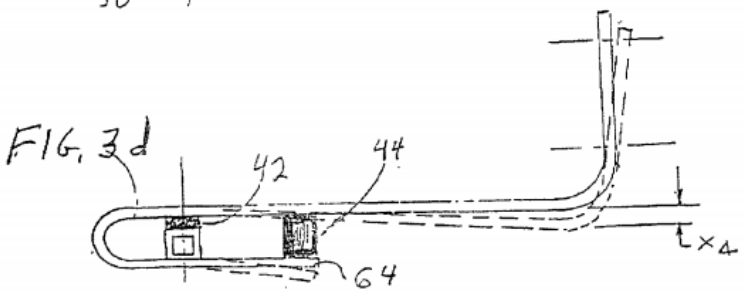


FIG. 3d



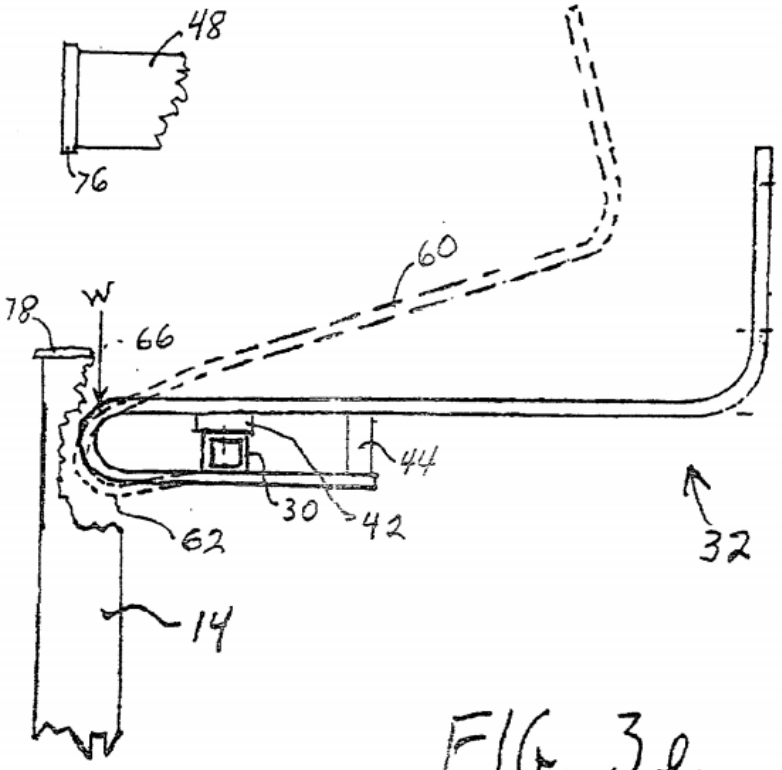
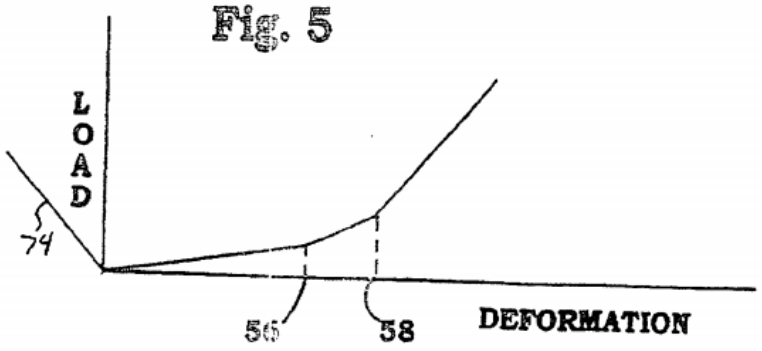


FIG. 3e

Fig. 5



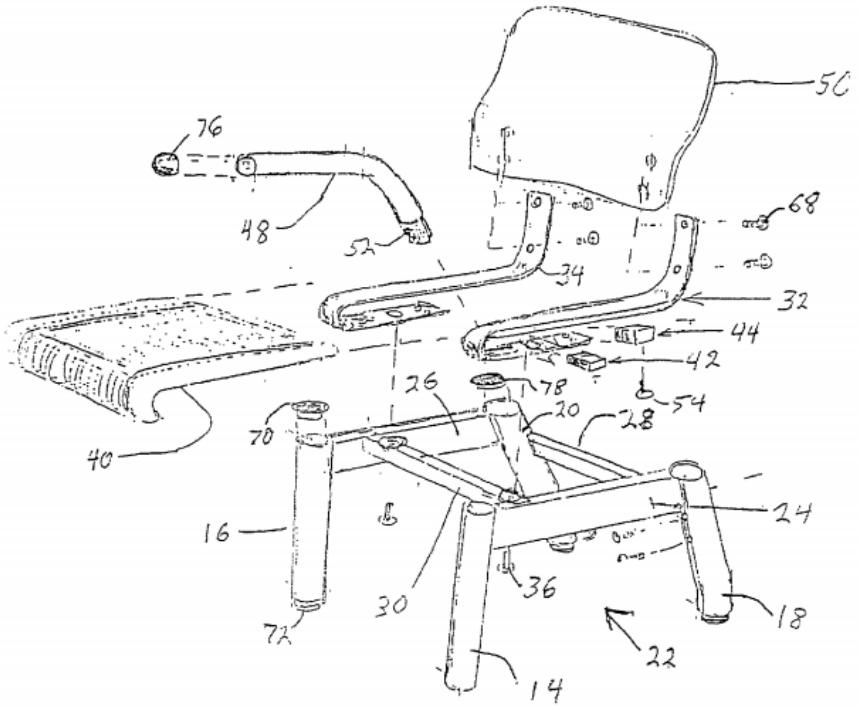


FIG. 4

PATIENT CHAIR WITH QUATERNARY SPRING MOTION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/212,326 filed Jun. 16, 2000 and entitled PATIENT CHAIR WITH QUATERNARY SPRING MOTION

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to chairs and more particularly, patient chairs as used, for example, in health care facilities.

[0004] 2. Description of the Related Art

[0005] Patient or health care chairs are commonly used in hospital rooms, assisted living homes, waiting rooms, hospices, extended care facilities, and at home. Health care chairs are used primarily, but not exclusively, by persons who have difficulty rocking or reclining in commonly available rockers and/or recliners. An additional complication with the latter chairs is, a health care requiring person may have difficulty in entering, sitting, or egressing that chair.

[0006] There are many recliners and rocker type chairs on the current market and used in health care applications. Most of these recliners, and rockers, require some type of physical effort to make the chair rock or recline, that is by pulling on levers, pushing buttons, or using the force of legs onto a leg panel, or the human back pressing onto a chair's back-rest, to make it recline. All or any one of these physical efforts, i.e. motion, may not be possible for a sitting person who is recovering from surgery, age enfeebled or obese. The latter persons usually cannot lean down to grab a handle, or a post surgery person is unable or restricted from use of arm, chest, or back muscles. There are also powered chairs which are motor driven between a seated or reclining position and a forward upright position which aids ingress and egress. These powered chairs are relatively large, heavy and expensive, and not well suited to use in health care facilities.

[0007] Health care patient chairs typically have only two primary legs integral with and extending upward at the front of the chair from a sled type base. This type of structure possesses a significant degree of instability. The seat of this type of chair is supported by, and on, or cantilevered directly off of the front legs. This type of construction is inherently unstable for a person who may need to sit by impacting the seat, or otherwise falls into the seat due to disability. This type of impact could cause the entire chair to "skitter" backwards, away from the entering person, causing them to lose balance and fall. This type of action could impose a force upon the chair that would have force vector components that are substantially perpendicular to the support, the front legs, and be of a sufficient magnitude to result in upsetting the chair from its normal upright position. The seat of the typical patient chair has no structural connection to or support directly from the rear legs, if any, of the chair, thus adding to the instability of the chair.

[0008] The arm supports of typical patient chairs are supported only by the vertical extension of the front legs of the chair. The arm supports lack any structural connection to or support directly from the rear legs, if any, of the chair. Thus, even further instability is added to the typical patient chair. A weakened patient attempting to sit down in the typical patient chair will naturally use the arm supports to assist in maintaining balance and to enable a gradual entry into the chair. In so doing, a patient will impose a force which is, at any one moment in time, composed of vertical and horizontal vector components. In an unsteady patient, the magnitudes of those horizontal and vertical vector components will vary significantly over a very brief period of time. The typical patient chair, with arm supports lacking, connection to or support from the rear legs, if any, will become unstable when the sum of those horizontal and vertical vector components of the force applied by the patient is of a direction and magnitude which is not substantially and directly aligned with the support structure of the chair.

[0009] The front edge of the seat of the typical patient chair is positioned in line with the front legs, thereby making it difficult for an unsteady patient to place his feet and legs in a position and orientation that will enable sitting or standing. Furthermore, the arm supports of the typical patient chair do not extend substantially in front of the front edge of the seat, thereby increasing the difficulty encountered by an unsteady patient attempting to position their body in preparation for ingress or egress.

[0010] Some patient chairs provide a rocking motion. However, the rocking motion provided often forces the feet of the patient seated in the chair to lose contact with the floor, thus placing a degree of pressure on the back of the thigh of the patient's legs. Such pressure can severely restrict or cut off the circulation in a patient's lower legs. Furthermore, the rocking motion provided by some patient chairs is relatively undamped. An undamped rocking motion can cause an excited state in patients, particularly patients recovering from heart surgery and Alzheimer's.

[0011] Patient chairs typically have either all wood frames, or frames composed of wood and metal, which are mechanically fastened together. With continued use of a patient chair such mechanical fasteners are prone to loosen.

[0012] What is needed in the art is a patient chair which remains stable during a patient's ingress and egress, reduces the difficulty of ingress and egress, and provides a self-damped rocking, motion.

SUMMARY OF THE INVENTION

[0013] This invention provides a health care patient chair having a pair of arm supports extending forward of the seat, a seat positioned substantially rearward of the front legs. The present invention further provides a stable, self-damping, rocking motion, and a limited recline sitting position. Chair use is, of course, not limited to the infirmed.

[0014] The invention comprises, in one form thereof, a chair having a seat, a backrest, a support pedestal adapted to rest on a floor or other horizontal support surface, and a pair of U-shaped compound springs coupling the seat and backrest to the pedestal. Each spring has an upper longer portion, a lower shorter portion extending generally horizontally and parallel to the longer portion, and a bight or U-shaped end coupling the shorter and longer portions together. The

shorter portion is fastened to the support pedestal between the shorter portion free end and the bight. The seat is fastened to the longer portion between the bight and longer portion free end, and the backrest is fastened to the longer portion free end. A pair of resilient pads are fixed to each spring shorter portion, engage the longer portion when the spring is compressed by a chair occupant and contribute to the overall spring action.

[0015] An advantage of the present invention is that the structure and configurations of the chair inhibit continued, volunteer oscillation, yet provide a stable rocking motion.

[0016] Another advantage is that the structure and configuration of the chair prevent movement as a result of the forces applied by a person during the process of sitting in or standing up (egressing) from the chair.

[0017] A further advantage of the present invention is that the suspension senses the size and weight of the sitting, person and reacts to these attributes, and/or limitations.

[0018] An additional advantage is that the suspension of this inventions does not require external actuating levers, buttons, or manually activated mechanisms to achieve rocking or reclining motion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

[0020] **FIG. 1** is a perspective view of the basic chair components of leg frame, mesh seat, backrest and removable arms;

[0021] **FIG. 2** is a more detailed perspective view of the chair suspension components;

[0022] **FIGS. 3*a*-3*e*** are side elevation views of progressive development of the spring system;

[0023] **FIG. 4** is an exploded perspective view showing all the components of the basic chair of **FIG. 1**; and

[0024] **FIG. 5** is a graph of load vs. deflection for an illustrative spring system.

[0025] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplification set out herein illustrates one preferred embodiment of the invention, in one form, and such exemplification is not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE INVENTION

[0026] Referring now to the drawings and particularly to **FIGS. 1 and 4**, there is shown a patient chair **12** having support pedestal **22** comprising two front legs **14** and **16**, two rear legs **18** and **20**, and a pair of side members **24** and **26**. A rear frame member **28** connects the two rear legs **18** and **20**. A cross member **30** connects the side members **24** and **26** intermediate the front and rear legs at a position substantially rearward of the front legs **14** and **16**. Two configured leaf springs **32** and **34** are attached to the bottom of the cross member **30**, for example, by screws such as **36**, and thereafter extend rearwardly in a substantially horizontal manner.

[0027] Comparing **FIGS. 2 and 3**, the front of the leaf spring extends forward of the cross member **30**, but terminates rearward of the front legs **14** and **16**, curves substantially downward and loops rearwardly passing under the cross member. The leaf spring attaches to the cross member as it passes thereunder, then the leaf spring continues rearwardly for a short distance or extension **38** (**FIG. 3*b***), past the cross member, under and parallel to the leaf spring upper, longer top layer **60**.

[0028] The seat **40** is connected to and supported by the leaf springs **32** and **34**. The seat may be formed of a flexible, porous fabric sewn into a hammock shape and disposed between the two primary seat springs. This hammock shape and flexible, porous fabric allow the springs to act in harmony with each other, creating a continuously flexible seat. The front edge of the seat bottom is positioned rearwardly of the front of the front legs **14** and **16**. A compression spring medium such as and elastomeric spring mass **42** is attached to the topside of the cross member **30** under each leaf spring top layer, at the point where each leaf spring, passes over the cross member **30**. A second compression spring such as **44** is attached to the bottom rearward facing projection such as **38** of each leaf spring, and touches the underside of the leaf spring top layer.

[0029] Two arm supports **46** and **48** are positioned above the seat and extend substantially forward of the front edge of the seat **40**. The armrests or supports have reduced diameter sections such as **52** which are telescopically inserted into and supported by the open tops of the rear legs **18** and **20**. A rigid molded wood backrest **50** is connected to and supported by the leaf springs and terminates the ends of the two primary springs **32** and **34** by attachment to these springs in a substantially vertical position. The backrest is attached by screws such as **68**. This backrest has flexibility limited by its cantilever position at the terminus of the primary spring. Each of the rear legs **18** and **20** is angled forward upwardly toward the seat. Decorative and/or protective caps such as **70**, **76** and **78** may be inserted into or over the upper open arm and leg ends, and floor engaging feet such as **72** may be inserted into or over the open lower leg ends.

[0030] In **FIG. 3*a***, primary leaf spring **32** is attached to cross bar **30** by bolt **36**. This is the primary spring system, a cantilevered leaf spring. In **FIG. 3*b***, secondary spring **42** is fixed to the cross bar **30**, also by the bolt **36**. In **FIG. 3*c***, trinary spring **44** is fastened to the lower extension **38** of leaf spring **32** by screw **54**. **FIG. 3*e*** illustrates a reverse (counterclockwise) deflection of one of the primary leaf springs, the fourth or quatenary spring mode of the support system.

[0031] For a simple horizontally cantilevered beam, the deflection or deformation x, is directly proportional to the product of the applied (concentrated) load, W, and the cube of the distance, L, from the load to the beam support, and inversely proportional to three times the flexural rigidity (EI, the product of the moment of inertia of the beam cross-section and the modulus of elasticity), that is

$$x = WL^3/3EI.$$

[0032] For a fixed distance between support and load, and assuming modest deflections, all terms except for the load are constants and this relationship may be written as

$$W=k_1x_1.$$

[0033] For large deflections, the effective lever arm length is not a constant, but continuously decreases with increased deflection. This relationship is also a good approximation of the deflection of other beam configurations, such as the doubly cantilevered beam of **FIG. 3***a*.

[0034] Assume that, in an unoccupied state, the chair upper spring portion **60** is spaced away from both compression springs **40** and **42**. For relatively small displacements, the spring assembly behaves as though these resilient members were absent as depicted in **FIG. 3***a*, the above linear relationship holds and is illustrated by the linear segment between the origin and the abscissa value at **56** in **FIG. 5**. Further assume that at this abscissa value, the upper spring portion engages the only the compression spring **42** as depicted in **FIG. 3***b*. Now the upper spring portion begins to behave like an overhanging beam and the load vs. displacement curve slope increases due to the additional resistance of the member **42** and due to an effectively shorter lever arm length. Depending on the respective stiffnesses, the beam may actually experience an upward deflection between the bight **62** and resilient member **42**. The relationship continues along the second linear path until the second resilient member **44** is engaged at abscissa value **58**. Between the values at **56** and **58**, the force required to depress the spring a distance x_2 is the force required to move it from its rest position into engagement with the compression spring plus the additional force required to compress the spring **42** and further flex the beam an additional incremental distance x_i

$$W=k_1x_1+k_2x_i.$$

[0035] If the upper spring portion is initially in contact with the compression spring **42**, the two distances are the same and the overall load may be approximated by

$$W=k_1x_2+k_2x_2.$$

[0036] When the deformation reaches point **58**, further downward seat motion additionally compresses the resilient member **44** as illustrated in **FIG. 3***c* and, depending on the relative stiffness of the upper spring portion and resilient member, may deflect the lower spring portion **64** downwardly as in **FIG. 3***d*. In either case, there is even more resistance to loading and the slope of the relationship increases beyond point **58**. k_3 x_i expresses the additional force required to incrementally compress the member **44** beyond point **58** and k_4 x_i expresses the additional force to depress the free lower spring portion **64**. The natural resonant frequencies of the different spring elements corresponding to the differently sloping regions of the graph of **FIG. 5** are, of course, different.

[0037] If both resilient members are initially engaged by the upper spring portion **60**, the three line segments of **FIG. 5** blend together into a single generally linear relationship between the net deflection x and force required to achieve the deflection may be approximated as

$$W=(k_1+k_2+k_3+k_4)x.$$

[0038] When an occupant of the chair moves forward to exit the chair, the load may be shifted to the front seat edge as indicated by the egress load arrow **66** of **FIG. 3***e*. Upper spring portion **60** separates from the two resilient members and behaves much as discussed in conjunction with **FIG. 3***a*, but the deformation or deflection is counterclockwise with the bight **62** opening as deflection increases. Thus, the first and second resilient members **42** and **44** contribute forces opposing spring compression to close the U-shape from its unstressed position, while the forces opposing opening the U-shape are contributed solely by the leaf primary spring **32**. This relationship between load and deflection is illustrated by line **74** in **FIG. 5**. The effective lever arm is much shorter than earlier, the slope of line **74** is greater and the deflection in **FIG. 3***e* is somewhat exaggerated. Note the force is still inboard of the front legs such as **14** and the probability of pivoting of the chair forwardly with potential injury to the occupant is minimized.

[0039] While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

What is claimed is:

1. A chair having a seat, a backrest, a support pedestal adapted to rest on a floor or other horizontal support surface, and a pair of U-shaped compound springs coupling the seat and backrest to the pedestal, each spring having a longer portion, a shorter portion extending generally parallel to the longer portion, and a bight coupling the shorter and longer portions, the shorter portion fixed to the support pedestal intermediate the shorter portion free end and the bight, the seat fixed to the longer portion intermediate the bight and longer portion free end, and the backrest connected to the longer portion free end.

2. The chair of claim 1, wherein each spring further includes a first resilient member fixed to one portion and engaging the other portion when the seat is supporting a load.

3. The chair of claim 2, wherein the first resilient member is fixed to the shorter portion in substantially the same region as the region in which the shorter portion is fixed to the pedestal.

4. The chair of claim 2, wherein each spring further includes a second resilient member spaced from the first resilient member, fixed to one of the portions and engaging the other portion when the seat is supporting a load.

5. The chair of claim 4, wherein the second resilient member is fixed to one of the portions near the free end of the shorter portion.

6. The chair of claim 5, wherein the first resilient member is fixed to the shorter portion in substantially the same region as the region in which the shorter portion is fixed to the pedestal and the second resilient member is fixed to the shorter portion near the free end of the shorter portion whereby, as an occupant slides rearwardly in the seat, or the load otherwise increases, the bight closes somewhat and the upper longer portion bends downwardly compressing the first and second resilient members and urging the free end of the shorter portion downwardly.

7. The chair of claim 5, wherein, the first resilient member is fixed to the shorter portion in substantially the same region as the region in which the shorter portion is fixed to the pedestal and the second resilient member is fixed to the shorter portion near the free end of the shorter portion whereby, as an occupant slides forwardly in the seat, the lower portion intermediate the bight and region in which the shorter portion is fixed to the pedestal bends downwardly, the bight opens somewhat, and the upper longer portion bends upwardly separating from the first and second resilient members to aid occupant egress from the chair.

8. The chair of claim 1, wherein the pedestal comprises a frame, two front legs and two rear legs extending downwardly therefrom, the forward extremity of the seat being located rearwardly of the front legs.

9. The chair of claim 8, wherein the rear legs extend from the frame downwardly and rearwardly to provide an expanded pedestal rest area of enhanced stability.

10. A patient chair, comprising:

a support pedestal having a pair of front legs, a pair of rear legs, a pair of side members, a rear frame member connecting the two rear legs and a cross member connecting the side members intermediate the front and rear legs; and

a pair of leaf springs attached to the underside of the cross member and having portions extending forwardly and rearwardly therefrom in a substantially horizontal manner, each leaf spring including a U-shaped bight portion at the forwardmost extremity of the leaf spring coupling the forwardly extending portion with a horizontal overlying portion which passes over the cross member and extends rearwardly therefrom terminating in an orthogonally generally upwardly extending back support portion.

