



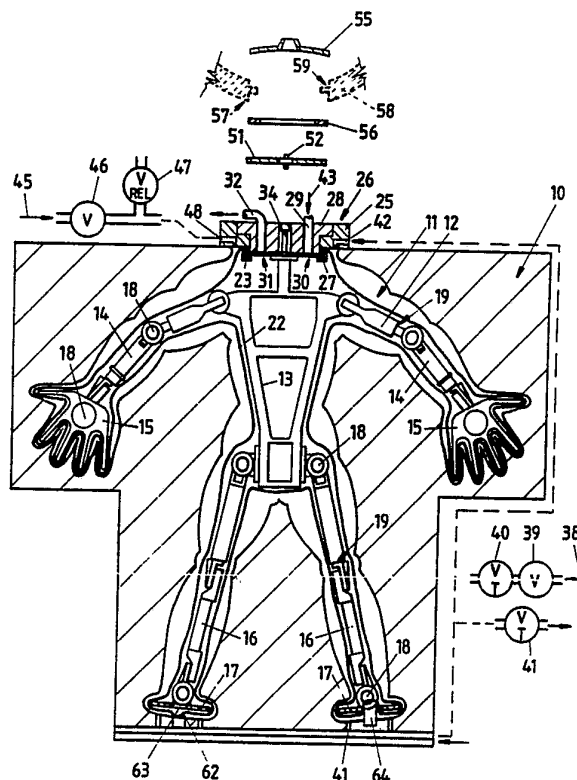
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁵ : B29C 45/14, 45/26, 45/34 // B29K 105/04, 75/00 B29L 31/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 91/15352 (43) International Publication Date: 17 October 1991 (17.10.91)</p>
<p>(21) International Application Number: PCT/AU91/00134 (22) International Filing Date: 10 April 1991 (10.04.91) (30) Priority data: PJ 9564 10 April 1990 (10.04.90) AU (71)(72) Applicant and Inventor: DE PORTEOUS, Karl, Martin [AU/AU]; 4 Martindale Avenue, Toorak Gardens, S.A. 5065 (AU). (74) Agent: R K MADDERN & ASSOCIATES; 345 King William Street, Adelaide, S.A. 5000 (AU). (81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</p>		<p>Published <i>With international search report.</i></p>

(54) Title: MOULDING OF FOAM WITHIN AN ELASTOMERIC SKIN

(57) Abstract

A moulding method for moulding polyurethane foam around a skeletal frame and within a latex skin, firstly inserting the frame into the skin, and supporting the frame (12) and skin (22) in a hollow (11) of a female die (10) the internal surface of which is complementary to a finished article shape, evacuating the air from the interior of the skin (22) in order to collapse the skin, and injecting a foam-forming liquid (43) into the collapsed skin (22) so as to form a foam which will expand the skin and urge it into contact with the internal surface of the die, while at the same time maintaining a low back pressure of air (38). The air pressure can be very low, in the order of 0.3 psi, and usually will lie in the range of 0.1 to 5 psi.



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MOULDING OF FOAM WITHIN AN ELASTOMERIC SKINFIELD OF THE INVENTION

This invention relates to a moulding method wherein a polyurethane or other foam is moulded within an elastomeric skin to form a finished article. The invention has general application in many areas, but the preferred embodiment described herein relates to the production of a doll, whether it be a small doll as may be used for example by a child, or a large mannequin which can be used for the display of fashion garments or the like.

This invention is one of a series of inventions which also include PCT Application WO89/06564 wherein a skeleton of a doll was described and claimed.

In the PCT Application AU90/00388 a moulding method was described and claimed wherein the subject matter centred around the use of a thin latex skin.

In the Australian Patent Application PJ 9526 (PCT) reference was made to what might be termed "mould cloning" for a moulding means and method.

Finally, one of the requirements for a doll is that the limbs should be capable of simulating human limbs and should have sufficient resistance to movement that once set in a position they will stay in that position, and the Australian Patent Application PJ 9390 (PCT) was directed to a hinge which is suitable for dolls, mannequins and other mould products wherein relative movement of limbs is a desirable feature.

