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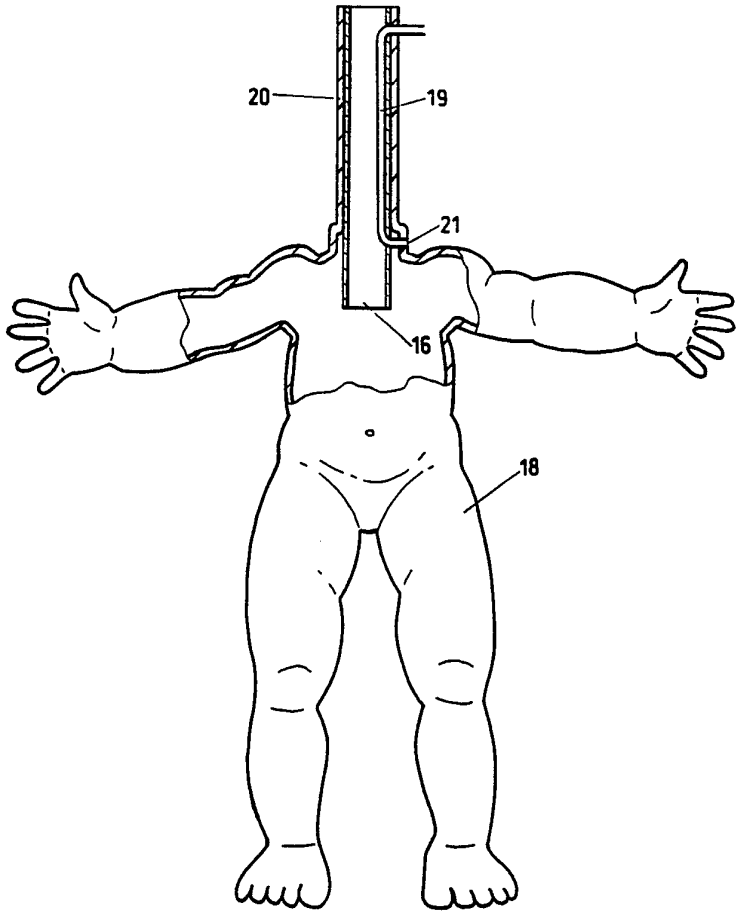
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(54) Title: MOULDING METHOD

(57) Abstract

A former (18) is initially moulded to have a relatively thick wall (average about 2mm) with an outer shape forming surface and an inner surface defining a hollow, and a hollow extension (20) which extends from one end, and the shape forming surface has a liquid coagulant (22) applied to it and is subsequently immersed in a liquid latex (25) which sets over the former (18), whereupon the former (18) is evacuated of air and therefore reduces its volume and the relatively thin latex skin (29) (average about 0.25mm thickness) is removed from the former (18).



* See back of page

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"MOULDING METHOD"

This invention relates to a moulding method which is particularly suitable for moulding of polymeric articles which are elongate and have a plurality of extending arms, and although not limited to models which simulate human or animal action, the invention is particularly suitable for the production of such models, for example dolls or mannequins.

In prior art, it is known to construct a thick walled product over an inflated thin wall bladder, for example in the production of certain balls. In some instances, the bladder has been deflated and removed through an aperture in the product. However, the reverse arrangement of withdrawing a thick walled former through an aperture in a thin walled product is fraught with serious difficulties, and it is the main object of this invention to provide a satisfactory production method wherein this can be achieved.

BACKGROUND OF THE INVENTION

This invention is one of a series of inventions which is related more particularly to the production of dolls, including mannequins, and reference can be made to the following co-pending applications:-

PCT application WO89/06564 relating to the forming of a skeleton or a model;

Australian Patent application PJ 9390 dated 30th March, 1990 which relates to an improved hinge for such a skeleton;

Australian Patent application PJ 9526 which relates to the formation of a chiller die, male pattern and metal dies which are useful in the production of models and mannequins; and

Australian Patent application PJ 9564 dated 10th April, 1990 which is directed to the entire process of moulding and in particular to the final steps in the production of a doll or mannequin.

In the preferred embodiments of the invention, it is desirable to utilise a thin film skin into which a foaming material is injected when the skin is within a mould, the foam material expanding within the skin to cause it to conform with the mould shape, and experiments have established that the best way of forming a thin film skin is by a dipping process, wherein a form having an outer shape forming surface is dipped into a latex, the latex forming a skin which coagulates over the shape forming surface to form the required outer skin, and subsequently removing the skin from the former. In order to achieve desired production rates, it is necessary to have a plurality of formers which can be occupied for as long as ten minutes before the skin can be removed. Therefore the production of the formers themselves is an important aspect of the invention described herein.

BRIEF SUMMARY OF THE INVENTION

In an embodiment of this invention, a former is initially moulded to have a relatively thick wall (average about 2mm) with an outer shape forming surface and an inner surface defining a hollow, and a hollow extension which extends from one end, and the shape forming surface has a liquid coagulant applied to it and is subsequently immersed in a liquid latex which sets over the former, whereupon the former is evacuated of air and therefore reduces its volume and the relatively thin latex skin (average about 0.25mm thickness) is removed from the former.