11. The chair of claim 10, further comprising a seat fixed to the horizontal overlying portion of each leaf spring for receiving and supporting a chair occupant.

12. The chair of claim 11, wherein the seat is formed of a flexible, porous fabric sewn in to a hammock shape and disposed between the two leaf spring horizontally overlying portions.

13. The chair of claim 11, further comprising a backrest fixed to the generally upwardly extending back support portion of each leaf spring.

14. The chair of claim 11, wherein the front of each leaf spring extends forward of the cross member, but rearward of the front legs, curves substantially downward and loops rearwardly passing under the cross member.

15. The chair of claim 14, wherein the leaf spring attaches to the cross member as it passes thereunder and continues rearwardly for a short distance past the cross member under and generally parallel to the leaf spring overlying portion.

16. The chair of claim 15, wherein each leaf spring is provided with a first resilient member fixed to the cross member and engaging the horizontal overlying portion when the seat is supporting a load.

17. The chair of claim 16, wherein leaf spring is further provided with a second resilient member spaced from the first resilient member and fixed to the spring in the region where the leaf spring continues rearwardly for a short distance past the cross member, the second resilient member engaging the horizontal overlying portion when the seat is supporting a load.

18. The chair of claim a pair of armrests extending upwardly, then forwardly from the rear legs, and terminating forwardly of the seat forwardmost end and rearwardly of the forward most edge of the front legs.

19. A chair support spring assembly, comprising:

a leaf primary spring fabricated from spring-steel, and shaped into a double cantilever spring-form of generally U-shape having a longer portion, a shorter portion extending generally parallel to the longer portion, and a bight coupling the shorter and longer portions;

a first resilient member fixed to one portion and engaging the other portion; and

a second resilient member spaced from the first resilient member, fixed to one of the portions and engaging the other portion.

20. The chair support spring assembly of claim 19, wherein the first and second resilient members contribute forces opposing spring compression to close the U-shape from its unstressed position, while the forces opposing opening the U-shape are contributed solely by the leaf primary spring.

* * * * *

US 20120292877 A1 – Mobile rocking patient chair and method of use

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(54) **MOBILE ROCKING PATIENT CHAIR AND METHOD OF USE**

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(21) Appl. No.: **13/251,273**

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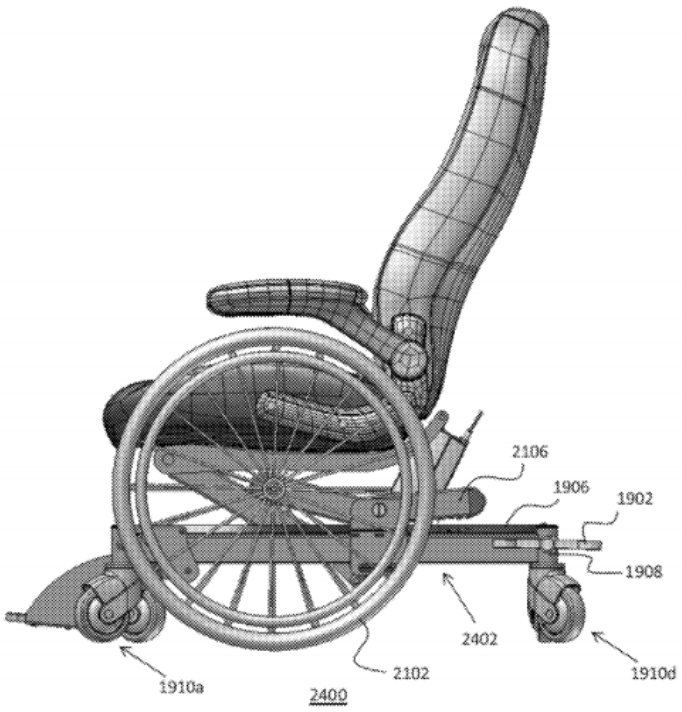
Publication Classification

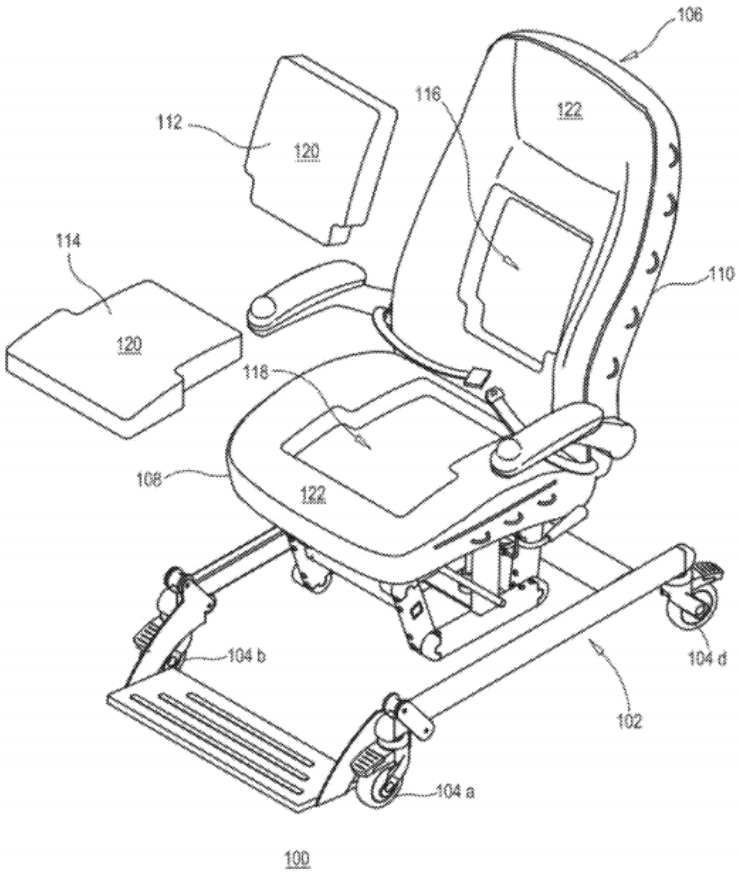
(51) **Int. Cl.**
A61G 5/10 (2006.01)

(52) **U.S. Cl.** **280/250.1**

(57) **ABSTRACT**

A mobile patient chair and method of transferring a patient include providing a mobile patient chair with a seat portion and an undercarriage supporting the seat portion, where the undercarriage includes a set of four wheels providing mobility to the patient chair, a left wheelchair-type wheel coupling member, a right wheelchair-type wheel coupling member, and a pair of levers operable to move the wheelchair-type wheel coupling members away from a flooring surface upon which the patient chair is supported. The method includes manipulating each of the levers in a first direction, coupling wheelchair-type wheels to the wheelchair-type wheel coupling members, manipulating the levers in a second direction, and manipulating the coupled wheelchair-type wheel to cause the mobile patient chair to move.

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104 b
104 d
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104 a
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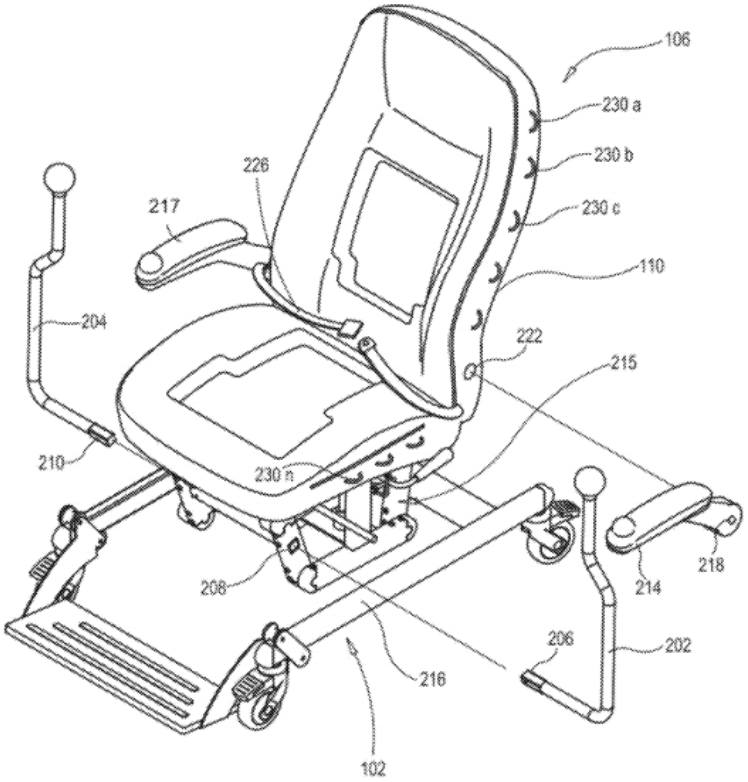
FIG. 1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230 a
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FIG. 2

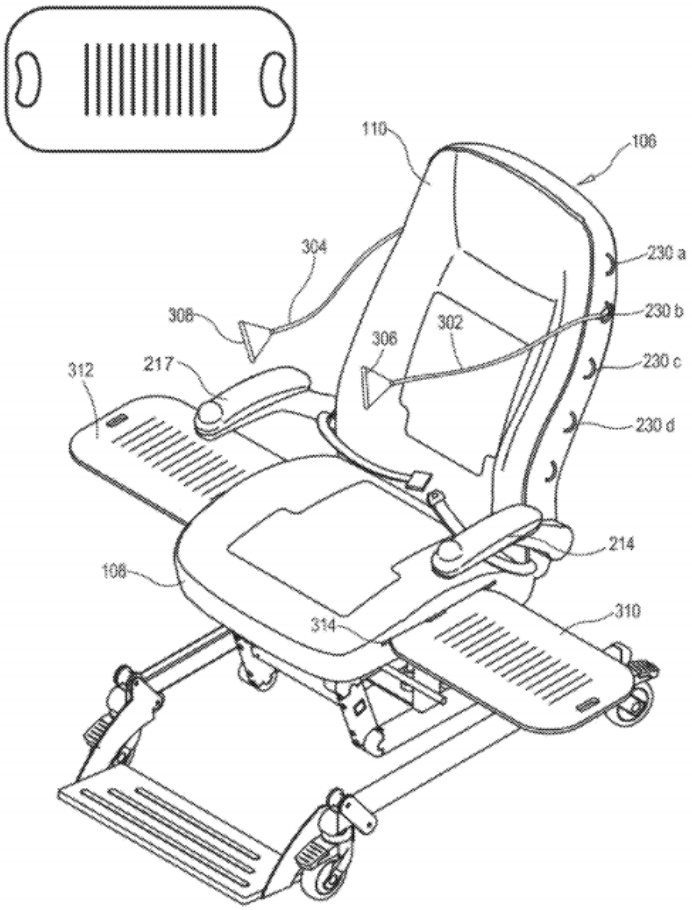
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FIG. 3

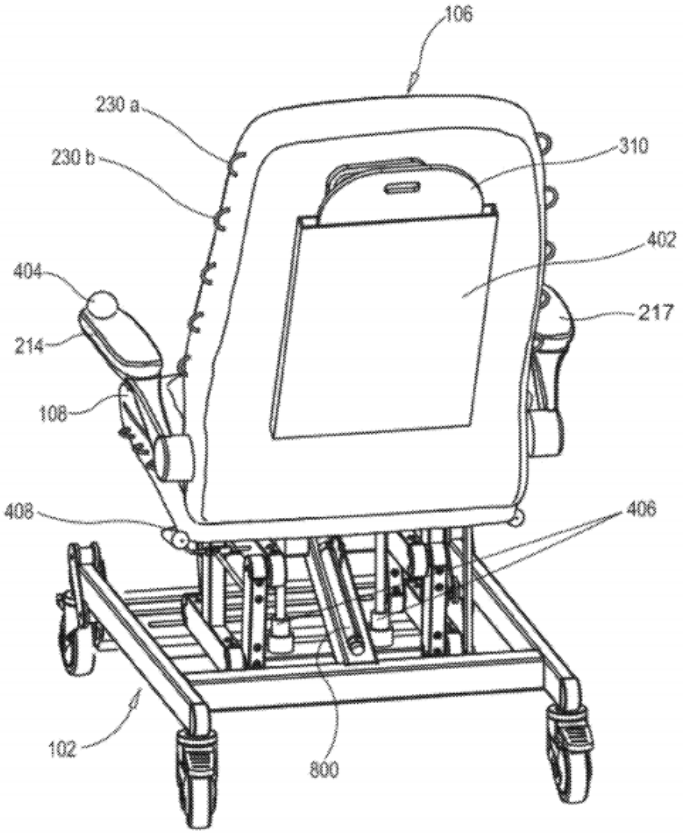

FIG. 4

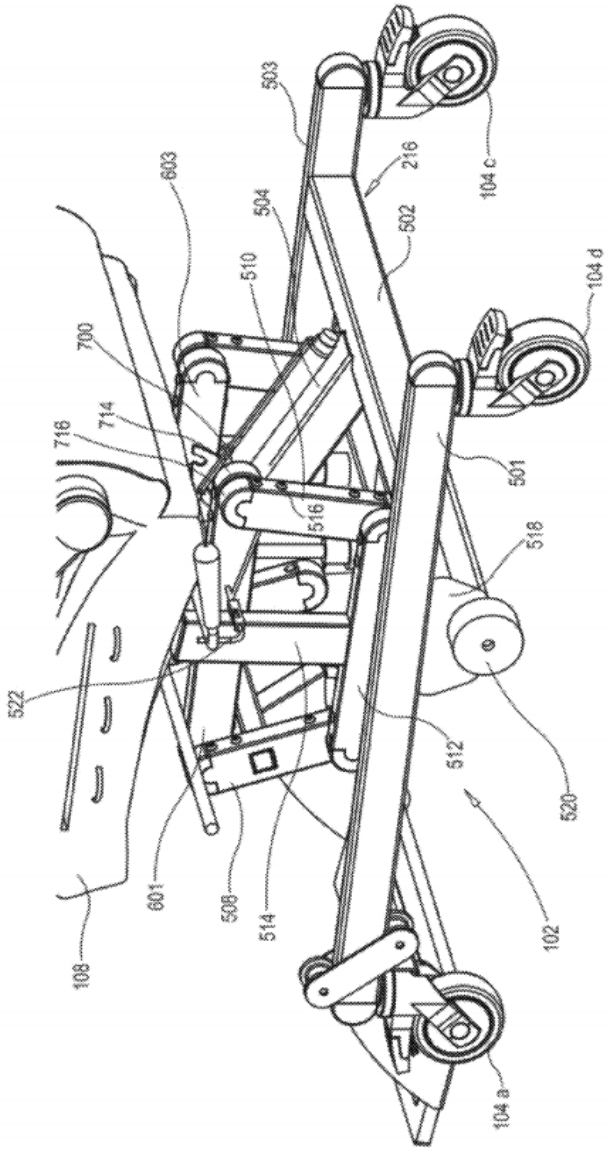
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FIG. 5

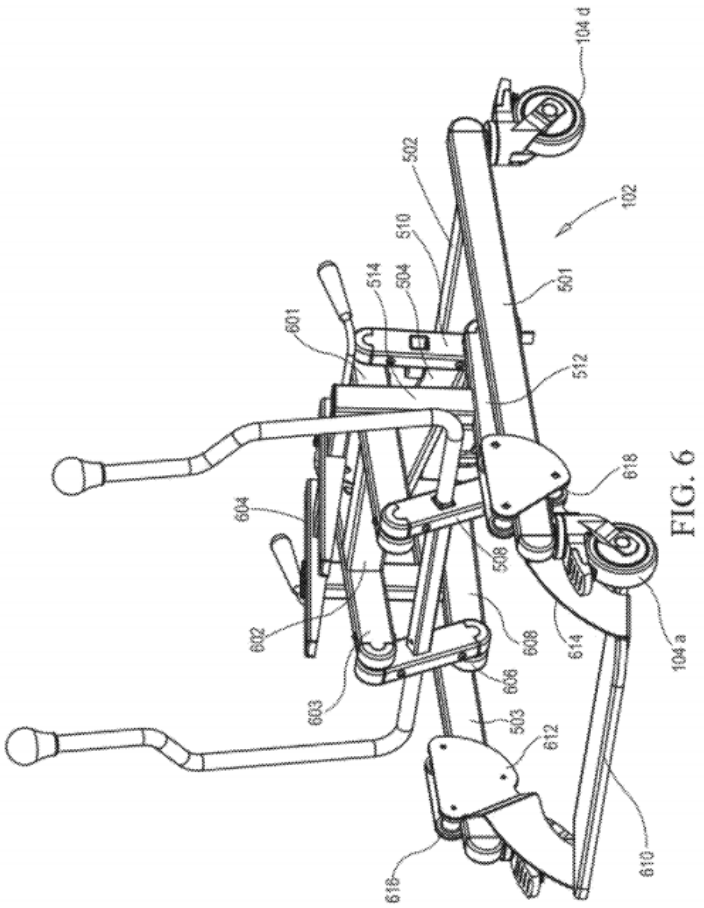
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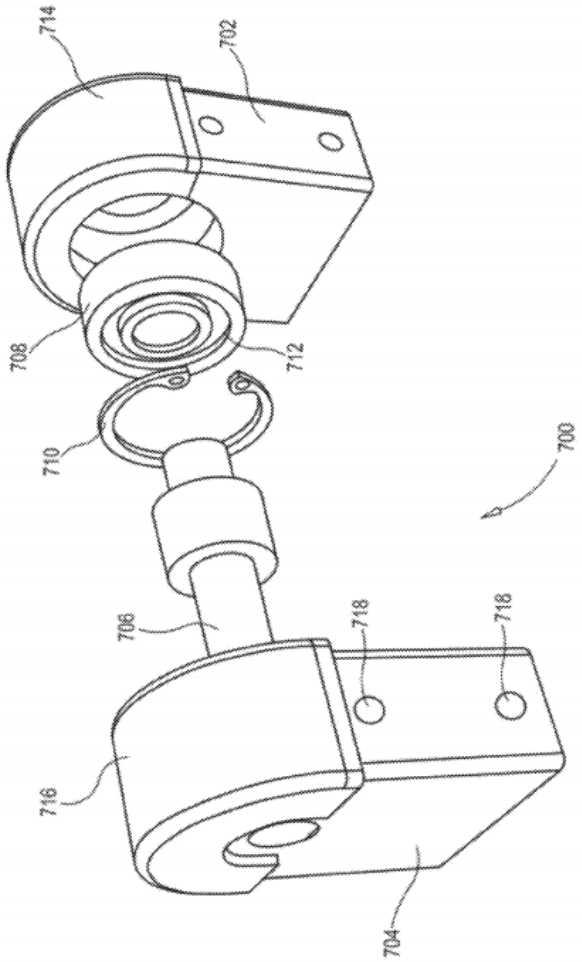
FIG. 6



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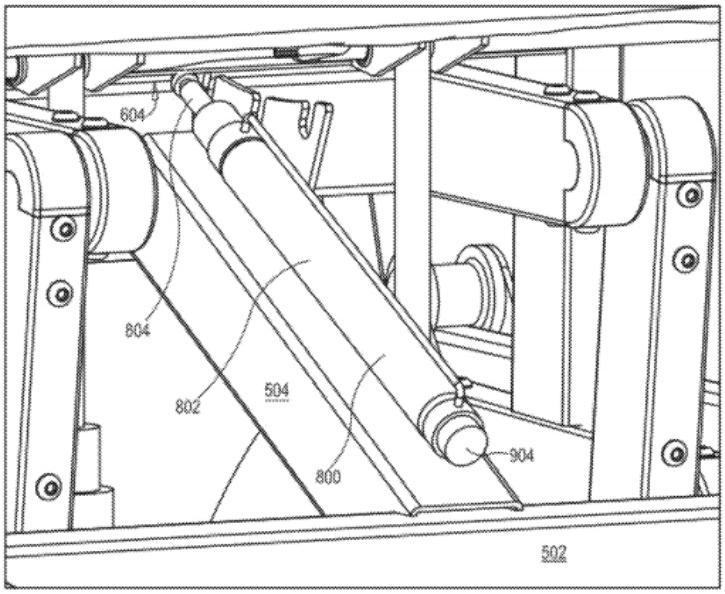
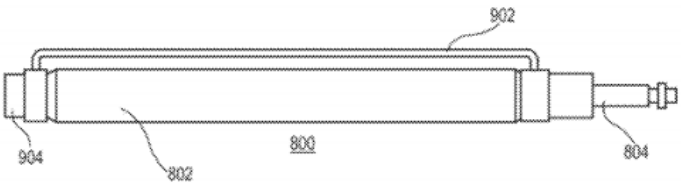


FIG. 8



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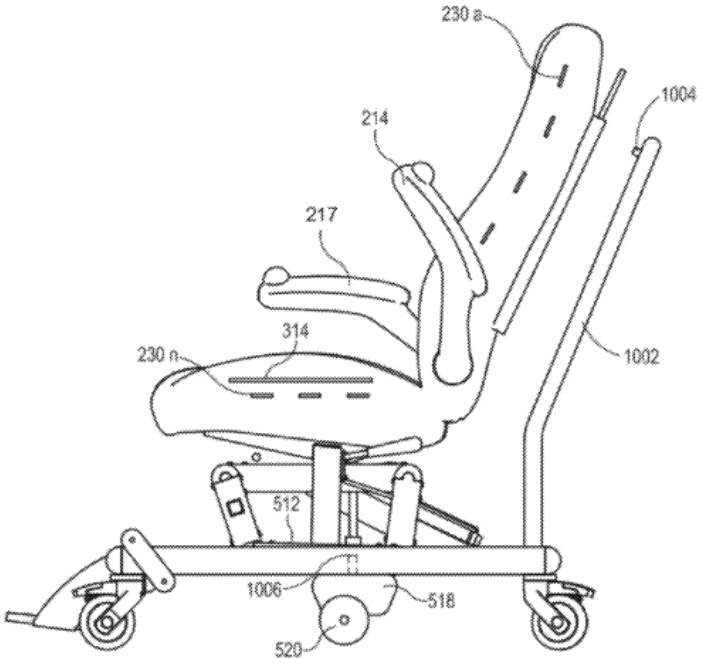