BACKGROUND OF THE INVENTION

One of the difficulties which is encountered in moulding a polyurethane foam between a skeletal frame and an elastomeric skin is that entrapped air tends to move to the

extremities, in the case of the doll being the fingers or
toes. This is unacceptable commercially, and experimentation
has established that if air is evacuated from the interior of
the skin in order to collapse the skin around a skeletal
5 frame, the foam-forming liquid is then injected to within the
collapsed skin in a sufficient quantity to form a foam which
expands the skin and urges it into contact with the internal
surface of a die within which it is housed, and a back
10 pressure of air is applied to the space between the skin and
the die surface, the foam is much more uniformly distributed
and can be made to form right down to the extremities, for
example fingers or toes of a doll.

BRIEF SUMMARY OF THE INVENTION

15 In this invention, a method of moulding foam over a
skeletal frame and within a skin comprises firstly inserting
the frame into the skin, and supporting the frame and skin in
a hollow of a female die the internal surface of which is
complementary to a finished article shape, evacuating the air
20 from the interior of the skin in order to collapse the skin,
and injecting a foam-forming liquid into the collapsed skin
so as to form a foam which will expand the skin and urge it
into contact with the internal surface of the die, while at
the same time maintaining a low back pressure of air. The air
25 pressure can be very low, in the order of 0.3 psi, and
usually will lie in the range of 0.1 to 5 psi.

30 Thin skins are generally desirable and the above-
identified PCT Application AU90/00388 emphasised the need for
a thin latex skin for a doll. However thin skins are not
always required and it is desirable that a method exists
whereby thicker skins can be used, for example up to 0.8mm
for a mannequin. Further, it is desirable that the skin
should not lose its shape during the moulding process, but
rather take the shape of the internal surface of the die, and
in an embodiment of this invention the skin is only partially

cured when it is formed over a former, and the partly cured skin is removed and the curing of the skin is completed by the reaction heat of the foam-forming liquid during the foaming of the liquid.

5 Another practical problem which is encountered in moulding between a skeletal frame and an imperforate skin is the correct location of frame and skin, and this invention achieves the satisfactory location by having the skin with an opening surrounded by a circular bead at one end and at least
10 one protuberance at the other end, the skeletal frame being located in the die by sealably engaging the circular bead over a discoid-shaped moulding plate which is carried by the skeletal frame at one end, and deforming the protuberance or protuberances into an aperture or apertures in the other end
15 by means of a locating spigot carried by the die. With this method of location the skin is not punctured.

For high production rates it is necessary for the valving of the foam-forming liquid to be efficiently and effectively achieved, and in a further embodiment of this
20 invention the aforesaid moulding plate is provided with an aperture which, during injection, is aligned with the rotor of an injecting valve which also has a stator which bears against the bead surrounding the opening of the skin, the rotor however being moved out of alignment when injection is
25 terminated.

When polyurethane foam is moulded into a thin skin of elastomer, the thin skin does not provide a very strong retaining means for retaining the size and shape of the moulded product, and in prior art it has been customary to
30 damage the cell structure of the internal foam so as to reduce the tension applied to the skin by continued expansion of the foam, and also to give the skin a softer "feel". In this invention however use is made of the availability of

pressure air to be applied between the die inner surface and the skin as the foam nears its full expansion, and this has the dual effect of compressing some of the cells and fracturing some of the membranes between cells of the foam contained within the skin and avoiding the need for a separate operation.

When a skeletal frame is liable to misuse by excessive articulation of limbs, it is desirable that the denser foam which is adhering to the inner surface of the skin should not be internally torn, and further in this invention there is provided a construction method whereby a less dense foam is first applied over the skeletal frame before it is inserted into the skin, and this enables a greater degree of articulation of the bins without seriously damaging the internal foam.

BRIEF SUMMARY OF THE DRAWINGS

Two embodiments of the invention are described hereunder in some detail with reference to, and are illustrated in, the accompanying drawings in which:-

Fig. 1 is a sectional elevational view through a die, illustrating the skeletal frame, the skin in its collapsed form over the skeletal frame, and the internal surface of the die which forms the hollow, the walls of which provide the final skin shape;

Fig. 2 is a plan view of a closure disc which is applied to the article after moulding;

Fig. 3 is a plan view of the moulding plate which is otherwise shown in section in Fig. 1;

Fig. 4 is a fragmentary plan view of a first end of the skeletal frame showing a spigot which engages and supports

the moulding plate of Fig. 3;

Fig. 5 is a fragmentary end elevation which illustrates the spigot which is otherwise shown in Fig. 1 and Fig. 4; and

5 Fig. 6 illustrates the second embodiment wherein a less dense foam has been pre-applied to the skeletal frame before it is inserted into the skin.