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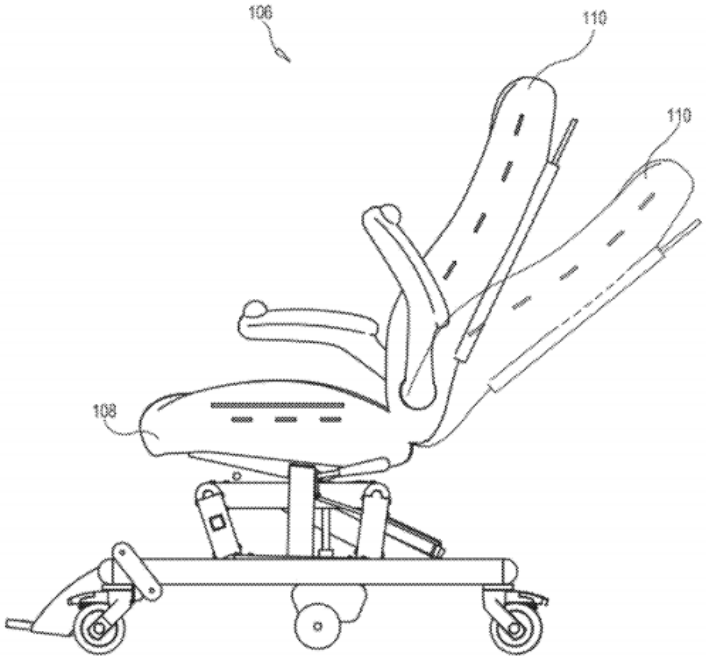

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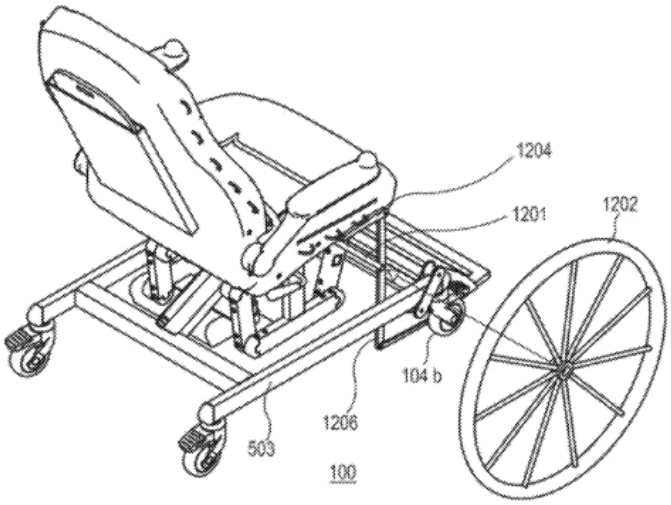

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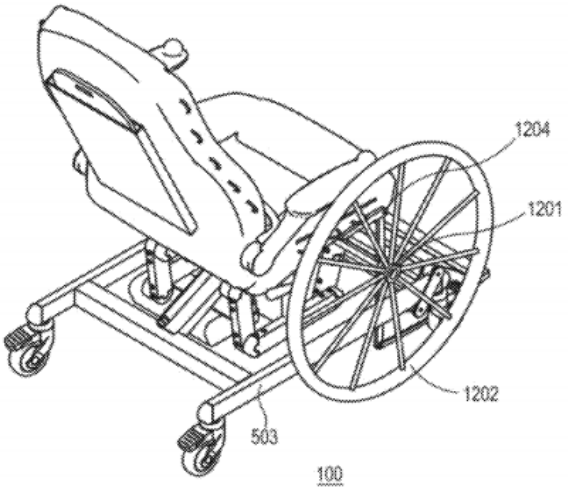

FIG. 13


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FIG. 14

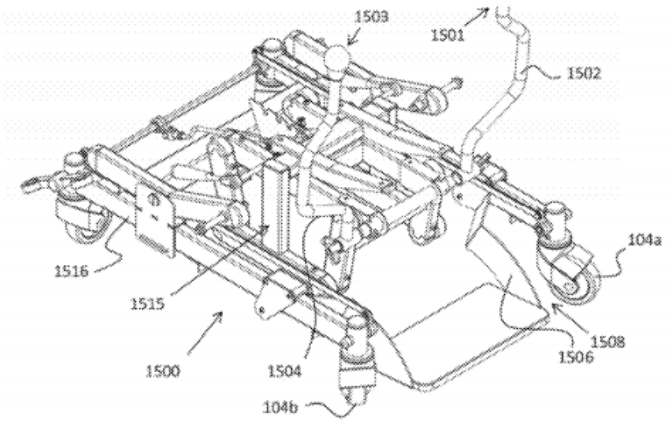
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FIG. 15

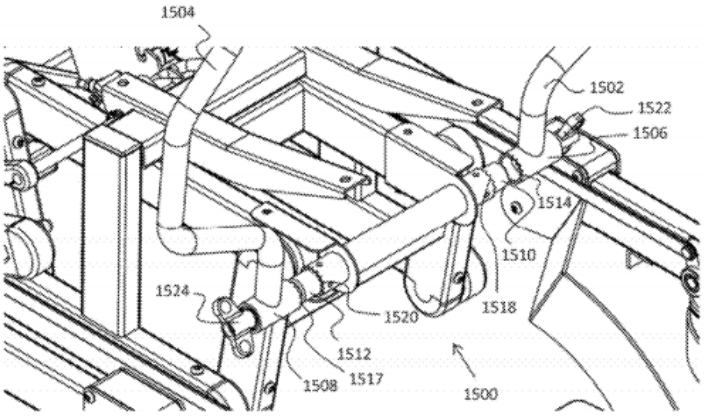
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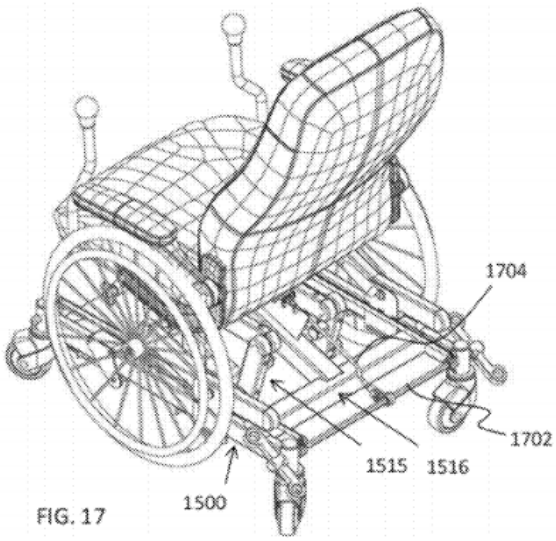
FIG. 16



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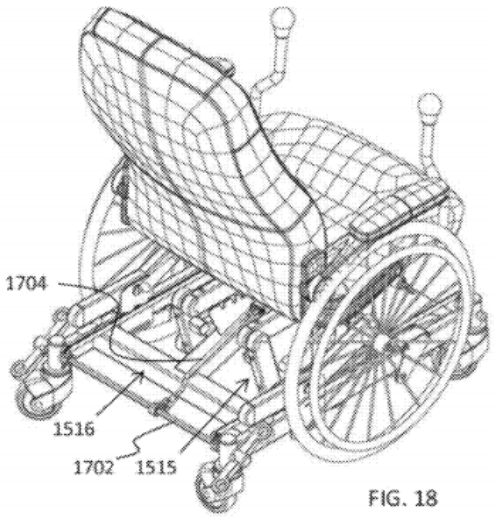

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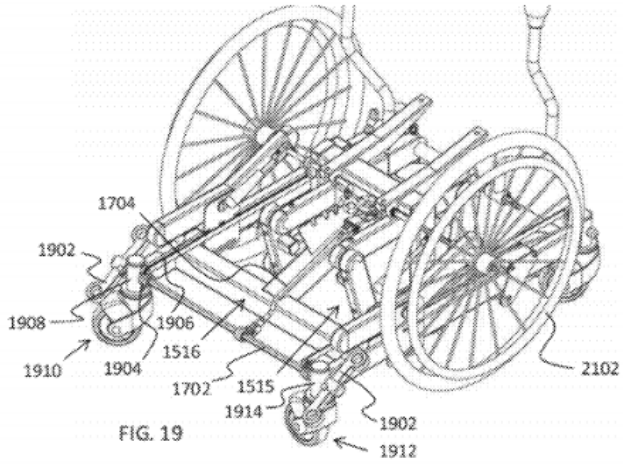
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FIG. 19

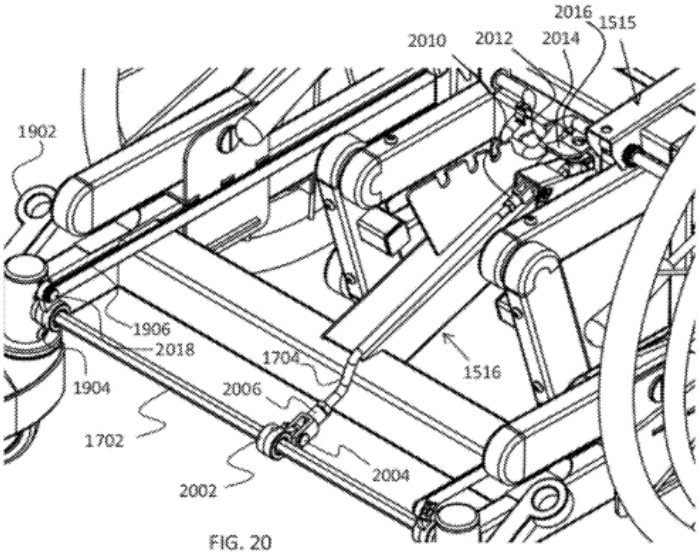
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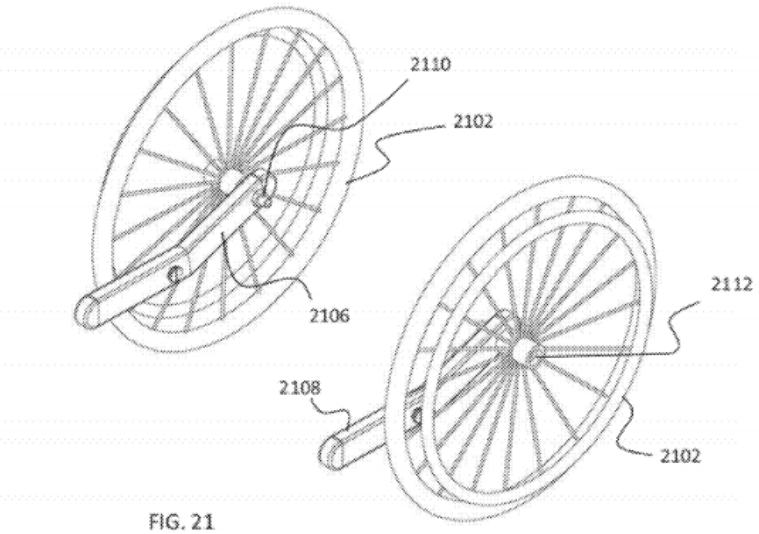
FIG. 20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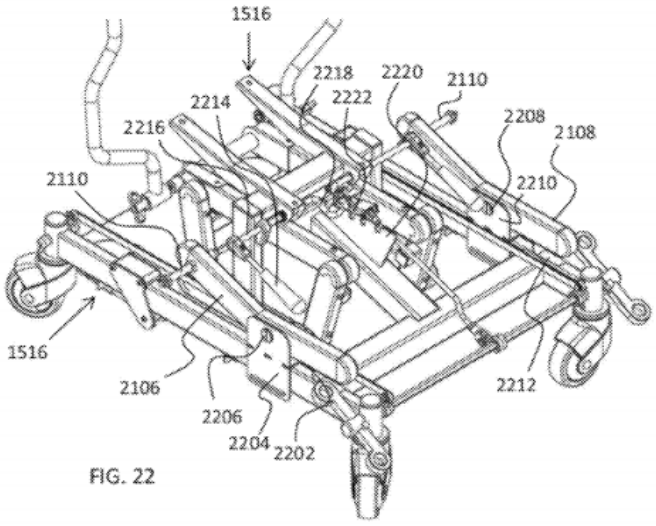
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FIG. 22

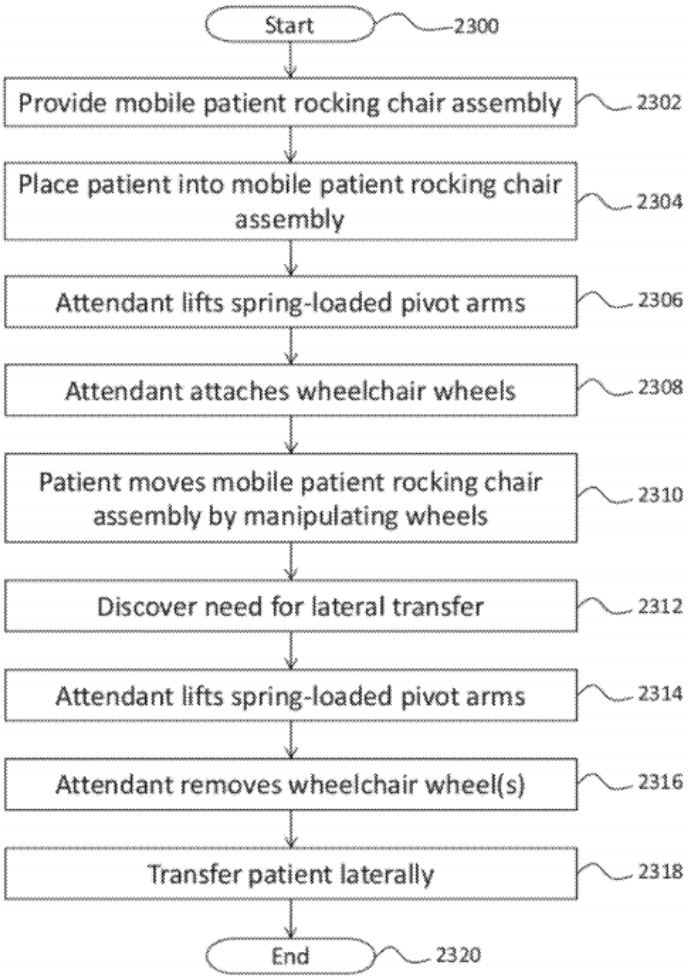
Start
2300
Provide mobile patient rocking chair assembly
2302
Place patient into mobile patient rocking chair assembly
2304
Attendant lifts spring-loaded pivot arms
2306
Attendant attaches wheelchair wheels
2308
Patient moves mobile patient rocking chair assembly by manipulating wheels
2310
Discover need for lateral transfer
2312
Attendant lifts spring-loaded pivot arms
2314
Attendant removes wheelchair wheel(s)
2316
Transfer patient laterally
2318
End
2320

FIG. 23

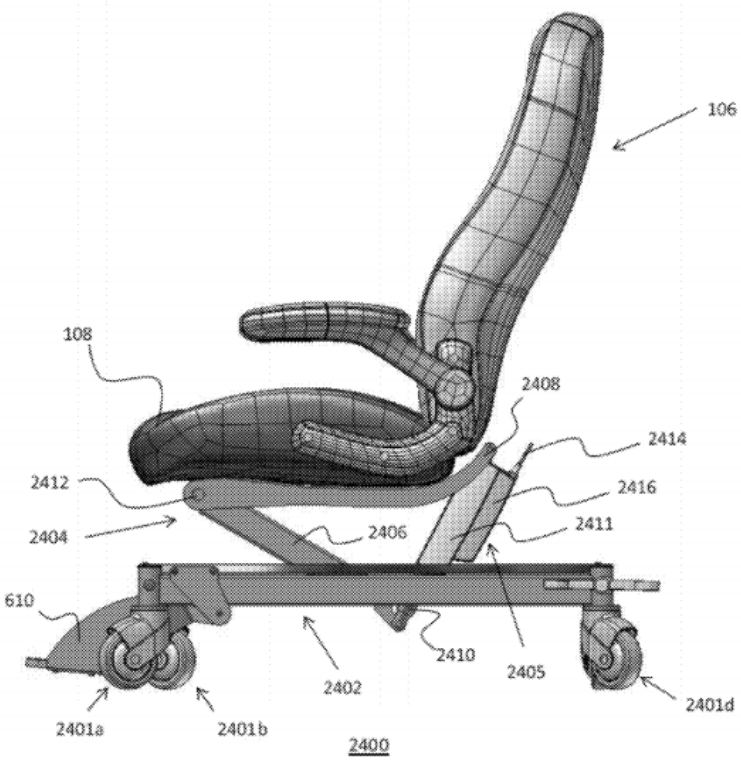
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FIG. 24

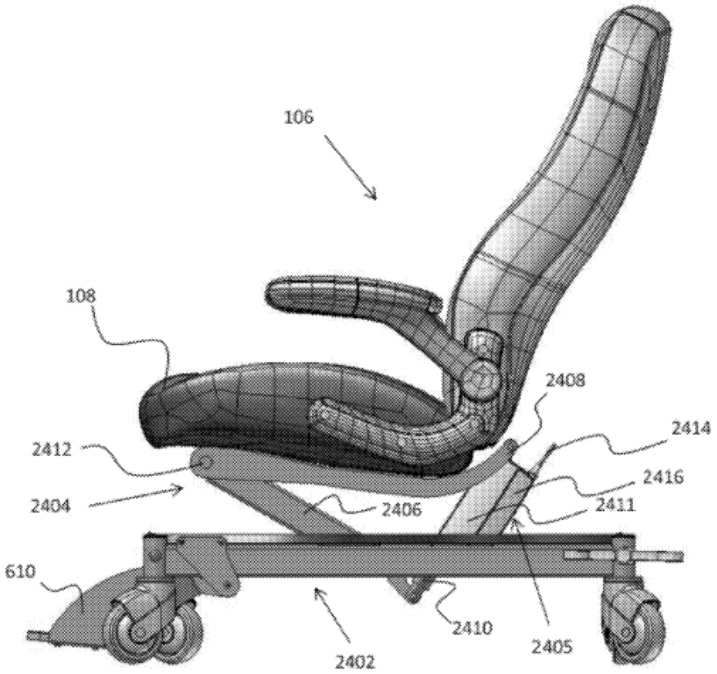
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FIG. 25