10 Referring first to the embodiment of Figs. 1 through to 5, a die 10 comprises two portions which, when closed, define between them a hollow 11 which is defined by the respective surfaces of the die parts which are complementary in shape to the required final shape of the article to be produced, in this embodiment being a doll.

15 A skeletal frame 12 in this embodiment comprises a torso 13, two arms 14 in at least partly outstretched attitude as shown in Fig. 1, hands 15, legs 16 and feet 17. Articulation is provided by the hinges 18 which are in accordance with the aforesaid Patent Application PJ 9390, and relative rotation of the limbs is provided by the rotary joints 19.

20 The skin is designated 22 and is shown in semi-collapsed form in Fig. 1 over the skeletal frame 12. The skin is formed from natural latex by the method disclosed in the aforesaid PCT Application AU90/00388, and in this embodiment has a thickness of about 0.2mm, but can range up to 0.6 or as high as 0.8mm. A very thin skin would be about 0.1mm thickness.
25 However when the skin is first applied to the skeletal frame 12, it is not fully cured but has had its moisture content reduced to between 3% and 5%, that is it is in a semi-cured state. The skin is formed to have an upper circular bead 23 which is retained in an annular trough 24 (Fig. 3) by the
30 stator 25 of an injecting valve 26 bearing down around the periphery of a discoid-shaped moulding plate 27, and the

rotor 28 of the injecting valve 26 is provided with an injecting nozzle 29 which is aligned with aperture 30 in the moulding plate 27. The other aperture 31 in moulding plate 27 is in air flow communication with an evacuation conduit 32 through which air is withdrawn by a vacuum pump (not shown) from within the skin 22 in order to cause the skin to collapse over the skeletal frame 12. The rotor 28 is located over the upstanding spigot 34 (shown separately in Figs. 4 and 5) of the skeletal frame 12. The spigot 34 has two small locating webs 35 which are engaged by the rebates 36 and these assist in accurately locating the moulding plate 27 with respect to the die 10 so that alignment is ensured for injection purposes.

Low pressure air 38 at between 0.1 and 5 psi (0.7 and 35 kPa) enters the die space between the hollow 11 and the skin 22 through a control valve 39 and a throttle valve 40, both at the location of the feet and hands through a plurality of small apertures, represented by the gallery 41 and also represented as passing through the stator 25 which contains a gallery 42. The pressure is maintained by adjustment of the throttle valve 40 and also a bleed valve 41, excessive pressure being undesirable. However that small pressure is sufficient that when foam-forming liquid 43 is injected through the nozzle 29, the rate of foaming is constrained and the foam is urged to flow into the extremities of the skin. The evacuation conduit 32 is closed during the injection process.

When sufficient injection has taken place the rotor 28 is rotated over the moulding plate 27 to place the nozzle 21 out of alignment with aperture 30 and this functions as a shut-off valve, and at the same time shuts off the exhaust air passing out through the evacuation conduit 32.

As foaming takes place, temperature is released and this can be in the order of 90°C which is a convenient temperature for final curing of the skin 22. However the pressure built

up in foaming is sufficiently great that a very thin skin will continue to expand after removal of the moulded product from the die 10. In order to inhibit this and secondly in order to give a better and softer "feel", higher pressure air 45 is introduced through valve 46 and is maintained to be less than 25 psi (175 kPa) by the pressure relief valve 47. The pressure applied to the outside of the skin through the gallery 48 of the stator 25 has the effect of compressing and partly fracturing some of the cells closest to the skin of the foam, and that pressure can be applied before the foam has fully set so that the membranes of the foam can be effectively distorted.