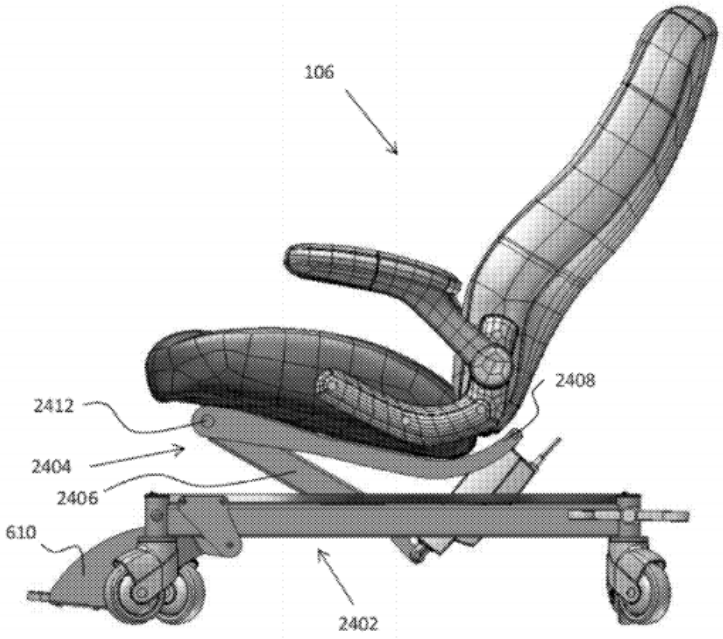

FIG. 26

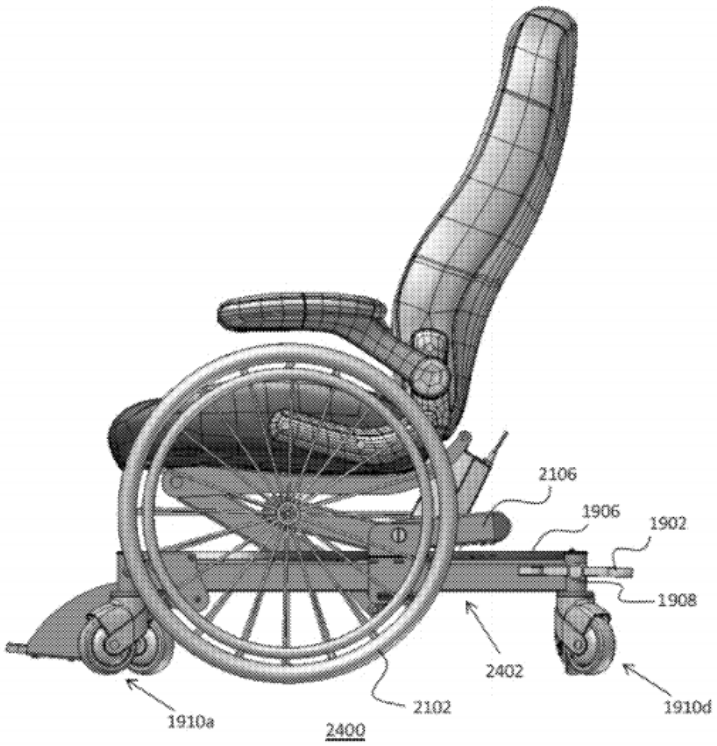

FIG. 27

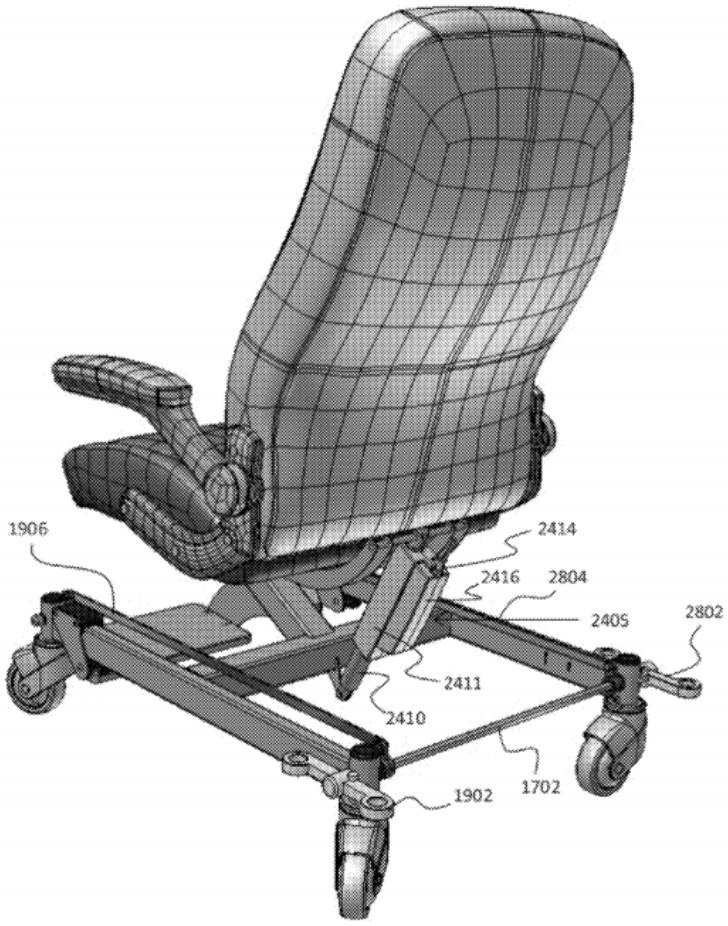

FIG. 28

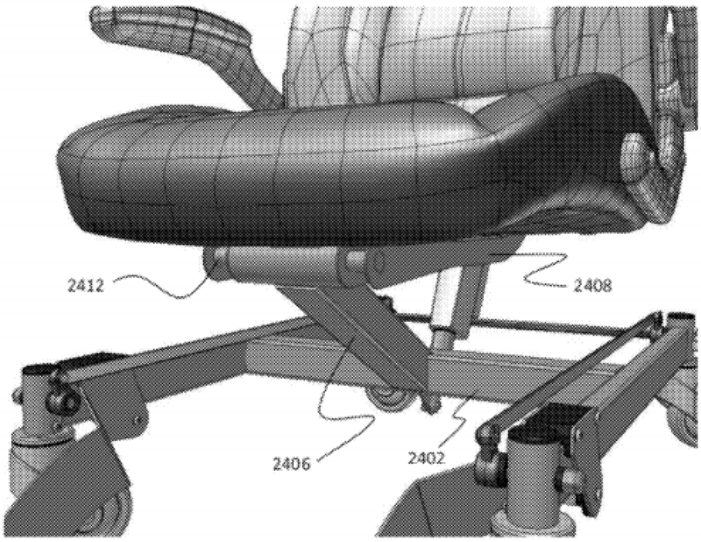

FIG. 29

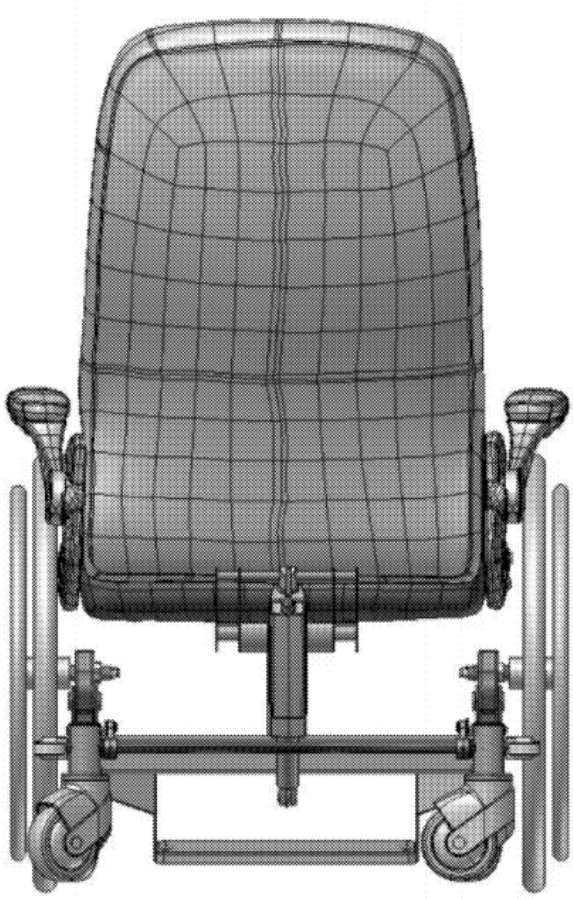

FIG. 30

FIG. 31

MOBILE ROCKING PATIENT CHAIR AND METHOD OF USE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application No. 61/487,113, filed on May 17, 2011, the prior application being herewith incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to wheeled, movable chairs, and, more particularly, relates to a movable chair with rocking and other capabilities.

BACKGROUND OF THE INVENTION

[0003] Although rocking is a part of virtually every human's childhood, much more often than not, it becomes an infrequent activity in the adult years. This is largely due to the fact that few people are aware of the myriad benefits conveyed by the rocking movement on the body.

[0004] Historically, rocking chairs have been a considered a treasured piece of furniture. Originating in England, by the 1700s, rocky chairs had become an American phenomenon. A common and functional piece of furniture, rocking chairs were used in virtually every home. In addition to soothing emotional wounds and providing comfort in times of illness, rocking chairs were widely accepted as a cradling device, ensuring the emotional bond between mother and child.

[0005] Through scientific research and case studies, today, society is discovering the therapeutic and life-changing effects rocking chairs have on psychosocial well-being, among other types. The use of rocking chairs has spread far beyond the mother/child cradle—they are now considered a cure for a wide range of health problems.

[0006] Studies have shown that the gentle motion of a rocking chair releases endorphins; a chemical known to improve mood and lessen pain. The study confirms that rocking chair therapy increases the quality of life for people suffering from Dementia and Alzheimer's disease. Studies further show that the calming movement of a rocking chair can dramatically speed up the healing process in severely ill patients. Not surprisingly, rocking chairs are now being used as therapy for post-surgery recovery.

[0007] Unlike other pieces of furniture and medical devices, rocking chairs provide a place for rest and relaxation with both psychological and physical benefits. They have been scientifically proven to be of benefit for many medical conditions. By working the muscles and tendons of the thighs, lower legs and ankles, studies have revealed that rocking chairs provide light to moderate exercise, even for those with limited mobility. They contribute to fitness and assist in maintaining or losing weight. Only five to ten minutes of rocking per day can reduce blood pressure and improve circulation. Rocking chairs have also been shown to reduce the impact of diseases such as arthritis, assist in the promotion of prenatal nervous system development, progress healing after surgery, positively impact the immune system, and improve the quality of living by rejuvenating the mind.

[0008] Some studies indicate that rocking has been linked to improved cognitive conditions such as Alzheimer's disease, and sensory disorders including autism. Researchers believe that the motion of rocking satisfies the autistic individual's need to keep moving, while allowing them to concentrate and study.

[0009] Rocking Chair Therapy appears to ease health problems, and it has been applied and proven beneficial to at least the following conditions:

[0010] 1. Abdominal hysterectomy pain: Rocking chairs have been proven helpful for people with abdominal hysterectomy pain. Studies have suggested that the back and forth motion of rocking helps relieve intestinal gas buildup and abdominal distension. Researchers have hypothesized that the rhythmic repetitive motion of rocking stimulates the vestibular nerves and has a modulating effect on the stress response.

[0011] 2. Anxiety and depression: It has been reported that the act of rocking improves anxiety and depression in people suffering from Alzheimer, dementia, ADHD, Autism and sensory disorders. Rocking chair therapy has also been shown to have a positive effect on the emotional well-being of dementia patients in nursing homes. In addition to reducing anxiety, depression and medication consumption, patients' balance tends to improve, resulting in fewer subsequent falls and related injuries.

[0012] 3. Arthritis: Experts highly recommend the use of rocking chairs. According to studies, rocking is relaxing and can improve strength and flexibility, especially in a person's knees.

[0013] 4. Back pain: President John F. Kennedy is often credited for the worldwide acceptance of rocking chair therapy. After being diagnosed and suffering from extreme back pain, Kennedy's physician prescribed him a rocking chair. Amazed by the healing effects of the rocker, Kennedy insisted that the chair accompany him to the White House after his presidential election. Over the years, Kennedy had at least 14 rocking chairs, some of which were kept in the most exclusive locations including, the Oval Office, his bedroom at the White House, a suite at the New York Carlyle's Hotel, and Air Force One. Today, research studies have confirmed that rocking chairs block pain impulses, relax the muscles in the lower hack, and ease lower back pain.

[0014] 5. Blood pressure: In a pilot study of men and women over 55 who often suffer from lower blood pressure and low blood return to the brain, 30 min of steady rocking led to an average 12 mmHg increase in systolic blood pressure and a 3.6 average increase in diastolic blood pressure. Rocking tends to increase blood pressure, which in turn helps get blood to the brain.

[0015] 6. Cardio vascular issues: Rocking chairs are an excellent source for cardio vascular training. To improve upper body training, accessories or training devices can be attached to the chairs.

[0016] 7. Children with ADHD and other disorders: There is gathering anecdotal evidence for the benefits of allowing children with Attention Deficit Hyperactivity Disorder to use a rocking chair while reading. ADHD cases appear to be able to concentrate better when rocking chair therapy is used. It is believed that the rocking motion gives an outlet to excess energy.

[0017] 8. Chronic fatigue, stroke and heart attack: Rocking in a rocking chair has been proven beneficial for chronic fatigue, stroke and heart attack victims.

[0018] 9. Fragile X syndrome: Fragile X is a family of genetic conditions which impacts individuals and families in different ways. Fragile X Syndrome is the most common form of inherited mental impairment and is sometimes referred to as mental retardation. Sensory impairment or sensory processing difficulties are often a part of the puzzle. Rocking in a rocking chair is a recommended part of the therapy, cited for its calming effects.

[0019] 10. Sensor integration therapy: SIT is a theory used by occupational therapists and has been applied to autism learning disabilities, attention problems, and developmental problems including Fragile X. Rocking in a rocking chair is one of the calming activities that is recommended. The late A. Jean Ayres, Ph.D. developed the theory and practice of sensory integration. She believed every autistic child should have a rocker in his room.

[0020] 11. Sleep: For children, rocking chairs assist in getting them to sleep and reduce the odds of apnea and Sudden Infant Death Syndrome (SIDS). For adults, it is believed that rocking chairs release tension, similarly aiding them in sleep.

[0021] 12. Strength and flexibility: According to the results of study groups, strength and flexibility increase in patients who use rocking chairs as a form of therapy.

[0022] 13, Surgical healing process: A recent study found that short periods of regular rocking chair therapy speed recovery from bowel dysfunction, a common side effect of abdominal surgery for colon, small bowel, pancreatic and liver cancers. Patients who spent time rocking in a rocking chair resumed bowel activity more quickly than patients who did not, which meant they felt better sooner and recovered faster.

[0023] Rocking in a Rocking Chair has also been proven helpful for women after a C-section. One study found that rocking mothers who had cesarean sections had less gas pains, walked faster, and left the hospital one day sooner than non-rocking mothers. This could explain why rockers are a standard in maternity wards today.

[0024] 14. Stuttering: Rocking chairs are recommended for children who stutter. The distracting rhythm works on vestibular function.

[0025] 15. Varicose veins: Rocking chairs have been linked to the prevention and cure of varicose veins. According to the research, rocking stimulates circulation and improves muscle tone, thereby reducing and preventing the development of varicose veins.

[0026] 16. Weight loss: Rocking chairs have proven to be successful in the maintenance and reduction of weight. In fact, rocking in a rocking chair burns approximately 150 calories per hour.

[0027] Unfortunately, at a time when people need rocking the most when they are immobilized they are deprived of the ability to rock. For example, when persons reach an advanced age, they are often times confined to a wheel chair and are unable to rock. Once such improvement to the art is described in U.S. Pat. No. 4,707,026, which was issued to one of the co-inventors of the instant application, the entire disclosure of which is incorporated herein by reference. The device described in U.S. Pat. No. 4,707,026 however lacks several important features that render a mobile patient rocking chair suitable for everyday use.

[0028] Therefore, a need exists to overcome the problems with the prior art as discussed above.

SUMMARY OF THE INVENTION

[0029] The invention provides a mobile rocking patient chair and method of use that overcomes the hereinafore-mentioned disadvantages of the heretofore-known devices and methods of this general type and that allows a patient to be mobile and enjoy the ability to rock in a rocking chair.

[0030] With the foregoing and other objects in view, there is provided, in accordance with the invention, a patient chair that includes a seat portion and an undercarriage coupled to and supporting the seat portion, where the undercarriage includes a frame, a rocking mechanism coupling the seat portion to the frame, a selectively pivotable pivot arm coupled to the frame, and at least one wheelchair-type wheel selectively couplable to the pivotable pivot arm.

[0031] In accordance with another feature, an embodiment of the present invention includes a set of wheels coupled to the frame that operable to reduce friction between the frame and a flooring surface upon which the patient chair is supported. In other words, the wheels allow the frame to glide across the floor.

[0032] In accordance with a further feature of the present invention, the set of wheels provides mobility and stability to the patient chair independent of a coupled/decoupled state of the wheelchair-type wheels.

[0033] In accordance with a further feature of the present invention, the pivot arm further includes a wheel-coupling end, a pivot-arm manipulating end, and a pivot point located between the wheel-coupling end and the pivot-arm manipulating end.

[0034] In accordance with yet another feature of the present invention, a bias member biases the wheel-coupling end of the pivot arm in a downward direction.

[0035] In accordance with an additional feature of the present invention, the pivot arm is arranged on the frame so that movement of the pivot-arm manipulating end moves a wheelchair-type wheel coupled to the wheel-coupling end in a direction away from a surface upon which the patient chair is supported.

[0036] In accordance with one more feature of the present invention, the wheelchair-type wheel is coupled to the pivot arm with a quick couple.

[0037] With the foregoing and other objects in view, there is further provided, in accordance with the invention, a patient chair that includes a seat portion and an undercarriage supporting the seat portion, where the undercarriage includes a set of at least three wheels providing mobility to the patient chair, a left wheelchair-type wheel coupling member, a right wheelchair-type wheel coupling member, and a lever operable to move at least one of the left wheelchair-type wheel coupling member and the right wheelchair-type wheel coupling member away from a flooring surface upon which the patient chair is supported.

[0038] In accordance with a further feature of the present invention, the lever is a selectively pivotable pivot arm that is activatable by a user's foot.

[0039] In accordance with another feature, the lever also includes a wheel-coupling end, a pivot-arm manipulating end, and a pivot point located between the wheel-coupling end and the pivot-arm manipulating end.

[0040] In accordance with yet another feature, an embodiment of the present invention includes a bias member biasing the wheel-coupling end of the pivot arm in a downward direction.

[0041] In accordance with the present invention, a method of transferring a patient includes providing a mobile patient chair that has a seat portion and an undercarriage supporting the seat portion, where the undercarriage has a set of at least three wheels providing mobility to the patient chair, a left wheelchair-type wheel coupling member, a right wheelchair-type wheel coupling member, and a lever operable to move at least one of the left wheelchair-type wheel coupling member and the right wheelchair-type wheel coupling member away from a flooring surface upon which the patient chair is supported. The method further includes manipulating the lever in a first direction, coupling at least a first wheelchair-type wheel to at least one of the left wheelchair-type wheel coupling member and the right wheelchair-type wheel coupling member of the mobile patient chair, manipulating the lever in a second direction, and manipulating the coupled wheelchair-type wheel to cause the mobile patient chair to move.

[0042] In accordance with yet another feature, an embodiment of the present invention includes the step of maneuvering the mobile patient chair to a first position adjacent a target patient delivery location, manipulating the lever in the first direction, decoupling one of the first wheelchair-type wheel and the second wheelchair-type wheel from its respective wheel coupling member, maneuvering the mobile patient chair to a second position adjacent the target patient delivery location, the second position closer to the target patient delivery location than the first position, and transferring a patient from the seat portion to the target patient delivery location.

[0043] In accordance with still another feature, the step of transferring the patient includes moving the patient sideways relative to the seat, i.e., over a location of the respective wheel coupling member.

[0044] In accordance with still another feature, the method includes pressing down on the lever with a user's foot to manipulate the lever in the first direction.

[0045] In accordance with still another feature, a bias member biases the lever in the second direction.

[0046] A mobile patient chair and method of transferring a patient include providing a mobile patient chair with a seat portion and an undercarriage supporting the seat portion, where the undercarriage includes a set of four wheels providing mobility to the patient chair, a left wheelchair-type wheel coupling ember, a right wheelchair-type wheel coupling member, and a pair of levers operable to move the wheelchair-type wheel coupling members away from a flooring surface upon which the patient chair is supported. The method includes manipulating each of the levers in a first direction, coupling wheelchair-type wheels to the wheelchair-type wheel coupling members, manipulating the levers in a second direction, and manipulating the coupled wheelchair-type wheel to cause the mobile patient chair to move.

[0047] Although the invention is illustrated and described herein as embodied in a mobile rocking patient chair, it is, nevertheless, not intended to be limited to the details shown because various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims. Additionally, well-known elements of exemplary embodiments of the invention will not be described in detail or will be omitted so as not to obscure the relevant details of the invention.

[0048] Other features that are considered as characteristic for the invention are set forth in the appended claims. As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one of ordinary skill in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention. While the specification concludes with claims defining the features of the invention that are regarded as novel, it is believed that the invention will be better understood from a consideration of the following description in conjunction with the drawing figures, in which like reference numerals are carried forward. The figures of the drawings are not drawn to scale.

[0049] Before the present invention is disclosed and described, it is to be understood that the terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting. The terms "a" or "an," as used herein, are defined as one or more than one. The term "plurality," as used herein, is defined as two or more than two. The term "another," as used herein, is defined as at least a second or more. The terms "including" and/or "having," as used herein, are defined as comprising (i.e., open language). The term "coupled," as used herein, is defined as connected, although not necessarily directly, and not necessarily mechanically.

[0050] As used herein, the terms "about" or "approximately" apply to all numeric values, whether or not explicitly indicated. These terms generally refer to a range of numbers that one of skill in the art would consider equivalent to the recited values (i.e., having the same function or result). In many instances these terms may include numbers that are rounded to the nearest significant figure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0051] The accompanying figures, where like reference numerals refer to identical or functionally similar elements throughout the separate views and which together with the detailed description below are incorporated in and form part of the specification, serve to further illustrate various embodiments and explain various principles and advantages all in accordance with the present invention.

[0052] FIG. **1** is a left-side perspective view of a mobile patient rocking chair assembly showing removable cushion inserts in accordance with the present invention;

[0053] FIG. **2** is a left-side perspective view of the mobile patient rocking chair assembly of FIG. **1** showing removable exercise handles and armrests in accordance with the present invention;

[0054] FIG. **3** is a left-side perspective view of the mobile patient rocking chair assembly of FIG. **1** showing concealable patient transfer mats and exercise handles in accordance with the present invention;

[0055] FIG. **4** is a rear-facing perspective view of the mobile patient rocking chair assembly of FIG. **1** showing a storage container holding the patient transfer mats in accordance with the present invention;

[0056] FIG. **5** is a fragmentary, side perspective view of the undercarriage of the mobile patient rocking chair assembly of FIG. **1**;

[0057] FIG. **6** is a left front perspective view of the undercarriage of the mobile patient rocking chair assembly of FIG. **1**;

[0058] FIG. **7** is an exploded perspective view of a coupling connector in accordance with the present invention;

[0059] FIG. **8** is a rear-facing fragmentary perspective view of a resistance-producing member coupled to the undercarriage of the mobile patient rocking chair assembly in accordance with the present invention;

[0060] FIG. **9** is an elevational side view of the resistance-producing member of FIG. **9**;

[0061] FIG. **10** is an elevational side view of the mobile patient rocking chair assembly of FIG. **1** with a push handle and an electric motor that is able to propel the chair assembly as well as prevent rocking movement while the chair assembly is in motion in accordance with the present invention:

[0062] FIG. **11** is an elevational side view of the mobile patient rocking chair assembly of FIG. **1** with an adjustable back portion of the chair in accordance with the present invention;

[0063] FIG. **12** is a perspective right rear view of the mobile patient rocking chair assembly of FIG. **1** with a wheelchair wheel aligned with an axle in accordance with the present invention;

[0064] FIG. **13** is a perspective right rear view of the mobile patient rocking chair assembly of FIG. **1** with a wheelchair wheel installed on an axle in accordance with the present invention;

[0065] FIG. **14** is a perspective left-side view of a mobile patient rocking chair assembly having a food tray and food tray support bar that converts to a push handle as well as a mechanism that prevents rocking movement when the wheels are not in a locked position in accordance with the present invention;

[0066] FIG. **15** is a perspective downward-looking front view of an undercarriage having a frame and rocking mechanism with the chair removed and exercise handles partially installed in accordance with the present invention;

[0067] FIG. **16** is a close-up partial perspective downward-looking front view of the partially-installed exercise handles of FIG. **15**;

[0068] FIG. **17** is a perspective downward-looking left rear view of a mobile patient rocking chair assembly with a rear frame bar that controls a lockout bar that prevents the chair of the mobile patient rocking chair assembly from rocking relative to the frame in accordance with the present invention;

[0069] FIG. **18** is a perspective downward-looking right rear view of the mobile patient rocking chair assembly of FIG. **17**;

[0070] FIG. **19** is a perspective downward-looking right rear view of the mobile patient rocking chair assembly of FIG. **18** with the chair portion removed;

[0071] FIG. **20** is a perspective downward looking close-up partial right rear view of the undercarriage of the mobile patient rocking chair assembly of FIG. **17**;

[0072] FIG. **21** is a perspective view of two wheelchair wheels coupled to pivot arms through quick connect couplers in accordance with the present invention;

[0073] FIG. **22** is a downward-looking left rear view of the mobile patient rocking chair assembly of FIG. **17** with the chair removed to show the wheelchair wheel coupling pivot arms coupled to the frame of the undercarriage as well as a frame plate and handle for coupling the rocking mechanism to the frame in accordance with the present invention;

[0074] FIG. **23** is a process flow diagram illustrating a method of attaching and removing wheel chair wheels from a mobile patient rocking chair assembly;

[0075] FIG. **24** is an elevational left side view of a mobile patient chair assembly in an upright position in accordance with the present invention;

[0076] FIG. **25** is an elevational left side view of the mobile patient chair assembly of FIG. **24** in a partially reclined position;

[0077] FIG. **26** is an elevational left side view of the mobile patient chair assembly of FIG. **24** in a fully reclined position;

[0078] FIG. **27** is an elevational left side view of a mobile patient rocking chair assembly with a left wheelchair wheel coupled to a pivot arm that is attached to the frame of the mobile patient rocking chair assembly in accordance with the present invention;

[0079] FIG. **28** is a perspective left rear view of the mobile patient chair assembly of FIG. **24** and illustrates an actuator for selecting a decline angle of the chair and foot levers that manipulate a frame bar to lock one or more of the casters upon which the mobile patient chair assembly receives movement capabilities in accordance with the present invention;

[0080] FIG. **29** is a perspective close-up partial front view of the mobile patient chair assembly of FIG. **24**;

[0081] FIG. **30** is an elevational rear view of the mobile patient chair assembly of FIG. **24**; and

[0082] FIG. **31** is a perspective left front view of the mobile patient chair assembly of FIG. **24**.

DETAILED DESCRIPTION

[0083] While the specification concludes with claims defining the features of the invention that are regarded as novel, it is believed that the invention will be better understood from a consideration of the following description in conjunction with the drawing figures, in which like reference numerals are carried forward. It is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms.

[0084] The present invention provides a novel mobile patient chair that allows the seated person to rock back and forth. Embodiments of the invention provide the ability to quickly and easily transfer the seated person from the novel chair to an adjacent surface. In addition, embodiments of the invention provide various rocking features that result in exercise for the seated person during the rocking motion. Further, embodiments of the invention provide removable cushion inserts that provide comfort and ease of cleaning while maintaining durability of the surrounding seat surfaces.

[0085] Referring now to FIG. **1**, one embodiment of the present invention is shown in a perspective view. FIG. **1** shows several advantageous features of the present invention, but, as will be described below, the invention can be provided in several shapes, sizes, combinations of features and components, and varying numbers and functions of the components.

[0086] The first example of a mobile patient rocking chair assembly **100**, as shown in FIG. **1**, includes an undercarriage **102** that supports a chair **106** on top and features a set of wheels **104***a-d* below that provide mobility to the undercarriage **102**. The chair **106** is used to support a person when placed in the inventive patient rocking chair assembly **100**. Although four wheels are shown, the invention is not so limited and can utilize any number of wheels, rollers, casters, and other elements to provide mobility.

[0087] The chair **106** also includes a seat portion **108** and a back portion **110**. The seat portion **108** supports the lower portion of a person's body and the back portion **110** supports the upper portion of a person's body. As is shown in FIG. **1**, the chair **106** is formed, although not necessarily, in an ergonomic shape that conforms to the contours of a user's body when the user is sitting in the chair **106**. The chair however, is not required to have such a shape and any chair that supports a person's body is within the spirit and scope of the present invention.

[0088] Removable Inserts

[0089] It is envisioned that the mobile patient rocking chair assembly **100** will be used, at times, by those suffering from issues of incontinence. When an episode of incontinence occurs, the chair in which the user is seated can come into contact with the moisture. For this reason, easy cleaning of the chair **106** is desired. To facilitate easy cleaning, many prior-art patient chairs wrapped foam or some other pillow-type material with an easy-to-clean material, such as leather, Naugahyde, vinyl or other similar materials. However, these materials do not "breathe," i.e., allow air to circulate, and quickly become hot and uncomfortable to sit on. On the other hand, cloth materials, which provide improved air circulation, allow moisture to soak in and are not desirable for chairs used by people suffering from incontinence.

[0090] In accordance with the present invention, the inventive mobile patient rocking chair assembly **100** provides a chair **106** with removable inserts **112** and **114**. Each insert **112** and **114** fits within a corresponding cavity **116** and **118**, respectively, formed in the chair **106**, More specifically, the removable insert **112** fits within the cavity **116** formed in the back portion **110** of the chair **106**. Similarly, the removable insert **114** fits within the cavity **118** of the seat portion **108** of the chair **106**.

[0091] Although any material can be used, in accordance with a preferred embodiment of the present invention, each removable insert **112** and **114** features a cushion on its interior surrounded by a "breathable" material **120**, such as cloth. It is envisioned, that the cushion surrounded by the breathable material **120** is surrounded by a waterproof non-permeable protective covering that prevents moisture from contacting the cushion material. The waterproof protective covering can be, for example, plastic, vinyl, leather, Naugahyde, or other similar materials.

[0092] In accordance with embodiments of the present invention, the back portion **110** of the chair **106** and the seat portion **108** of the chair **106** can be covered in a waterproof material **122**, such as vinyl, leather, Naugahyde, plastic, and other similar materials that do not allow moisture to penetrate to the interior of the back portion **110** or the seat portion **108**.

[0093] Upon the detection of an incontinence episode or any other occurrence of moisture contacting the chair **106**, the novel chair can be quickly and effectively cleaned. In a first step, the removable inserts **112** and **114** are removed from their respective cavities **116** and **118**. The breathable material **120** is then removed from its supporting cushion. The removal can be through use of a zipper, VELCRO, elastic material, or other materials that allow the breathable covering material **120** to be removed from its cushion.

[0094] Next, the cushions, which are, as described above, covered in a waterproof material, are wiped down with a disinfecting solution. Similarly, the back portion **110** and the seat portion **108**, which are both also covered with a waterproof material, are wiped down with a disinfecting solution. This includes the cavity portions **116** and **118**. Because both of the removable inserts **112** and **114** and the back portion **110** and the seat portion **108** are waterproof, no moisture penetrates to the interior of either. It should be noted that the shape and size of the removable inserts **112** and **114** and corresponding cavity portions **116** and **118** are merely exemplary and the present invention is not so limited, in one embodiment, the lower insert **112** extends to and up the back portion **110** of the chair **106** and features an "L" bend that captures liquid. In another embodiment, the upper insert **112** extends to the bottom of the back portion **110**.

[0095] The removable breathable coverings **120** of the removable inserts **112** and **114** can easily be washed and replaced back onto their respective cushions once clean. In addition, any patterns or colors used on the coverings **120** can be easily updated without having to re-upholster the entire chair. Furthermore, the cushions within the breathable coverings **120** can be selectively replaced with cushions of varying densities. For example, a cushion having an increased density can be used for a heavier patient, where a cushion of a lower density can be used for a lighter patient. In this way, the chair can be configured specifically to the desires of the patient.

[0096] The inventive chair **100** can also be provided with optional pads that slip onto the seat portion **108**, back portion **110**, or the armrests to provided improved comfort for the user.

[0097] Advantageously, the inventive chair **106** of the mobile patient rocking chair assembly **100** provides an ergonomic comfortable seat that conforms to the patient's body as well as a seat and back portion that does not trap heat and moisture as do prior-art patient seats but can also be cleaned quickly, easily, effectively, and inexpensively.

[0098] Exercise Handles

[0099] Referring now to FIG. **2**, the front-side downward-looking perspective view of the mobile patient rocking chair assembly **100** shows a left **202** and a right **204** exercise handle that can be removably attached to the undercarriage **102**. The left exercise handle **202** features a coupling portion **206** that selectively removably couples to a receiver **208** in the left side of the undercarriage **102**. Similarly, the right exercise handle **204** features a coupling portion **210** that selectively removably couples to a receiver **212** in the right side of the undercarriage **102**, although the right-side receiver **212** cannot be seen in the left-side perspective view of FIG. **2**.

[0100] The undercarriage **102** provides therein a rocking mechanism **215** that allows the chair **106** to move back and forth with respect to a frame **216**. The rocking mechanism **215** will be described in detail below however, for the instant discussion, it is to be understood that the rocking mechanism **215** provides a rocking motion similar to that found in many prior-art nursing chairs utilized by new mothers to rock their babies.

[0101] As with prior-art rocking chairs, the rocking motion can be caused by movement of the user's upper body or by a force applied by the user's feet, which causes the upper por-

tion of the chair to move relative to the frame **216**. Advantageously, the left **202** and right **204** exercise handles of the present invention provide a further structure for allowing a user to obtain exercise. That is, in addition to the standard methods of pushing with their feet or rocking their upper body, a user can now utilize a pushing or pulling motion with their arms to cause the chair **106** to rock with relation to the flame **216**. Pushing and/or pulling on the exercise handles **202**, **204** involves the user's chest muscles, back muscles, triceps, biceps, and other muscles that are not involved in traditional rocking motion.

[0102] Advantageously, because the exercise handles **202**, **204** are removably coupled to the undercarriage **102**, they can be selectively removed and stored when not needed, which allows improved mobility and an improved ability for the user to enter and exit the chair **106**. In accordance with an embodiment of the present invention, the exercise handles **202**, **204** can be reconfigured to provide a push handle so that a technician can push the mobile patient rocking chair assembly **100**, for example, down a hallway. Several alternative embodiments allow the exercise handles **202**, **204** to be utilized as pushing handles. In accordance with a first embodiment, the back portion **110** of the chair **106** is provided with a left **214** and a right **217** armrest. Each armrest **214**, **217** is provided with a receiver **218**, **220**, respectively. Each receiver **218**, **220** is substantially similar to the receivers **208**, **212** formed and the undercarriage **102**. In this embodiment, the exercise handles **202**, **204** are simply relocated from their respective receivers **208**, **212** in the undercarriage **102** to the receivers **218**, **220** in the armrest portions **214**, **217**, respectively. Advantageously, the exercise handles **202** and **204**, when in the secondary receivers **218**, **220**, are not only conveniently stored and out of the way of the person seated in the chair **106**, but can now be used by a person pushing the chair.

[0103] Alternatively, the armrests **214**, **217** can be removed from the back portion **110** and the exercise handles **202**, **204** can be inserted into exposed receivers **222**, **224** of which the armrests **214**, **217** were previously inserted. In this mode, because the armrests **214**, **217** are no longer present, a seat belt **226** can be utilized to ensure that the patient does not become separated from the chair **106**.

[0104] It should be noted that the primary left receiver **208** and its non-illustrated counterpart, right receiver **212**, can be provided in locations other than that shown in FIG. **2**. Other suitable locations will be apparent from the below description of further mechanical elements of the rocking mechanism **215**.

[0105] FIGS. **15** and **16** provide an illustration of an alternate coupling between the exercise handles **1502** and **1504** and an undercarriage **1500**. The close-up view of FIG. **16** shows that each of the handles **1502** and **1504** have lower coupling portions **1506** and **1508**, respectively, that slidably engage with extensions **1510** and **1512**, respectively, of the undercarriage **1500**. The extensions **1510** and **1512** are mechanically and fixedly attached to the undercarriage **1500** and provide structural support for attaching the handles **1502** and **1504** to the undercarriage **1500**.

[0106] In accordance with the embodiment shown in FIGS. **15** and **16**, each of the coupling portions **1506** and **1508** is provided with a set of teeth **1514** and **1517**, respectively. Likewise, each of the extensions **1510** and **1512** of the undercarriage **1500** are provided with a corresponding set of teeth **1518** and **1520**. The teeth allow the handles **1502** and **1504** to be coupled to the undercarriage **1500** in one of a plurality of selectable angles, or rotational positions, around an axis of the extensions **1510** and **1512**. Each of the coupling portions **1506** and **1508** is provided with a set key **1522** and **1524**, respectively. Each set key **1522** and **1524** engages with one of the extensions **1510** and **1512** and independently selectively fixes a rotational position of its respective handle **1502** and **1504** about the axis of its respective extensions **1510** and **1512**. In one embodiment, the set keys **1522** and **1524** include threaded members that are received within a threaded interior of a corresponding one of the extensions **1510** and **1512**. By selectively fixing the handles **1502** and **1504** to the undercarriage **1500**, the handles **1502** and **1504** and undercarriage **1500** allow the user to cause the chair (not illustrated in FIG. **15**) to move in a substantially lateral direction, i.e., back and forth, with respect to a frame **1516**, by applying sufficient force to the grasping ends **1501** and **1503** of the handles **1502** and **1504**, respectively, while sitting upon the chair. By selecting from among many available angles for attaching the handles **1502** and **1504** to the undercarriage **1500**, the user can select the most comfortable position of the handles **1502** and **1504** and/or the position that targets a particular muscle (s) while performing the pushing/pulling exercises made available by the handles **1502** and **1504**.

[0107] Exercise Bands

[0108] Referring now back to FIG. **2**, in a further embodiment of the present invention, the mobile patient rocking chair assembly **100** includes a set of exercise connector points **230***a-n* (where "a-n" represents any range of numbers) along the back portion **110** and, in some embodiments, along the seat portion **108** of the chair **106**. The exercise connector points **230***a-n* shown in this view are simply half loops that provide points of attachment for connectors. The loops can be solid or flexible.

[0109] Referring now to FIG. **3**, a pair of elastic exercise resistance bands **302** and **304** are showing coupled to respective ones of the exercise connector points **230***a-n* on the back portion **110** of the chair **106**. The resistance bands **302**, **304** can be, for example, plastic, rubber, or other stretchable materials. The exercise resistance bands **302** and **304** are provided with exercise handles **306** and **308**, respectively. The exercise handles **306** and **308** are gripped by a patient seated in the mobile patient rocking chair assembly **100** and used to cause the resistance bands **302** and **304** to stretch against the resistance forces provided by the elastic properties of the resistance bands **302** and **304**. Overcoming the resistance forces causes the user's muscles to exert force, provides muscle stimulation for the user, resulting in muscle conditioning, increased heart rate, and improve health. The specific muscles targeted by the particular exercise can be selected based on which of the exercise connector points **230***a-n* the resistance bands **302** and **304** are coupled to. For example, the patient can perform exercise motions that target their chest area when the resistance bands **302** and **304** are coupled to exercise connector points **230** on the upper area of the back portion **110** of the chair **106**. The patient can perform exercise motions that target their arms, e.g., biceps, when the resistance bands **302** and **304** are coupled to exercise connector points **230** of the seat portion **108** of the chair **106**. When the exercise resistance bands **302** and **304** are coupled to the exercise connector points **230** on the lower area of the back portion **110**, multiple muscles are involved in the exercise, such as shoulders, biceps, and chest.

[0110] The resistance bands **302** and **304** can be quickly and easily detached from the exercise connector points **230** and stored, for example, in a storage bin **402** shown in FIG. **4**.

[0111] Transfer Mat

[0112] Referring still to FIG. **3**, the mobile patient rocking chair assembly **100** is shown provided with a pair of transfer mats **310** and **312**. More specifically, the seat portion **108** of the chair **106** features a first pocket **314** that receives and conceals the first transfer mat **310** and a second pocket **316** (not visible in the left-side perspective view of FIG. **3**) that receives and conceals the second transfer mat **312**. Each transfer mat **310**, **312** is operable to extend from and be inserted within its respective pocket **314**, **316**. Once removed from its pocket, the transfer mat is placed as far as is reasonable possible between the seat and the patient's buttocks. Transfer mats and methods of using transfer mats are described in U.S. Pat. No. 4,700,416, issued to the inventor of the present invention. In accordance with an embodiment of the present invention, an upper surface of the transfer mat **310**, **312** is provided with a low-resistance material that allows easy transfer of the patient across the transfer mat **310**, **312**.

[0113] An exemplary method of using the transfer mats **310**, **312** would be as follows. A patient seated in the mobile patient rocking chair assembly **100** is wheeled to a position adjacent a receiving surface. For example, the patient may be wheeled next to a toilet. Next, the appropriate armrest **214**, **217** would be pivoted upward or simply removed from the chair **106**. The appropriate transfer mats **310**, **312** (left or right) would then be removed from the pocket **314**, **316**. The proximal end of the transfer mat is placed between the patient's buttocks and the distal extended end of the transfer mat **310**, **312** would reach and rest upon the destination surface. At this point, a bridge is provided from the seat portion **108** of the chair **106** to the destination seating location.

[0114] In accordance with an alternate embodiment of the present invention, once extended, as shown in FIG. **3**, each transfer mat **310**, **312** remains secured to the seat portion **108** at its proximal end. The opposing distal end of each transfer mat **310**, **312**, when the transfer mats are being utilized, is placed on a receiving surface. Generally, only one transfer mat **310**, **312** will be used at any given time. Once extended, the transfer mat **310**, **312** advantageously provides a bridge for sliding the patient from the seat portion **108** to the destination location, e.g., a patient bed, a toilet, a dining chair, etc.

[0115] In accordance with an embodiment of the present invention, the lower surface of the transfer mats **310**, **312** are provided with a shape or material that provides resistance and prevents the transfer mat **310**, **312** from moving away from the surface upon which it rests. The resistance shape can include notches in the lower portion of the board that receives portions of the destination surface. In other words, the notches grasp onto portions of the surface and prevent separation of the mat from the surface.

[0116] In an alternative embodiment, the seat portion **108** of the chair **106** is not provided with pockets for receiving and storing the transfer mats **310**, **312**. In this embodiment, as shown in FIG. **4**, the back portion **110** of the chair **106** is provided with a storage bin **402**. Here, only one transfer mat **310** is needed. A single transfer mat **310**, when necessary, is removed from the storage bin **402** and used to transfer the patient from whichever side of the seat portion **108** is appropriate. Here, the proximal end of the transfer mat **310** is simply placed on an edge of the seat portion **108** and the distal end of the transfer mat is placed on a surface of the destination location, thereby creating a bridge from the seat portion **108** to the destination location. Again, in this embodiment, the upper surface of the transfer mat **310** provides as little physical resistance as possible and the lower portion of the transfer mat **310** provides resistance that secures the transfer mat **310** and prevents it from slipping during the transfer process.

[0117] Adjustable Height

[0118] Looking to the rear-facing perspective view of FIG. **4**, a further alternative feature of the present invention is shown. In this view, a pair of height-adjustment members **406** can be partially seen positioned under the chair **106**. The height-adjustment members **406** have a lower portion fixedly coupled to the undercarriage **102** and are attached at an upper portion to the chair **106**. When operated, the height-adjustment members **406** can selectively raise or lower the chair **106**. The height-adjustment members **406** can be ratcheting devices, gas springs, hydraulic mechanisms, electric motors, or any other apparatus for raising and lowering the height of the chair **106**.

[0119] The height-adjustment members **406** are particularly useful for matching the height of the seat portion **108** to an adjacent surface onto which the patient is to be transferred. If the height between the seat portion **108** matches the surface onto which the patient is to be transferred, the transfer mat **310**, **312** can be easily extended from within its respective pocket **314**, **316** and easily rests on the adjacent surface.

[0120] In a first embodiment of the present invention, the patient seated within the chair **106** is able to manipulate the height-adjustment members **406** to cause the chair to raise or lower. This can be done by providing a handle, for example, handle **408** shown in FIG. **4**, that the patient can easily reach in manipulate. In other embodiments, the control for the height-adjustment members **406** is accessible only to a technician assisting the patient.