After the foaming has been completed, the injecting valve 26 is removed from the moulding plate 27, the die is opened, and the closure disc 51 (Fig. 2) is located over the moulding plate 27, the closure disc 51 having projecting location pins 52 which locate in the apertures 53 of the moulding plate 27, while the central aperture 54 of the closure disc 51 locates over the upstanding spigot 34 of the skeletal frame 12. A spacer ring 56 engages in the annular register 57 of the neck of a doll's head, while the inner retaining member 58 engages in a second register 59, and snaps over the head 60 of the spigot 34 to thereby retain the head of the doll to the skeletal frame 12 for relative movement which will take place between the spacer ring 56 and the closure disc 51. The neck of the doll is shown in dotted lines and designated by the numeral 58.

Fig. 6 illustrates a second embodiment wherein the skeletal frame 12 has initially applied to it a less dense foam 61 in a relatively thin layer which enables it to be inserted into the skin 22 by stretching and distorting the bead 23 which surrounds the opening. Otherwise a similar series of method steps to those described above with respect to Figs. 1 through to 5 are used to cover the lesser density

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foam 61 with the denser foam as described with respect to the first embodiment. The second embodiment does provide protection against tearing of the denser foam if excessive articulation of the limbs occurs.

5

In both embodiments the lower part of the skeletal frame 12 is located by forming the skin 22 to have protuberances 62 (not shown in Fig. 6), and these protuberances 62 are urged through apertures 63 by upstanding spigots 64 as shown on the right hand side foot of the skeletal frame in Fig. 1.

CLAIMS:

1. A method of moulding foam polymeric material over a skeletal frame, comprising:

(a) forming an elastomeric skin over a former and removing the skin from the former;

(b) inserting said skeletal frame into the skin, and supporting the frame and skin in a die having a hollow defined by an internal surface complementary to a finished article shape;

(c) evacuating air from the interior of the skin to collapse the skin and applying back pressure air between the die internal surface and the skin;

(d) injecting a foam-forming liquid into the collapsed skin in sufficient quantity to form a foam which expands the skin and urges it into contact with the die internal surface against pressure exerted by at least some of said back pressure air in the die hollow.

2. A method according to claim 1 wherein said die comprises air ports which open through said internal surface into the hollow, and comprising applying said back pressure air through those said air ports at a pressure of between 0.1 and 5 pounds per square inch (0.7 and 35 kPa), during the foaming of said foam-forming liquid.

3. A method according to claim 2 further comprising compressing foam cells and fracturing membranes between the foam cells by applying compressing air through said air ports at a pressure of between 5 and 25 pounds per square inch (35 and 175 kPa), after the foaming of said foam-forming liquid.

4. A method according to claim 1 comprising forming said

5 skin of natural rubber elastomer over a former, partially curing the skin while on the former, removing the partly cured skin from the former, and further setting and curing of the skin by reaction heat of the foam-forming liquid during the foaming thereof.

5. A method according to claim 4 comprising part-curing said skin to have a moisture content of between 3% and 5% by weight.

6. A method according to claim 4 comprising forming said skin to a thickness of between 0.2 and 0.8mm.

5 7. A method according to claim 1 comprising forming said skin to have an opening surrounded by a circular bead at one end and at least one protuberance at the other end, locating the skeletal frame in the die by sealably engaging¹ said circular bead over a discoid-shaped moulding plate carried by the skeletal frame at said one end, and by positioning at least one locating spigot into an aperture in said other end, while urging said at least one protuberance into that said aperture with said locating spigot.

5 8. A method according to claim 7 wherein there is a plurality of said locating spigots and a corresponding plurality of said protuberances and said apertures, and further comprising positioning said spigots into respective said apertures while urging respective said protuberances into said apertures.

5 9. A method according to claim 1 comprising forming said skin to have an opening surrounded by a circular bead, sealably engaging the circular bead over an apertured discoid-shaped moulding plate, and effecting said evacuation of air from the interior of the skin through an aperture in said discoid-shaped moulding plate.

10. A method according to claim 9 further comprising compressing said circular bead into an annular groove in said discoid-shaped moulding plate by engagement with a stator of an injecting valve, injecting said foam-forming liquid
5 through an injection nozzle in a rotor of the injecting valve and through an aligned second aperture in said discoid-shaped moulding plate, and rotationally moving said rotor out of alignment with said second aperture to terminate said injection.

11. A method according to claim 9 further comprising locating both said discoid-shaped moulding plate and said injecting valve on a spigot projecting from said skeletal frame.