[0121] Arm Rest

[0122] As the rear-facing perspective view of FIG. **4** illustrates, the armrests **214**, **217** can be provided with a tactile feature **404**. The exemplary tactile feature **404** illustrated in FIG. **4** is a curved ball-like shape. It has been scientifically proven that people, in particular, elderly persons, benefit from regular use of their tactile senses. By providing the alternative tactile feature **404** on the armrest **214**, **217** a patient seated within the chair **106** has the tactile feature **404** at their fingertips at all times. Touching and allowing their fingers to explore the shape of the tactile feature **404** provides constant stimulation for the patient, thereby producing a positive therapeutic result both physically and mentally.

[0123] Embodiments of the present invention allow the tactile feature **404** shown in FIG. **4** to be exchanged with alternate tactile features having shapes that vary from that shown in FIG. **4**, The alternate tactile features can simply snap into place once the tactile feature **404** is removed.

[0124] Rocking Mechanism

[0125] Referring now to FIG. **5**, the undercarriage **102** is shown in a perspective left-hand partial rear view. The undercarriage **102** has a frame **216** that includes a lower center support member **502** that couples to a lower left runner **501** on the left side thereof and a lower right runner **503** on the right side thereof. The lower center support member **502**, the lower left runner **501**, and the lower right runner **503** provide the main structure upon which the other undercarriage components are supported. This main frame structure is spaced from the flooring surface upon which the chair is supported and

receives mobility from the plurality of wheels **104***a-d*. More specifically, left-side wheels **104***a*, **104***d* are attached to the lower left runner **501** and the right-side wheels **104***b*, **104***c* are attached to the lower right runner **503**. The wheels shown are caster-type wheels, but do not necessarily have to be casters.

[0126] Extending from a central location along the lower center support member **502** is a crossbar **504** that extends in a diagonal upward direction. Attached to the crossbar **504** at a height above the lower center support member **502** is an upper center support member **602**, which is best shown in the front left-hand side perspective view of the undercarriage **102** in FIG. **6**. The upper center support member **602** couples to an upper left runner **601** on the left side thereof and an upper right runner **603** on the right side thereof. The left and right upper runners **601** and **603** are substantially parallel to the left and right lower runners **501** and **503**. Each of the connections between the lower center support member **502**, the lower left runner **501**, the lower right runner **503**, and the crossbar **504** is fixed, e.g., welded. Similarly, each of the connections between the crossbar **504**, the upper left runner **601**, and the upper right runner **603** is fixed, e.g., welded.

[0127] Returning once again to left-side view of FIG. **5**, it can be seen that a left front swing bar **508** and a left rear swing bar **510** are attached to the left upper runner **601**. In accordance with the present invention, each of the left swing bars **508**, **510** are rotationally coupled to the left upper runner **601** at their upper ends. This rotational coupling allows the left swing bars **508**, **510** to rotate with respect to the fixed left upper runner **601**. A coupling linkage **700** allows the left swing bars **508**, **510** to rotate with respect to the left upper runner **601**. The coupling linkage **700** is shown in detail in FIG. **7** and fully described below in the section entitled "Coupling Linkage."

[0128] At their lower ends, each of the left swing bars **508**, **510** are rotationally coupled to a left swing bar connector **512**, which places the left swing bars **508**, **510** in mechanical communication with each other at their lower ends. Because the left swing bars are rotationally coupled to the left swing bar connector **512**, when the left swing bars **508**, **510** swing relative to the fixed left upper runner **601**, the left swing bar connector **512** also moves relative to the left upper runner **601**.

[0129] A left vertical support member **514** is coupled to the left swing bar connector **512** and extends upwardly and substantially perpendicularly therefrom. Referring once again to FIG. **6**, the downwardly-looking perspective view of the undercarriage **102** with the chair portion **106** removed shows that a chair coupling platform **604** is provided at an upper portion of the vertical support member **514**. The chair coupling platform **604** provides a location for the chair **106** to be attached.

[0130] FIG. **6** also shows that the left front swing bar **508** has a right counterpart **606** on the right side of the frame. Likewise, the left swing bar connector **512** has a right counterpart **608** on the right side of the frame, which is itself coupled to a right vertical support member **614** that mirrors the left vertical support member **514**. Although it cannot be seen in the perspective left-side view of FIG. **6**, the left rear swing bar **510** also has a right counterpart **607**. In essence, the undercarriage **102** provides two separate four-bar linkage assemblies, with elements **601**, **508**, **512**, and **510** defining the left four-bar linkage assembly. Likewise, elements **603**, **606**, **607**, and **608** define the right four-bar linkage assembly.

[0131] During a swinging motion, once the chair **106** is mechanically coupled to the chair coupling platform **604**, the chair **106** will move in unison with the swing bar connectors **512**, **608**. The mechanical movement of the rotating swing bars **508**, **510**, **606**, **607** gently moves the swing bar connectors **512**, **608** forwards and backwards delivering a gentle rocking motion to the attached chair **106**.

[0132] Coupling Linkage

[0133] FIG. **7** provides an exploded perspective view of a coupling linkage **700** that is used in accordance with an embodiment of the present invention to provide the rotational coupling between elements of the left and right four-bar linkage assemblies shown in FIGS. **5** and **6**.

[0134] The coupling linkage **700** includes a first sleeve insert **702** and a second sleeve insert **704**. A shaft **706** is fixedly coupled to one of the sleeve inserts, in this embodiment, the second sleeve insert **704**. A bearing **708** is coupled to the opposing sleeve insert **702** by a cap **714**. A circlip **710** is used to secure one end of the shaft **706** within the bearing **708**. The circlip **710** is a semi-flexible metal ring fastener with open ends which can be snapped into place, into a machined groove **712** on an interior edge of the bearing **708**, to permit rotation but to prevent lateral movement of the shaft **706**. Because the shaft **706** is fixedly attached to the second sleeve insert **704**, the circlip **710** ensures that during rotation, the first **702** and second **704** sleeve inserts remain a fixed lateral distance from each other.

[0135] In the embodiment shown in FIG. **7**, the right sleeve insert **702** is provided with a right cap **714** and the left sleeve insert **704** is provided with a left cap **716**. Each cap **714**, **716** has a dimension that is slightly larger than that of the sleep insert upon which it is connected. The larger dimension of the caps **714**, **716** allows the sleeve inserts **713**, **714**, respectively to only travel a certain distance into the sleeves in which they are installed. The larger dimension of the caps **714**, **716** will hit the sleeves and prevent further entry of the sleeve inserts.

[0136] Referring again back to FIG. **5**, and focusing on the left rear swing bar **510** and the left upper runner **601**, the coupling linkage **700** is shown coupling the two members **510**, **601** together. In particular, the first cap **714** can be seen extending from the left upper runner **601** and the second cap **716** can be seen extending from the left rear swing bar **510**. Within the left upper runner **601** is the first sleeve insert **702**. Likewise, within the left rear swing bar **510** is the second sleeve insert **704**. A pair of bolts **516** penetrate through the left rear swing bar **510** and into a set of threaded voids **718** shown in FIG. **7**. The bolts **516** secure the sleeve insert **704** within the sleeve of the left rear swing bar **510**.

[0137] The inventive coupling linkage **700** advantageously provides for quick and easy assembly of the components of the undercarriage **102**. One simply needs to insert the sleeve inserts **702**, **704** within any particular members of the undercarriage assembly requiring pivotable coupling. Upon the securing of a couple of bolts **516**, the two components are securely pivotably connected. The coupling linkage **700** thereby obviates the need for assembling the rotationally-related parts at the factory and shipping them in a larger assembled configuration. In addition, unlike other bearings that must be pressed out of the assembly parts, the coupling linkage **700** can quickly and easily be replaced if necessary.

[0138] Variable Resistance Member

[0139] As has been scientifically proven, the motion of rocking produces a myriad of positive therapeutic effects on the human body. In addition to the simple rocking movement,

forces exerted by the human body to cause the rocking motion have the benefit of stimulating the muscles of the user and increases heart rate and blood flow as well. For this reason, it has been found to be advantageous to provide a resistive force to the rocking mechanism so that the user is caused to exert force in order to perform the rocking movement.

[0140] Referring now to FIG. **8**, a perspective partial close-up view of the undercarriage is shown. A variable resistance member **800** can be seen positioned on top of the crossbar **504**. In this particular embodiment, the variable resistance member **800** has a main body section **802** that is fixedly coupled to the fixed crossbar **504**. The variable resistance member **800** also has a movable piston **804** that is received by and extends from the body section **802**. At its distal end, the movable piston **804** is fixedly coupled to the movable chair coupling platform **604**. As was explained above, because of the provision of the swing bars, the chair coupling platform **604** is able to move back and forth relative to the crossbar **504**. Therefore, when the chair coupling platform **604** moves, the piston **804** slides into or out of the body section **802** in correspondence to the movement of the chair coupling platform **604**.

[0141] FIG. **9** provides an elevational side view of the variable resistance member **800**. The type of variable resistance member **800** depicted in FIGS. **8** and **9** is commonly referred to as a "gas spring." In these devices, as the piston **804** moves into and out of the body section **802**, a return line **902** allows a gas contained within a first compartment of the body section **802** to transfer to a second compartment of the body section **802**. By controlling the resistance applied to this gas-exchange process, the resistance necessary for moving the piston **804** with reference to the body section **802** can also be controlled. More specifically, by making it more difficult for the gas to travel through the return line **902**, it also becomes more difficult to move the piston **804** with reference to the body section **802**. In contrast, by making it easy for the gas to travel through the return line **902**, less force is needed to move the piston **804** with reference to the body section **802**. Therefore, the present invention provides a control knob **904** on the variable resistance member **800**. By manipulating the control knob **904**, the resistance necessary to move the piston **804** with reference to the body section **802** is selectively adjusted.

[0142] Once again, referring to FIG. **8**, because the body section **802** of the variable resistance member **800** is fixedly coupled to the stationary crossbar **504** and the piston **804** is fixedly coupled to the movable chair coupling platform **604**, one simply needs to manipulate the control knob **904** to selectively adjust the amount of force necessary to cause the chair **106** to rock relative the stationary frame section **502**, **504**.

[0143] It should be noted that the embodiment of the variable resistance member **800** is merely exemplary and many other types of devices that can provide a movable resistance can be used and are within the spirit and scope of the present invention.

[0144] If the rocking motion is caused by force applied by the user's feet, force applied by the variable resistance member **800** advantageously results in an exercise that focuses on the user's legs. When the exercise handles **202**, **204** shown in FIG. **1** are utilized, resistance applied by the variable resistance member **800** advantageously results in an exercise that is directed to the user's arms.

[0145] Foot Rest

[0146] A footrest **610** is shown in FIG. **6** and is slidably mounted onto the left and right runners **501** and **503**, respectively, by a pair of support arms **612** and **614**. Each of the support arms **612** and **614** include a set of bearings or rollers **616** and **618** mounted on opposite sides of the left and right runners **501** and **503** and slidable thereon. The footrest **610** thus can be moved back out of the way for a patient to enter or exit the chair. In addition, if the chair hits an obstacle, the footrest can simple slide backwards to avoid damage. The footrest **610**, although illustrated in a fixed orientation, also can be adjustable to different heights to accommodate the size of different patients.

[0147] As FIG. **6** also shows, when the footrest **610** is slid all the way forward, the support arms **612** and **614** are immediately adjacent the front wheels **104***a* and **104***b*. The adjacency between the support arms **612** and **614** and the front wheels **104***a* and **104***b* ensures that the front wheels **104***a* and **104***b* are aligned in a forward direction and also prevents the front wheels **104***a* and **104***b* from being able to turn as the chair is being moved. The rear wheels **104***c* and **104***d*, of course, remain free to rotate and allow the person pushing the chair to manipulate the trajectory of the chair as it moves.

[0148] In other embodiments, the footrest **610** does not prevent rotation of the front wheels **104***a* and **014***b*. For example, FIG. **15** shows a foot rest bracket **1506** that defines a space **1508** around the front wheel **104***a*. Although it cannot be seen in FIG. **15**, a similar space allows opposing front wheel **104***b* to freely rotate about its mounting axis.

[0149] Drive Motor

[0150] Referring once again to FIG. **5**, a drive motor **520** is shown coupled to a lower section of the undercarriage **102**. The drive motor **518** includes a driving wheel **520** that makes contact with the floor. Upon activation of the drive motor **518**, the driving wheel **520** will cause the mobile patient rocking chair assembly **100** to move. In accordance with an embodiment of the present invention, the motor **518** is electrically coupled to a push handle, such as push handle **1002** illustrated in FIG. **10**. A button **1004** is electrically coupled to the motor **518** and, when manipulated, causes the motor **518** to rotate the drive wheel **520** and move the mobile patient rocking chair assembly **100** in a direction. This is convenient for the technician charged with moving the mobile patient rocking chair assembly **100**. Drive motors, power sources, switches, and driving wheels are well known in the art and, as such, are not described in great detail here.

[0151] Rocking Prevention

[0152] It is anticipated that there will be times when the rocking feature of the present invention will not be desired. For instance, when an attendant is pushing the patient rocking chair assembly **100**, continuous rocking by the user would interfere with the attendant's navigation of the patient rocking chair assembly **100**. In addition, there may be times, for example, when the user is eating, that the rocking function would not be appropriate. For this reason, embodiments of the present invention provide one or more features for selectively preventing rocking. Referring first to FIGS. **17** and **18**, the perspective downward-looking left rear view of the mobile patient rocking chair assembly shows a rotatable frame bar **1702** that is coupled to the frame **1516** of the undercarriage **1500** and spans between the two rear wheels. Near its center,

the frame bar **1702** is fixedly coupled to a lockout bar **1704**. As will now be explained in detail, the lockout bar **1704** is selectively engageable with the rocking mechanism **1515** and selectively and fixedly couples the frame **1516** to the rocking mechanism **1515** when desired, to prevent rocking of the rocking mechanism **1515** relative to the frame **1516**.

[0153] FIG. **20** provides a more detailed view of the rocker-stopping assembly in accordance with an embodiment of the present invention. In FIG. **20**, a frame bar coupler **2002** is rotationally fixedly coupled to the frame bar **1702** and exhibits a rotation that corresponds to a rotation of the frame bar **1702**, Referring briefly to FIG. **19**, a pair of foot levers **1902** are shown coupled to the frame **1516** and, more specifically coupled to both ends of the frame bar **1702**. The foot levers **1902** allow an attendant to cause a rotation of the frame bar **1702** simply by applying pressure with the attendant's foot.

[0154] Referring once again to FIG. **20**, a pin **2004** couples the frame bar coupler **2002** to a proximal lockout bar coupler **2006** that is attached to a proximal end of the lockout bar **1704**. Therefore, because the frame bar **1702** and the frame bar coupler **2002** share an axis of rotation, as the frame bar **1702** rotates about its longitudinal axis, the frame bar coupler **2002** experiences the same rotation and causes the connector pin **2004** to move in an arcuate path around the longitudinal axis of the frame bar **1702**. This movement of the connector pin **2004** pushes or pulls the lockout bar **1704** in a mostly longitudinal direction along its length. At the distal end of the lockout bar **1704** is a distal lockout bar connector **2010** that is coupled to a rocking mechanism engagement member **2012** that experiences a corresponding displacement as the lockout bar **1704** moves.

[0155] Coupled to the rocking mechanism **1515** of the undercarriage **1500** is a receiver plate **2014** that defines and aperture **2016**. The receiver plate **2014** is fixedly attached to the rocking mechanism **1515** so that the rocking mechanism **1515** cannot move without also moving the receiver plate **2014**. The aperture **2016** within the receiver plate **2014** is sized to receive at least a portion of the rocking mechanism engagement member **2012**. Therefore, movement of the foot levers **1902** rotate the frame bar **1702** which then causes a longitudinal movement of the lockout bar **1704** and moves the engagement member **2012** either into or out of the aperture **2016** in the receiver plate **2014**. The movement into the aperture **2016** by the engagement member **2012** either fixedly couples the frame **1516** to the rocking mechanism **1515**. This fixed coupling prevents movement of the rocking mechanism **1515** relative to the frame **1516** and, therefore prevents rocking. In contrast, disengagement of the engagement member **2012** from the aperture **2016** of the receiver plate **2014** allows the rocking mechanism **1515** to move independently, although always supported by, the frame **1516**. Therefore, the foot levers **1902** advantageously allow an attendant to selectively prevent rocking.

[0156] In an alternative embodiment, which is shown in FIG. **10**, the left lower swing bar connector **512** passes directly above the motor **518**. In accordance with this embodiment, the motor **518** is provided with a pin **1006** that extends upwards from the motor **518** when the motor **518** is activated. The pin **1006** engages with a receiving hole formed in the bottom surface of the left lower swing bar connector **512** and prevents the left lower swing bar connector **512** from moving relative to the lower center support member **502**. In this configuration, rocking is halted when the device is moving under power from the motor **518**. Preventing rocking motion while moving the inventive mobile patient rocking chair assembly **100** is advantageous. Rocking can cause the device to move in unintended ways, which can have ill effects, for instance, when maneuvering in tight areas.

[0157] Of course, a pin extending from the motor **518** is only one possible way of preventing the swinging members of the undercarriage **102** from moving. Many other methods of preventing the chair **106** from rocking while the device is under power is contemplated and within the scope of the present invention. For instance, as shown in FIG. **5**, a spring-loaded pin **522** fixedly coupled to the left vertical support member **514** can engage with a hole in the left upper runner **601** and prevent movement of the left vertical support member **514** relative to the left upper runner **601**. The spring bias of the pin **522** can be in a direction toward the left upper runner **601** so that the pin **522**, unless secured in a non-engaged position, will rest in the hole of the left upper runner **601**. In addition, the left upper runner **601** can be provided with a plurality of receiving holes so that the pin **522** can be selectively placed in any one of the receiving holes to secure the chair **106** at one of several possible rocking positions.

[0158] In a further embodiment, the motor **518** can be used to apply a resistive force to the rocking portions of the undercarriage **102**. In this embodiment, the motor **518** is selectively adjustable to resist motion by, for instance, the left lower swing bar connector **512**. For instance, a wheel coupled to and control by the motor **518** can be placed in contact with the left lower swing bar connector **512**. By adjusting the amount of power applied to the motor **518**, and thus the wheel, the resistive force applied to the left lower swing bar connector **512** can be selectively determined.

[0159] If the rocking motion is caused by force applied from the user's feet, force applied by the motor **518** advantageously results in an exercise that focuses on the user's legs. When the exercise handles **202**, **204** shown in FIG. **1** are utilized, resistance applied by the motor **518** advantageously results in an exercise that is directed to the user's arms.

[0160] It should be noted that a wheel coupled to and controlled by the motor **518** is merely exemplary and many other types of devices can be used to provide a movable resistance and are within the spirit and scope of the present invention.

[0161] In yet another embodiment shown in FIG. **22**, the rocking mechanism **1515** includes a handle **2214** that is mechanically coupled to a shaft **2216** so that movement of the handle **2214** causes a translated rotation of the shaft **2216** along a longitudinal axis thereof. The shaft **2216** includes a U-shaped bend **2218** along its length wherein an apex of the U-shape is offset from the longitudinal axis of the shaft **2216**. When the handle **2214** is manipulated, the shaft **2216** rotates about its longitudinal axis and causes the apex of the U-shaped bend **2218** to move in an arcuate path around the longitudinal axis of the shaft **2216**.

[0162] The frame **1516** is provided with a receiving plate **2220** fixedly attached thereto. The frame plate **2220** has formed therein a series of receiving areas **2222** that are sized and shaped to receive a portion of the U-shaped bend **2218**, Mating the U-shaped bend **2218** with one of the receiving areas **2222** within the frame plate **2220** mechanically couples the rocking mechanism **1515** to the frame **1516** and prevents rocking from taking place. Of course the bend feature **2218** does not have to be in the shape of a U. Having the ability to mechanically coupled to the frame **1516** and the rocking mechanism **1515** is advantageous during times when rocking is not desired, such as while seated at a dinner table or when

attempting to exit the chair **106**, among many other situations. Advantageously, because the receiving plate **2220** provides a plurality of receiving areas **2222**, a patient seated in the chair **106** (not shown in FIG. **22**) can select between several angles of recline while seated in the chair **106**.

[0163] Back Adjustment Angle

[0164] In accordance with an embodiment of the present invention, and as shown in FIG. **11**, the back portion **110** has an angle that is selectively adjustable with relation to the seat portion **108**. This adjustment is similar to that of the seat found in an automobile. Adjustment of the back portion **110** with relation to the seat portion **108** of the chair **106** advantageously provides the patient with a range of choices for the most comfortable sitting position.

[0165] Wheel Chair Wheels

[0166] Referring now to FIG. **12**, the mobile patient rocking chair assembly **100** is shown in a downward-looking rear perspective view. In this embodiment, the mobile patient rocking chair assembly **100** features a coupling pin **1201** that couples to a large wheelchair type wheel **1202**. The term "wheelchair type wheel," as used herein, is intend to indicate a wheel that can be manipulated by a patient's hands to propel the chair in a desired direction. The coupling pin **1201** can be inserted into the center of the wheelchair type wheel **1202** and the wheel **1202** secured so that it is fixedly rotationally coupled onto the coupling pin **1201**. Although not illustrated, a second wheel could be installed on the left side of the mobile patient rocking chair assembly **100**.

[0167] When in position, as shown in FIG. **13**, the wheelchair type wheel **1202** extends further below the right runner **503** than does the left front wheel **104***b* (shown best in FIG. **12**). Advantageously, as with a standard wheelchair, the larger wheels **1202** allow a patient to easily maneuver their chair through whatever space is necessary/desired and obviates the need for an attendant to push it.

[0168] To assist with installing the wheelchair type wheel **1202** onto the pin **1201**, the mobile patient rocking chair assembly **100** is provided with a lever **1204** that, when operated, drives a lift member **1206** in a downward direction. When the lift member **1206** makes contact with the ground, further movement of the lever **1204** causes the front wheel **104***b* to lift off of the ground. Of course, this also lifts the coupling pin **1201** making it easy to slip the wheelchair type wheel **1202** onto the coupling pin **1201**.

[0169] In yet another embodiment of the present invention, as shown in FIG. **21**, a pair of wheelchair wheels **2102** are coupled to a pair of spring-loaded levers, which are shown in FIG. **21** as pivot arms **2106** and **2108**. Each of the pivot arms **2106** and **2108** is provided with an axle **2110** that extends away from each arm and provides a location for attaching the wheelchair wheels **2102**. In a preferred, embodiment, however, the axle **2110** is fixedly attached to the wheelchair wheels **2102** and removably couples to receiving portions of the pivot arms **2016** and **2108**, the receiving areas being those locations shown receiving and holding the axles **2110** in FIG. **22**. In this embodiment, where the axle **2110** remains attached to the wheelchair wheels **2102**, when the wheelchair wheels **2102** are removed, there are no axles extending from the chair.

[0170] To facilitate attachment, each of the wheel chair wheels **2102** features a quick lock **2112** that provides for quick removable coupling of the wheelchair wheel **2102** to the axle **2110** or of the axle to the spring-loaded pivot arms **2106** and **2108**. Quick couples are couplers that can be manipulated with a single hand and/or without tools, for example, one known quick coupler, manufactured by BIG SKY PRECISION, INC. of Manhattan, Mont., called the SKY LOC BUTTON-HANDLE, includes a shaft with a push-button on one end and two opposing members on the opposite end that are retracted by depression of the push-button. Other quick couplers are well known in the art and will not be explained in great detail here. The invention, however, does not require quick couplers and any mode of connecting the wheelchair wheel **2102** to the axle **2110** can be used.

[0171] FIG. **22** illustrates how the spring-loaded pivot arms **2106** and **2108** couple to the frame **1516**. The frame **1516** is provided with a left bracket **2204** with a pivot pin **2206** that passes through one side of the left bracket **2204**, through the left pivot arm **2106**, and through the other side of the left bracket **2204**. The spring-loaded pivot arm **2106** pivots upon pivot pin **2206** and is spring biased by a bias member, e.g., a spring, **2202** in a direction that biases the axle **2110** in a downward direction toward the floor. The bias member **2202** can be any mechanism that exerts an upward three on the side of the spring-loaded pivot arm **2106** and **2108** that is opposite the wheelchair wheel axle **2110** or exerts a downward force on the side of the spring-loaded pivot arm **2106** and **2108** that has the wheelchair wheel axle **2110** coupled thereto.

[0172] Similarly, the frame **1516** is provided with a right bracket **2208** with a pivot pin **2210** that passes through one side of the right bracket **2208**, through the right pivot arm **2108**, and through the other side of the right bracket **2208**. The spring-loaded pivot arm **2108** pivots upon pivot pin **2210** and is spring biased by a spring **2212** in a direction that biases the axle **2110** in a downward direction toward the floor.

[0173] Referring now back to FIG. **19**, the wheelchair wheels **2102** are coupled to the wheelchair wheel axles **2110** of the spring-loaded pivot arms **2106** and **2108**. Because the springs **2202** and **2212** bias the spring-loaded pivot arms **2106** and **2108** in a direction that exerts a downward force on the wheelchair wheel axles **2110**, there is also a biasing force exerting a downward pressure on the wheelchair wheels **2102**. This downward force advantageously maintains contact between the wheelchair wheels **2102** and the floor. It allows a patient to easily propel and maneuver the mobile wheelchair assembly **100** the way a normal wheelchair is to be operated.

[0174] Advantageously, to remove the wheelchair wheels **2102**, an operator simply needs to place pressure, e.g., by pressing down with their foot, on the spring-biased end of the spring-loaded pivot arms **2106** and **2108**. When sufficient pressure is placed on the spring-biased end of the spring-loaded pivot arms **2106** and **2108** to overcome the biasing force, the wheelchair wheels **2102** lift off of the ground slightly and allow the operator to easily disconnect them from the axles **2110**. This easy connection and disconnection arrangement provides tremendous advantages in that there is no need to lift the chair from the ground in order to install or disconnect the wheelchair wheels **2102**. This is particularly useful when a patient needs to be transferred laterally from the chair to a nearby object such as, for example, a bed or a toilet. More specifically, referring briefly back to FIG. **13**, it can be seen that the wheelchair wheel **1202** extends above the seating surface. Without removing the wheelchair wheel **1202**, the patient cannot be transferred laterally, i.e., sideways from the seat, without lifting them up and over the wheelchair wheel **1202**. This would create a great deal of difficulty on the attendants and introduce an element of danger to the patient.

Because the present invention, as shown in FIG. **19**, allows the wheelchair wheels **2102** to be removed quickly and easily, for the first time, the chair can be provided to the patient that allows them to navigate and also allows them to bury easily be maneuvered up to an adjacent structure and transferred with extreme ease and safety.

[0175] FIG. **23** shows an exemplary process flow diagram for utilizing the removable wheelchair wheels of the present invention. The process begins at step **2300** and move directly to step **2302** where a mobile patient rocking chair assembly **100** is provided without wheelchair wheels. In step **2304**, a patient is placed into the chair **106** of the mobile patient rocking chair assembly **100**. In step **2306**, the attendant places pressure, e.g., by pressing down with his foot, on one of the spring-biased ends of the spring-loaded pivot arms **2106** or **2108**. When sufficient pressure is placed on the spring-biased end of the spring-loaded pivot aim **2106** or **2108** the attendant is able to and does attach a wheelchair wheel **1202**, **2102** to the wheel axle **2110** by using a quick connector **2112** provided at the hub of the wheelchair wheel **1202**, **2102** in step **2308**. In the same step, **2308**, the attendant installs the opposing wheelchair wheel **1202**, **2102**. In step **2310**, the patient uses the wheelchair wheels **1202**, **2102** to navigate the chair along any path desired by the patient. In step **2312**, the patient or the attendant recognizes a need to transfer the patient from the mobile patient rocking chair assembly **100** to another patient support structure, for example, the patient's bed. In step **2314**, the attendant places pressure, e.g., by pressing down with his foot, on one or both of the spring-biased ends of the spring-loaded pivot arms **2106** and **2108**. When sufficient pressure is placed on the spring-biased end(s) of the spring-loaded pivot arms **2106** or **2108**, in step **2316**, the attendant is able to and does remove one or both of the wheelchair wheels **1202**, **2102** from the wheel axle **2110** by using a quick connector **2112** provided at the hub of the wheelchair wheels **1202**, **2102**. In step **2318**, the patient is transferred laterally from the chair **106** of the mobile patient rocking chair assembly **100** and into the target patient support structure. The process ends at step **2320**.

[0176] Tray

[0177] Looking now to FIG. **14**, the mobile patient rocking chair assembly **100** is shown in a left-side perspective view where a tray **1404** is supported by a support bar **1402**. The tray **1404** is provided with a pair of clips **1406** that coupled to an upper portion of the support bar **1402**. When in use, the tray **1404** provides a surface for supporting food and beverages for the patient to enjoy. Tray **1404** includes a beverage holder **1408** that provides a recessed area for securing a drink.

[0178] When not in use, the tray **1404** can be easily stored in a storage compartment **402** provided on a backside of the back portion **110** of the chair **106**. The support bar **1402**, which is coupled to and supported by the left runner **501** and the right runner **503** at a front portion thereof can be removed and repositioned to a rear portion of the left runner **501** and the right runner **503**, which is also shown in FIG. **14**. When moved to the rear position, the support bar **1402** is advantageously able to serve as a push handle for moving the mobile patient rocking chair assembly **100**.

[0179] Locking Wheels

[0180] It is anticipated that there will be times when lateral movement, i.e., roiling, of the present invention will not be desired. For instance, when an attendant is not around to supervise the patient or the when the mobile patient rocking chair assembly **100** is located near an incline. In addition, there may be times when the patient is someone that needs to have their movement restricted. For this reason, embodiments of the present invention provide a feature for selectively preventing locking of one or more of the wheels **104***a-n*.

[0181] Referring to FIG. **19**, a pair of foot levers **1902** are shown coupled to the frame **1516** of the undercarriage **1500** and, more specifically, coupled to both ends of a frame bar **1702**. The foot levers **1902** allow an attendant to cause a rotation of the frame bar **1702** simply by applying pressure with the attendant's foot. The frame bar **1702**, in the embodiment shown, is provided with a plurality of flat spots around its outer surface. FIG. **19** also shows a wheel coupler **1904** rotationally fixedly coupled to the frame bar **1702**.

[0182] Located between the foot lever **1902** and the wheel coupler **1904** is an upper control portion **1908** of a caster **1910**. Casters are well known in the art and feature a wheel that is rotationally connected to a frame in a way that allows the wheel to rotate as it travels along the surface and also rotate about its connection point to the frame. These casters are commonly found on, for example, the front of the grocery shopping carts and on hospital beds. The casters, however, do not necessarily have to be rotationally connected so that they can rotate about the frame to which they are attached. Instead, the casters can be fixedly connected in a single position like, for example, the rear wheels of a grocery shopping carts.

[0183] In accordance with an embodiment of the present invention the upper control portion **1908** of the caster **1910** includes a locking feature that can prevent the wheel **1912** from rotating and, in accordance with some embodiments, can prevent rotation of the entire caster with reference to the frame **1516**. One exemplary known caster is part number 5444PJP100R36-32530 manufactured by TENTE CASTERS, Inc. Other such casters are manufactured by RHOMBUS CASTERS, Inc., among others. Rotation of the frame bar **1702** which passes through the upper control portion **1908** of the caster **1910** engages and disengages the locking feature of the caster **1910**.

[0184] In addition to caster **1910** at its upper control portion **1908**, the frame bar **1702** also passes through the opposing rear caster **1912** and its upper control portion **1914**. The opposing rear caster **1912** can also be locked by the rotation of the frame bar **1702** which is affected by the foot lever **1902**.

[0185] As an example of the advantageous features of a locking caster **1910**, it is supposed that an attendant wishes to leave a patient in the chair with the rocking ability enabled. In this instance, the attendant might want to ensure that the chair does not move while it is being rocked. Advantageously, the attendant only needs to activate the foot lever **1902** which not only locks the rotating ability of at least one of the wheels, as explained above, it also disengages the frame **1516** from the rocking mechanism **1515** to allow rocking to take place.

[0186] Referring once again to FIG. **20**, a pin **2018** couples the wheel coupler **1904** to a proximal end of a wheel-coupling rod **1906**. Therefore, because the frame bar **1702** and the wheel coupler **1904** share an axis of rotation, as the frame bar **1702** rotates about its longitudinal axis, the wheel coupler **1904** experiences the same rotation and causes the connector pin **2018** to move in an arcuate path around the longitudinal axis of the frame bar **1702**. This movement of the connector pin **2018** pushes or pulls the wheel-coupling rod **1906** in a mostly laterally direction along its length. At the distal end of the wheel-coupling rod **1906** is a front caster. By providing

the wheel-coupling rod **1906**, movement of the foot lever **1902** can effectively lock both the rear and front casters in a single motion.

[0187] Therefore, embodiments of the present invention allow for multiple modes of operation in terms of the wheels. For example, in a first mode, when the attendant activates the foot lever **1902**, all four wheels lock both in frame rotation, i.e., swivel relative to the frame, and in rolling rotation, i.e., rolling about a surface. In a second mode when the foot lever **1902** is in the opposite position, all four wheels are allowed to move in and unrestricted fashion. In yet another mode, one of the wheels/casters is in a fixed position relative to the frame. In other words, it is not able to swivel. This is similar to the back wheel of a grocery cart, and allows for improved travel of the inventive chair assembly. In some embodiments, a foot lever is present on the front of the frame **1516** and is accessible by the patient seated within the chair. In this embodiment, the patient is able to selectively engage and disengage a locking feature of the wheels/casters.

[0188] As was explained above, the frame bar **1702** is fixedly coupled to a lockout bar **1704**, which is selectively engageable with the rocking mechanism **1515** and selectively and fixedly couples the frame **1516** to the rocking mechanism **1515**. Because the lockout bar **1704** and the wheel-coupling rod **1906** are both activated by rotation of the frame bar **1702**, manipulation of the foot lever **1902** has the ability of advantageously preventing rocking of the chair **106** any time the wheels are free to roll. Conversely when the foot lever **1902** is in the locked position, i.e., the wheels are locked and prevented from providing the patient chair with lateral motion across a supporting surface, the rocking feature is unlocked and the chair **106** is free to rock back and forth relative to the frame **1516**. In other words, when the wheels are unlocked, the chair is unable to rock and when the wheels are locked, the chair is able to rock in both functions are selected simply by depressing the foot lever **1902**.

[0189] In a second embodiment for allowing controlled locking of the wheels, and as is shown in FIG. **14**, the left lower swing bar connector passes directly above a motion preventer **1410**. In accordance with an embodiment of the present invention, the motion preventer **1410** is provided with a pin **1412** that extends upwards from the motion preventer **1410**. The pin **1412** engages with a receiving hole formed in the bottom surface of the left lower swing bar connector **512** and prevents the left lower swing bar connector **512** from moving relative to the left runner **501**.

[0190] Each wheel **104***a-d* is provided with a brake **1414***a-d* that, when operated, prevents rotation of the wheel **104***a-d* to which it is coupled. Each brake **1414***a-d*, in the particular embodiment shown in FIG. **14**, has a lever **1416***a-d* that has a locked position for preventing movement of its respective wheel **104***a-d*. In addition, each brake lever **1416***a-d* is electrically coupled to the motion preventer **1410**. In accordance with this embodiment, the motion preventer **1410** will not disengage the pin **1412** from the left lower swing bar connector **512** until at least one of the brake levers **1416***a-d* indicated that it is in a locked position, thereby able to prevent movement of its wheel. This feature ensures that a patient rocking in the mobile chair will not cause the chair to move. Preventing rocking motion while the inventive mobile patient rocking chair assembly **100** is mobile is advantageous. Rocking can cause the device to move in unintended ways and can be particularly dangerous near stairs.

[0191] Of course, a pin extending from the motion preventer **1410** is only one possible way of preventing the swinging members of the undercarriage **102** from moving. Many other methods of preventing the chair **106** from rocking while the wheels are unlocked is also contemplated.

[0192] Leg Rest

[0193] In accordance with the present invention, an adjustable leg rest can be coupled to the seat portion **108** of the chair **106**. The leg rest can resemble that of a typical recliner and provide a support for the lower portion of the user's legs.

[0194] Front Tilt

[0195] A further embodiment of a mobile patient rocking chair assembly **2400**, as shown in FIG. **24**, includes an undercarriage **2402** that supports a chair **106** and features a set of wheels **104***a-d* (shown as casters in FIG. **24**) below that provide mobility to the undercarriage **2402**. The chair **106** is used to support a person when placed in the inventive patient rocking chair assembly **2400**. Although four wheels are show, the invention is not so limited and can utilize any number of wheels, rollers, casters, and other elements to provide mobility.

[0196] The connection between the chair **106** and the undercarriage **2402** is facilitated by a pivoting subassembly **2404** that includes a front frame brace **2406** coupled to an upper pivoting member **2408** upon which the chair **106** rests. The front frame brace **2406** and the upper pivoting member **2408** are coupled at a pivot point **2412**. At the rear of the upper pivoting member **2408** is an actuator **2405** that controls the amount of pivot between the front frame brace **2406** and the upper pivoting member **2408**. Because the chair **106** is mechanically coupled to the upper pivoting member **2408**, when the actuator **2405** causes the upper pivoting member **2408** to move relative to the front frame brace **2406**, the chair **106** experiences a corresponding movement in tilt angle. FIGS. **24-26** illustrate an exemplary range of tilt angles that the chair **106** can experience under the control of the actuator **2405**.

[0197] In accordance with an embodiment of the present invention, the actuator **2405** is electrically powered and includes a control shaft **2410** that extends from or retracts within the control shaft housing **2411**. The actuator **2405** also includes a control and power supply **2416** and a control switch **2414**. When the control switch **2414** is activated, the power supply **2416** causes the control shaft **2410** to extend from or retract into the control shaft housing **2411**, thereby causing a corresponding angular adjustment between the front flame brace **2406** and the upper pivoting member **2408**. For example, FIG. **24** shows the control shaft **2410** in a fully extended position placing the upper pivoting member **2408** in a substantially horizontal position, which also places the seat portion **108** of the chair **106** in a substantially horizontal position. FIG. **25** shows the control shaft **2410** partially retracted into the control shaft housing **2411**, which movement causes the upper pivoting member **2408** to pivot at the pivot point **2412** in tilt the chair **106** into a partially reclined position. FIG. **26** shows the control shaft **2410** fully retracted into the control shaft housing **2411**, thereby placing the chair **106** into a fully reclined position. Advantageously, because the upper pivoting member **2408** pivots at pivot point **2412**, which resides substantially directly below the patient's knee, the patient's feet can remained rested upon the foot rest **610** regardless of the angle of the upper pivoting member **2408**.

[0198] In other embodiments, the control switch **2414** is accessible to or can be controlled by a patient seated within the chair **106**. In this embodiment, the patient can dictate the recline angle of the chair **106**.

[0199] FIG. **27** provides an elevational left side view of the patient rocking chair assembly **2400** with a left wheel chair wheel **2102** coupled to the undercarriage **2402** through a left spring-loaded pivot arm **2106**. FIG. **27** also shows the undercarriage **2402** provided with a left foot lever **1902** coupled to and running through an upper control portion **1908** of the caster **1910***d*. In addition, FIG. **27** shows a left wheel-coupling rod **1906** coupling the upper control portion **1908** of the rear caster **1910***d* to a front caster **1910***a*. As was explained with regard to the embodiment shown in FIGS. **15-22**, activation of the left foot lever **1902** in a first direction causes the rear caster **1910***d* to lock up and simultaneously, due to a corresponding movement of the left wheel coupling rod **1906**, the front caster **1910***a* also locks and prevents movement of the patient rocking chair assembly **2400**.

[0200] FIG. **28** provides a perspective left rear view of the patient rocking chair assembly **2400** and shows the left wheel-coupling rod **1906** and a right wheel-coupling rod **2804** in more detail. The left wheel coupling rod **1906** and the right wheel coupling rod **2804** are activated by rotation of the frame bar **1702**, which itself is activated by either the left foot lever **1902** or a right foot lever **2802**. FIG. **28** also provides a perspective view of the actuator **2405**.

[0201] FIG. **29** provides a perspective left front view of the mobile patient rocking chair assembly **2400**. FIG. **29** provides a clear view of the front frame brace **2406** and the upper pivoting member **2408**, which are coupled to each other at pivot point **2412**.

[0202] An inventive mobile patient rocking chair has been described that provides multiple unique self-activating features for physical and mental well-being. Embodiments of the invention provide a mobile chair capable of producing a gentle rocking motion that can, among other things, increase cardio vascular circulation and relieve pressure points for a patient which can produce the benefit of, for example, prevent decubitus ulcers ("bed sores"). The present invention further provides an ergonomically shaped high backrest that is ideal for individuals who find it necessary or desirable to remain seated for extended time periods. The present invention is further capable of featuring attachable/detachable quick release wheelchair wheels for a patient's increased sense of mobility and independence. The wheelchair wheels can easily be removed to facilitate lateral transfers, even when a person is occupying the chair. Further advantages are realized through use of optional lower and/or upper body training features that provide increased physical and mental well-being. Hinged, foldable armrests allow for easy lateral transfer in and out of the chair and a central wheel locking provides increased safety and ease of operation, including automatic locking of the rocking mechanism when the wheels are unlocked. The inventive chair, in accordance with one embodiment, can be locked in five different comfortable tilt positions. Furthermore, a sliding footrest provides easy entrance to the chair and easy departure from the chair, while a height adjustable head rest provides increased comfort and neck support. A washable incontinence protection cover can be utilized that features optional, e.g., 30 mm, memory foam for increased comfort. A washable comfort seat cushion with, e.g., 30 mm, memory foam can also be included for increased comfort as can a washable comfort armrest cover with, e.g., 20 mm, memory foam for increased comfort.

What is claimed is:

1. A patient chair comprising:
- a seat portion;
- an undercarriage coupled to and supporting the seat portion, the undercarriage including:
  - a frame;
  - a rocking mechanism coupling the seat portion to the frame; and
  - a selectively pivotable pivot arm coupled to the frame; and
- at least one wheelchair-type wheel selectively couplable to the pivotable pivot arm.

2. The patient chair according to claim **1**, further comprising:
- a set of wheels coupled to the frame and operable to reduce friction between the frame and a flooring surface upon which the patient chair is supported.