12. A method according to claim 1 comprising applying a less dense foam over said skeletal frame before inserting into the skin, and effecting said injection of foam-forming liquid to form said foam which expands the skin as a layer of
5 denser foam which embodies the less dense foam.

13. A method substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

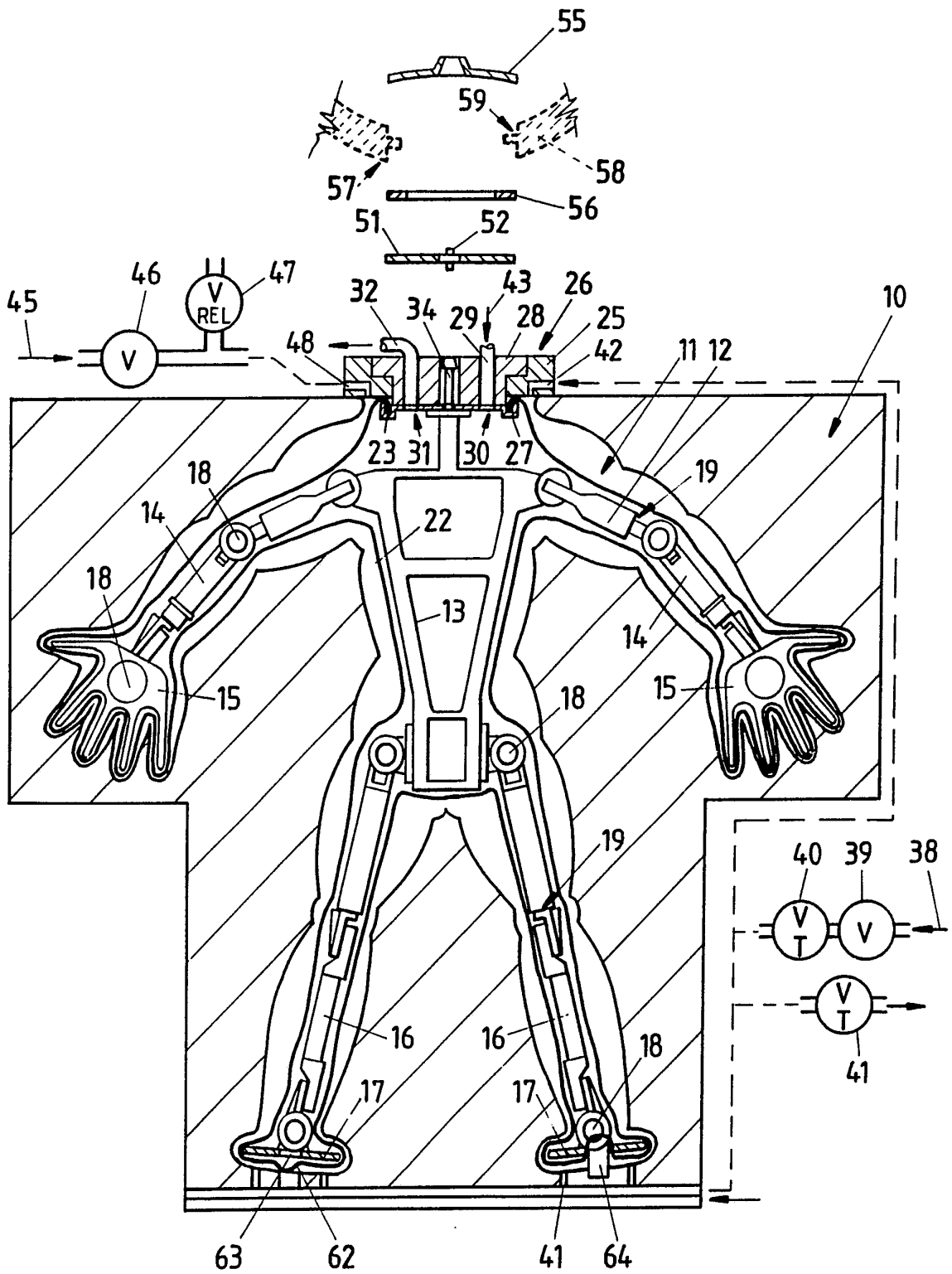


FIG 1

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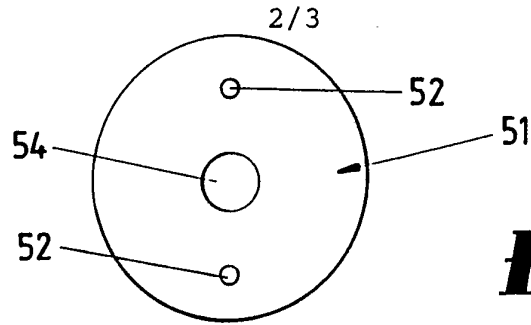


FIG 2

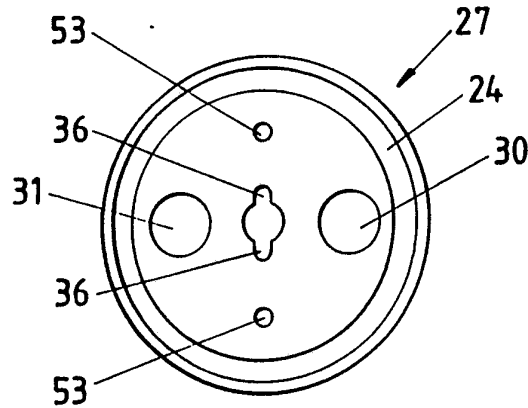


FIG 3

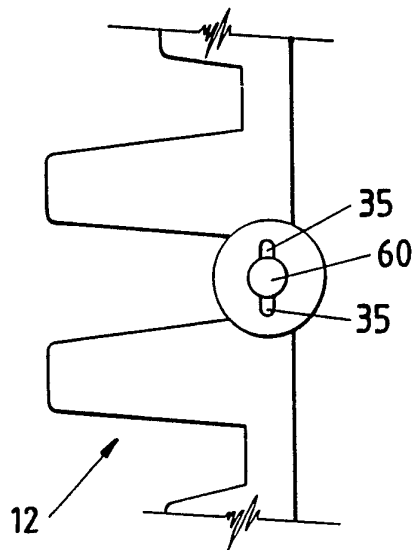


FIG 4

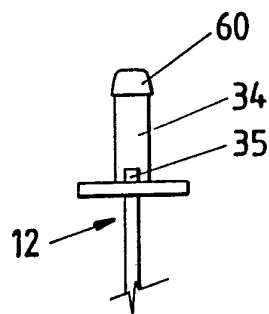


FIG 5

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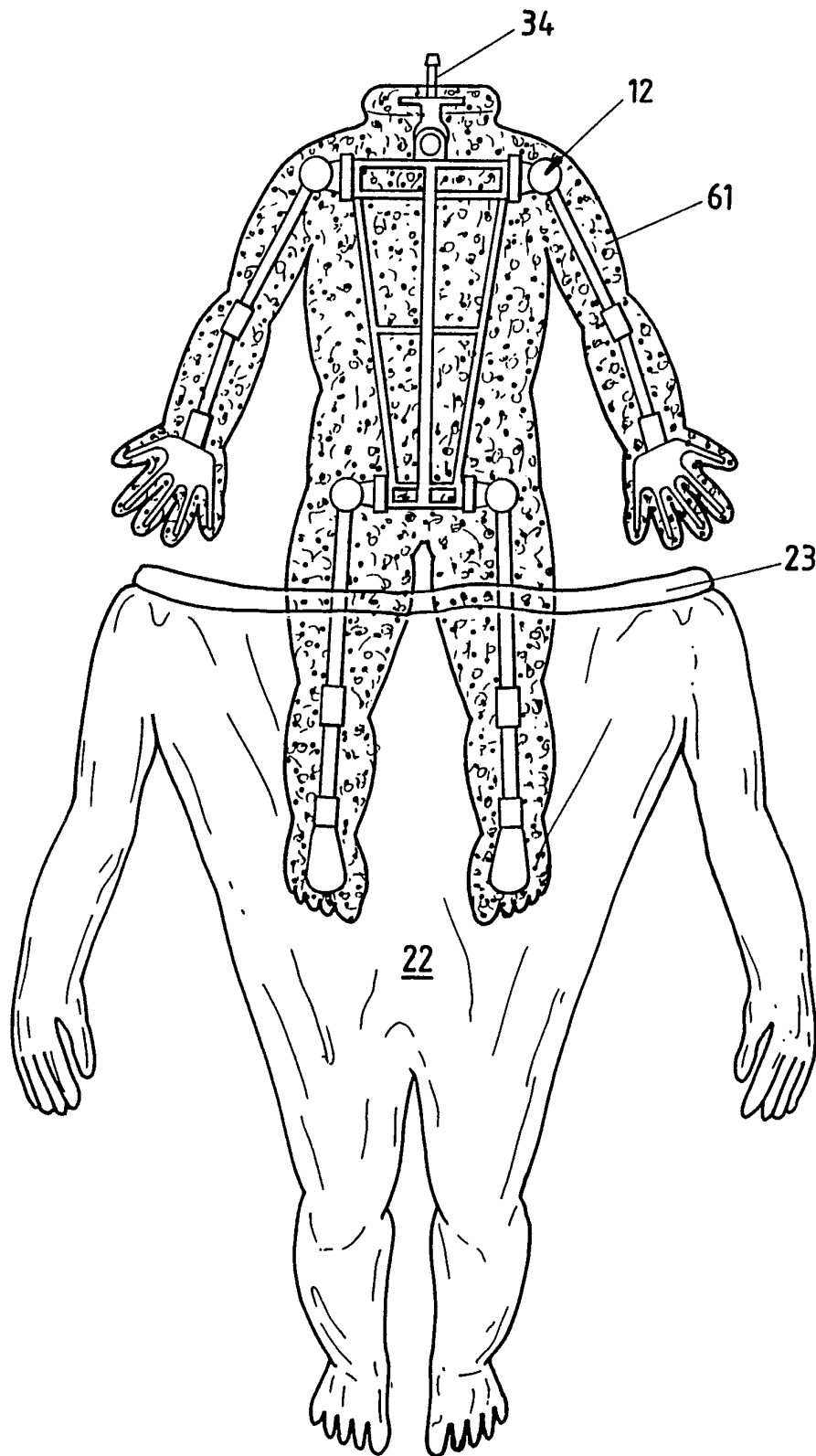
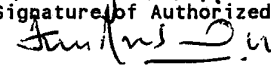


FIG 6

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INTERNATIONAL SEARCH REPORT

International Application No. **PCT/AU 91/00134**

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. ⁵ B29C 45/14, 45/26, 45/34 // B29K 105:04, 75:00, B29L 31:00		
II. FIELDS SEARCHED		
Minimum Documentation Searched 7		
Classification System	Classification Symbols	
IPC ³	B29C 45/14, 45/26, 45/34	
IPC ³	B29F 1/00, 1/10	
US Cl.	264/46.5, 264/46.6, 264/46.7, 264/DIG77	
Documentation Searched other than Minimum Documentation to the extent that such Documents are Included in the Fields Searched 8		
AU : IPC as above, IPC ⁵ B29C 67/20		
III. DOCUMENTS CONSIDERED TO BE RELEVANT 9		
Category*	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
A	US,A, 4900489 (NAGASE et al) 13 February 1990 (13.02.90) See claims	(1)
A	US,A, 4661391 (SCHRODER et al) 28 April 1987 (28.04.87) See Colimn 2, lines 1-10; claim 1	(1)
A	US,A, 3305196 (ROBERT G. HANLON) 21 February 1967 (21.02.67) See claim 1	(1)
P,A	US,A, 4959184 (AKAI et al) 25 September 1990 (25.09.90) See claims 1 and 6	(1)
<p>* Special categories of cited documents: 10 "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 27 June 1991 (27.06.91)	Date of Mailing of this International Search Report 1 July 1991	
International Searching Authority Australian Patent Office	Signature of Authorized Officer  K. RAMASUNDARA	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE 1

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

1. Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:

2. Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4 (a):

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING 2

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

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

The additional search fees were accompanied by applicant's protest.

No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 91/00134

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members			
US 4900489				
US 4661391	DE 3407737 GB 2155392	ES 537786 IT 8424011	FR 2560552 NL 8403679	
US 3305196				
US 4959184	DE 3837057 JP 1118417	FR 2622503	GB 2211781	

END OF ANNEX