3. The patient chair according to claim **2**, wherein:
- the set of wheels provides mobility and stability to the patient chair independent of a coupled/decoupled state of the wheelchair-type wheels.

4. The patient chair according to claim **1**, wherein the pivot arm further comprises:
- a wheel-coupling end;
- a pivot-arm manipulating end; and
- a pivot point located between the wheel-coupling end and the pivot-arm manipulating end.

5. The patient chair according to claim **4**, further comprising:
- a bias member biasing the wheel-coupling end of the pivot arm in a downward direction.

6. The patient chair according to claim **4**, wherein:
- the pivot arm is arranged on the frame so that movement of the pivot-arm manipulating end moves a wheelchair-type wheel coupled to the wheel-coupling end in a direction away from a surface upon which the patient chair is supported.

7. The patient chair according to claim **4**, wherein:
- the wheelchair-type wheel is coupled to the pivot arm with a quick couple.

8. A patient chair comprising:
- a seat portion; and
- an undercarriage supporting the seat portion and including:
  - a set of at least three wheels providing mobility the patient chair;
  - a left wheelchair-type wheel coupling member;
  - a right wheelchair-type wheel coupling member; and
  - a lever operable to move at least one of the left wheelchair-type wheel coupling member and the right wheelchair-type wheel coupling member away from a flooring surface upon which the patient chair is supported.

9. The patient chair according to claim **8**, wherein the undercarriage comprises:
- a frame portion coupled to the at least three wheels; and
- a rocking mechanism coupling the seat portion to the frame, the rocking mechanism capable of back and forth movement independent from the frame portion.

10. The patient chair according to claim **8**, wherein:
the lever is a selectively pivotable pivot arm that is activatable by a user's foot.
11. The patient chair according to claim **10**, wherein the lever further comprises:
a wheel-coupling end;
a pivot-arm manipulating end; and
a pivot point located between the wheel-coupling end and the pivot-arm manipulating end.
12. The patient chair according to claim **11**, further comprising:
a bias member biasing the wheel-coupling end of the pivot arm in a downward direction.
13. The patient chair according to claim **8**, wherein:
the set of at least three wheels provides mobility and stability to the patient chair independent of a coupled/decoupled state of a wheelchair-type wheel and the patient chair.
14. The patient chair according to claim **8**, further comprising:
a wheelchair-type wheel coupled to the wheelchair-type wheel coupling member with a quick couple.
15. A method of transferring a patient, the method comprising:
providing a mobile patient chair having:
a seat portion; and
an undercarriage supporting the seat portion and including:
a set of at least three wheels providing mobility to the patient chair;
a left wheelchair-type wheel coupling member;
a right wheelchair-type wheel coupling member; and
a lever operable to move at least one of the left wheelchair-type wheel coupling member and the right wheelchair-type wheel coupling member away from a flooring surface upon which the patient chair is supported;
manipulating the lever in a first direction;
coupling at least a first wheelchair-type wheel to at least one of the left wheelchair-type wheel coupling member and the right wheelchair-type wheel coupling member of the mobile patient chair;
manipulating the lever in a second direction; and
manipulating the coupled wheelchair-type wheel to cause the mobile patient chair to move.
16. The method according to claim **15**, further comprising:
maneuvering the mobile patient chair to a first position adjacent a target patient delivery location;
manipulating the lever in the first direction;
decoupling one of the first wheelchair-type wheel and the second wheelchair-type wheel from its respective wheel coupling member;
maneuvering the mobile patient chair to a second position adjacent the target patient delivery location, the second position closer to the target patient delivery location than the first position; and
transferring a patient from the seat portion to the target patient delivery location.
17. The method according to claim **16**, wherein the transferring the patient comprises:
moving the patient over a location of the respective wheel coupling member.
18. The method according to claim **15**, further comprising:
pressing down on the lever with a user's foot to manipulate the lever in the first direction.
19. The method according to claim **15**, wherein:
a bias member biases the lever in the second direction.

* * * * *

US 20060220429 A1 – Patient chair with a vertically movable seat

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(54) **PATIENT CHAIR WITH A VERTICALLY MOVABLE SEAT**

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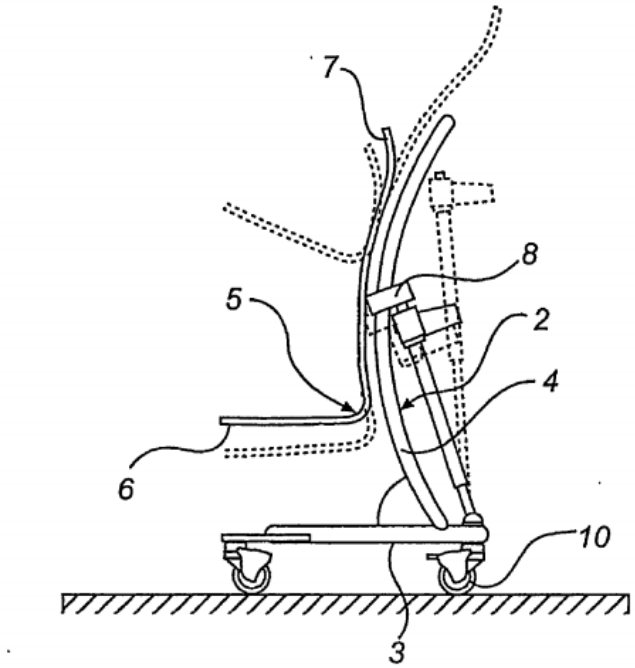
A47C 1/00 (2006.01)

(52) **U.S. Cl.** **297/344.12**

(57) **ABSTRACT**

A patient chair is provided that includes a chassis with a frame, a seating device intended for a patient and connected to the chassis, and a driving device for moving the seating device relative to the frame in the vertical direction between a lower position and an upper position, wherein in the upper position the seating device and, thus, a patient sitting in it are inclined backwards relative to the lower position. In one implementation, a stand belonging to the chassis extends upwards from the frame, and an element connected to the stand is continuously arched. Means cooperating with each other and positioned on the stand and the seating device are arranged for guiding the seating device along the element in the movement of the seating device between the lower and upper positions, so that the seating device is continuously gradually tilted in the course of its curved movement in the vertical direction.



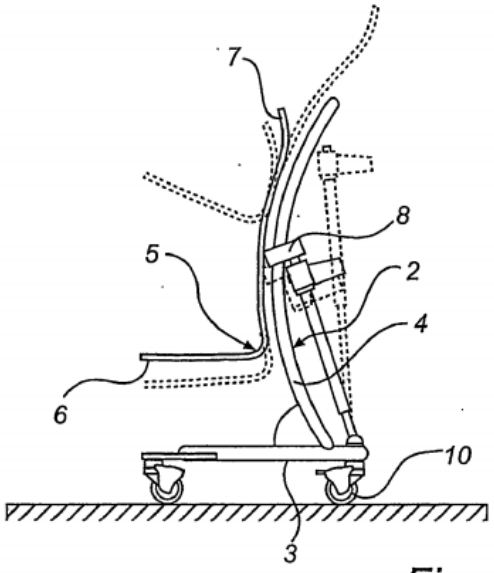


Fig. 1a

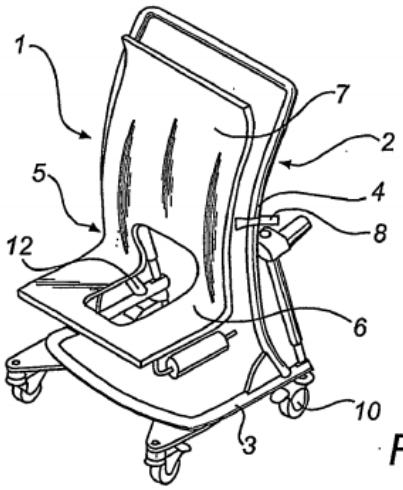


Fig. 1b

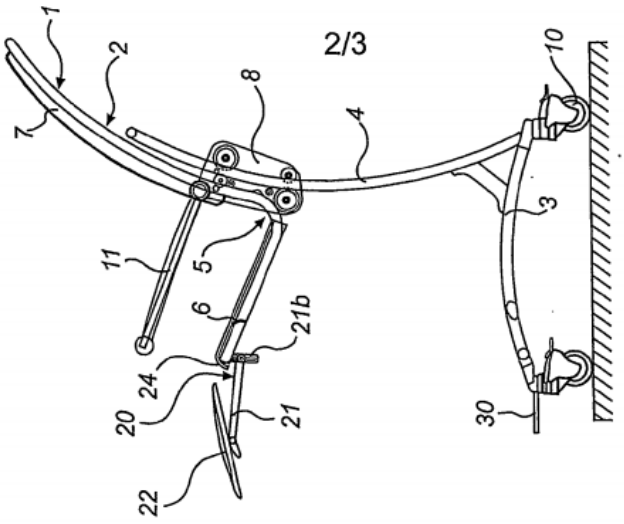

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Fig. 2b

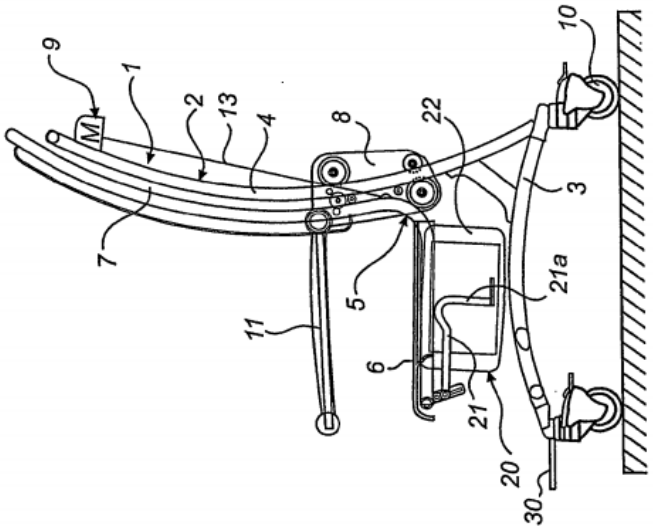
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Fig. 2a

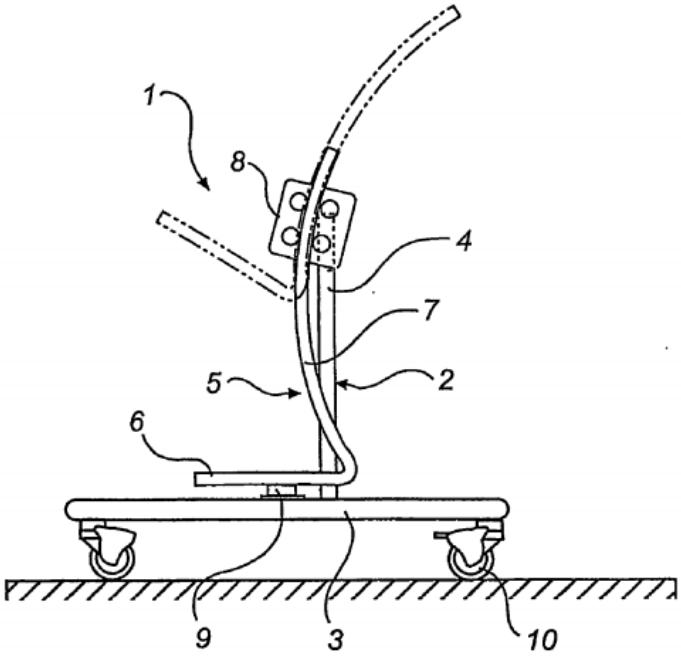

Fig. 3

PATIENT CHAIR WITH A VERTICALLY MOVABLE SEAT

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a patient chair with a vertically movable seat according to the preamble to claim **1**.

PRIOR-ART TECHNIQUE

[0002] In nursing and home care, patient chairs are used, whose seat and, in many cases, back are movable as a unit between upper and lower positions. The movability is desirable and frequently a requirement made by carers in order to be able in a fairly comfortable way, without straining their back, to move the patient between the patient chair and, for instance, a bed or a toilet.

[0003] A large number of patient chairs which more or less satisfy this requirement are available on the market and described in the patent literature. Thus, patient chairs are known, which only allow said movement in a completely vertical direction. The drawback of these patient chairs is that it is difficult for the carer to take off/put on the patient's trousers, skirt, pants, napkin etc. or take sanitary measures as regards the patient's genitals if the patient is sitting on the patient chair. Other prior-art patient chairs allow backward inclination of the seat and back unit and, thus, of the patient, in the course of the movement from the lower to the upper position, which makes it easy to reach the patient's lower garments and genitals. The latter patient chair constructions, however, are complicated and thus expensive to manufacture, frequently comprising different hinge and link systems, different motors to perform a vertical movement of the seat and back unit as well as a tilting movement of this unit to provide a backward inclination of the patient in the upper position, relative to the position of the patient in the lower position, where the patient is sitting "normal" or "straight" on the patient chair.

OBJECT OF THE INVENTION

[0004] An object of the invention is to provide a patient chair which is simple in terms of construction and thus can be manufactured at low cost, said patient chair allowing movement of its seat and possibly also its back between upper and lower positions, in which upper position the patient is inclined backwards.

SUMMARY OF THE INVENTION

[0005] The object of the invention is achieved by a patient chair having the features in claim **1**. Advantageous embodiments are defined in the dependent claims.

[0006] According to the inventive idea as defined in the claims, the patient chair has but a simple chassis which allows movement of the seat between upper and lower positions, during which movement the seat—and thus the patient sitting on it—automatically is continuously gradually inclined; backwards in the movement to the upper position and forwards in the movement to the lower position. There is no noticeable change between the horizontal and the vertical movement. The movement can be made by manual power or by machinery.

EMBODIMENTS, DRAWINGS

[0007] Embodiments of the invention will now be described with reference to the accompanying drawings, in which

[0008] **FIG. 1***a* illustrates particularly the principle of the invention with a first embodiment of the invention in a side view;

[0009] **FIG. 1***b* illustrates the first embodiment in a perspective view;

[0010] **FIGS. 2***a* and **2***b* illustrate, in a side view, an embodiment which is essentially identical to the one in **FIGS. 1***a* and **1***b*, but with a different driving device, and

[0011] **FIG. 3** shows a second embodiment of the invention.

[0012] In **FIGS. 1***a, b*, the patient chair **1** has a chassis **2** with a frame **3** and a vertically arched stand **4**. The stand **4** is connected to a unit **5** consisting of a seat of a chair and a back of a chair **6**, **7** by means of a roller bearing arrangement **8** (see in more detail **FIGS. 2***a, b*), which is attached to the unit **5** and adapted to roll on the stand **4**. To move the unit **5** on the stand **4**, there is a drive unit, in this case a hydraulic cylinder assembly **9**, the ends of which are articulated at suitable points on the chassis **2** and the roller bearing arrangement **8**. It is indicated by the dashed lines in **FIG. 1***a* that—with the drive unit activated—the unit **5** and, thus, the patient sitting on it will automatically be continuously gradually inclined backwards when moving the unit **5** from a lower position LP to an upper position HP, and vice versa when moving it in the other direction. To this end, the back **7** of the chair preferably has a curvature corresponding to the curvature of the stand **4**.

[0013] As is evident from the Figures—and obvious to a person skilled in the art—the chassis **2** is designed for stability, so that the patient chair does not overturn with the patient sitting in it and being moved up and down. The convexity of the stand **4** is here directed forward, and the stand **4** is fixed to the rear portion of the frame **3**.

[0014] It will also be obvious that said upper and lower positions HP, LP are not permanent but can be selected, for instance with regard to a comfortable working posture of the carer (tall or short carer) and/or with regard to the patient's comfort (the patient enduring a more or less pronounced backward/forward inclination) and with regard to the measure that is to be taken on the patient.

[0015] The roller bearing arrangement **8** is shown in more detail in **FIGS. 2***a* and **2***b*. The hydraulic assembly **9** is here not drawn.

[0016] In **FIG. 3**, the stand **4** of the patient chair **1** is straight and the back **7** of the unit **5** is arched. A roller bearing arrangement **8** is mounted on the stand **4** and the back **7** of the chair to guide the unit **5** in the arcuate path given by the curvature of the back **7** and extended between upper and lower positions. A drive unit, for instance a hydraulic cylinder assembly **9**, mounted on the chassis **2** under the seat **6** is arranged to move the unit **5** between upper and lower positions.

[0017] The chassis **1** preferably has wheels **10** on the frame **3**, thus allowing the patient chair to be wheeled. Armrests are designated **11** and pivotable footrests are designated **30**.

[0018] A person skilled in the art realises that the unit **5** can be moved on the stand **4** by many different driving devices. For instance, a winch may connect the unit **5** to the stand **4**/the roller bearing **8** and is manually operated by a crank. Instead of a roller bearing, for instance a gear arrangement can be used. Of course, it is also possible to use an electric motor. A person skilled in the art is capable of applying any suitable arrangement, of which there are many, for relative movement of the unit **5** and the stand **4**, by motor power or manually. In case of movement by motor power, (remote) control units can be used to stop, accelerate and retard the movement.

[0019] Nor is the shown upside-down U-shape of the stand **4** necessary. The stand **4** may consist of a single upright if the chassis **2** is designed with corresponding stability, to support the patient. Alternatively, the stand **4** may constitute the back **7** of the patient chair and only the seat **6** can be moved relative to this back.

[0020] The frame **2** is suitably designed so as to allow the patient chair **1** to be pushed under a bed, or round a toilet. For use with a toilet, the seat **6** may have an opening **12**.

[0021] It goes without saying the patient chair can also be provided with various usual leg rests, armrests and headrests, which can be adjustable.

[0022] **FIGS. 2***a* and **2***b* show another patient chair **1** according to the invention, provided with an advantageous calf rest structure **20**. The advantage resides in the fact that the calf rest structure takes up a small space in the inactive moved-away position (**FIG. 2***a*), which is used, for instance, while a patient is made to sit in the patient chair, when transporting or storing the patient chair without a patient or when transporting a patient in the patient chair in narrow spaces, such as lifts and narrow bathrooms/lavatories. The calf rest structure **20** comprises a mounting arm **21**, on which a plate-shaped calf rest pad **22** is tiltably mounted by means of a transverse arm part **21***a* at one end of the arm **21**. The other end of the mounting arm **21** is articulated to the underside of the seat **6** by means of a hinge. The hinge comprises a sleeve **21***b* at said other end of the arm, in which a pin **24** engages, which is fixed to the underside of the seat **6**, close to the front edge thereof, close to the corner of the seat. The hinge **21***b*, **24** is inclined on the seat underside in such a manner that the arm **21** and the calf rest pad **22** when pivoting from the inactive position to the active position in **FIG. 2***b* describe a part-circular sweeping motion in the course of which the calf rest pad **22** will be moved behind the leg of a patient sitting in the patient chair. The carer may possibly have to first lift the leg somewhat. This pattern of movements for the calf rest **20** facilitates the carer's work when the patient's leg is to be put on the pad **22**, especially if the seat **6** is in the raised position. As is evident from **FIG. 2***b*, the calf rest pad **22** extends in the active position straight away from the patient chair. The active and inactive positions are end positions, defined by a slot-lug connection in the sleeve **21***b* and the pin **24**.

[0023] Moreover, **FIGS. 2***a* and **2***b* illustrate an electric motor winch **9** for the unit **5**, the motor M being fixed to the upper part of the stand **4** and by means of a band **13** pulling and releasing, respectively, the unit **5** for movement between the lower and upper positions.

1. A patient chair comprising:

a chassis comprising a frame,

a seating device intended for the patient and connected to the chassis,

a driving device for moving the seating device relative to the frame in the vertical direction between a lower and an upper position, wherein in the upper position, the seating device and, a patient sitting in the seating device, are inclined backwards relative to the lower position,

a stand which belongs to the chassis and extends upwards from the frame,

an element which is connected to the stand and which is continuously arched, and

means cooperating with each other and positioned on the stand and the seating device for guiding the seating device along the element in the movement of the seating device between the lower and upper positions, so that the seating device is continuously gradually tilted in the course of its curved movement in the vertical direction.

2. A patient chair according to claim 1, wherein the stand itself constitutes the element.

3. A patient chair in according to claim 1, wherein the seating device includes a seat of a chair and a back of a chair, which form a unit.

4. A patient chair according to claim 1, wherein the element is included in the means cooperating with each other and consists of a back of a chair.

5. A patient chair according to claim 1, wherein the element constitutes the stand and includes a back of a chair, and the seating device consists of a seat of a chair.

6. A patient chair according to claim 1, wherein the driving device is manual, for instance a hand-operated winch.

7. A patient chair according to claim 1, wherein the driving device is a machine, for instance an electric motor or a hydraulic assembly.

8. A patient chair according to claim 6, wherein the driving device has a pulling effect on the seating device.

9. A patient chair according to claim 6, wherein the driving device has a pushing effect on the seating device.

10. A patient chair according to claim 1, wherein the cooperating means comprise a roller bearing arrangement.

11. A patient chair according to claim 1, wherein at least one plate-shaped calf rest with a calf rest pad is mounted on the patient chair, and wherein the calf rest is arranged by means of a joint arrangement to be pivotable between an inactive end position where the extent of the calf rest pad is essentially parallel to one side of the patient chair and the calf rest pad is located close to the patient chair, and an active end position where the calf rest pad is capable of supporting the patient's leg when extended, away from the patient chair.

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