This process overcomes some of the problems which are encountered in moulding articles with a polyurethane or other polymeric foam. A foam moulded with a skin can easily have a skin damage which, for industrial products, sometimes is of negligible importance but for a product such as a doll or a mannequin, skin damage is unacceptable. Secondly, in almost all foam moulding, moulding takes place between closed dies which, upon separation, disclose a seam or flash and this can cause a time consuming rework operation which will

nevertheless frequently result in a part which is unacceptable for a product such as a mannequin or doll, but all this is avoided by dipping a former into the latex to provide an unblemished skin into which foam can be injected. Still further, sometimes air voids may occur within a die space when injected foam expands, and to reduce this possibility it is usually considered necessary to have bleed apertures which result in the expulsion of some foam which needs subsequent trimming. Such a trimming operation is also avoided by this invention.

There is a very considerable advantage to be achieved if a skin when moulded can have an elastomeric collar around its opening, since such a collar not only provides additional strength where most of the stretching is required to remove the skin from the former, but it also provides a seal ring which is very useful in the subsequent operations of inserting the skeleton and injecting the foam to make a doll or mannequin. Therefore in some embodiments of the invention the hollow extension which extends from one end of the former is annular in cross-section, and after the latex has been applied, that portion of the latex which surrounds the extension can be rolled downwardly to form itself into a collar.

Of the available latexes known to the Applicant, the natural rubber latex is a particularly useful latex because of its high degree of elasticity and stretch and because of its natural strength even though it may be a thin walled skin. The quality of a rubber latex is improved if, during setting, it is heated for example by the application of hot water which, in this invention, can be injected into the former through the hollow extension. Furthermore, if calcium nitrate is the coagulant selected for the natural rubber, this being a proven and acceptable coagulant, some penetration of calcium nitrate solution occurs in the former and this is enhanced if the former is itself moulded from a polymeric material having some absorption properties, of which polyvinylchloride has been found by the Applicant to be

one of the most suitable. Therefore if polyvinylchloride is used for the former, and the former is either dipped into a hot coagulant or contains a hot liquid when dipped into the coagulant, there will be some penetration and retention of coagulant at and adjacent the surface of a polyvinylchloride which has the dual function of being able to provide a very thin wall skin from the latex and also a skin of consistent wall thickness. This overcomes a serious problem with prior art processes, wherein "runs" often occur.

More specifically, the invention consists of a moulding method for moulding an elongate article of polymeric material having an extending limb, comprising:

(a) moulding a former of polymeric material to have a relatively thick wall with an outer shape forming surface and an inner surface defining a hollow, and a hollow extrusion which extends from one end,

(b) applying a liquid coagulant to said shape forming surface,

(c) immersing the shape forming surface of the former into a liquid latex without allowing latex to flow into the hollow,

(d) removing the former from the liquid latex and allowing the latex adhering to the former to set as a skin over the shape forming surface,

(e) evacuating the former through the hollow extension sufficiently to cause its volume to reduce, and

(f) separating the set skin and former by applying a force to the skin while the former volume is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Fig 1 illustrates a two-part metal moulding die for the moulding of a former,

Fig 2 is a similar view partly sectioned showing the former,

Fig 3 illustrates the step of immersing the former in a liquid coagulant of calcium nitrate solution,

Fig 4 illustrates a further step of immersing the former in a rubber latex,

Fig 5 illustrates the evacuation of the former with a vacuum pump and the injection of water between the skin and former to cause the skin to drop away from the former, and

Fig 6 illustrates the former with the inclusion of a limb stiffening device which may be controlled to vary the aspect of outstretched arms, Fig 6 being applicable to the production of very large dolls or mannequins such as may be used in shop window dressing.

In this embodiment, a two-part rotational mould 10 is used to produce a plurality of PVC formers. It is produced from a wax male figure itself formed in the following manner:-

Firstly a male master figure (not shown) is created from which a flexible female casting mould is made. Wax is then cast into the female mould and the cast male wax figure is removed, redetailed and polished.

The wax male figure is then divided in an equational plane into two halves, that is a bottom half 11 and a top half 12, and a shelf or flange 13 is applied to the torso area of the bottom half 11 to project outwardly therefrom.

The bottom half portion 11 of the wax figure is coated with graphite up to the horizontal surface 14, from which the edge surface of flange 13 diverges downwardly. The bottom half is then subjected to an electroplating procedure and is plated in accordance with known art.

After plating, all wax is removed from the bottom half 11 and inside of the mould is cleaned. Because of the fragility of the electroplate, the underside of the flange 13 is reinforced with silver solder or some other flowable metal with which the electroplate metal will alloy, and the sloping surface is ground by hand to produce a chamfered edge.

Wax is again applied to the bottom half up to the level of the previous horizontal surface 14 and the two halves are then carefully joined, the wax on the top half cementing itself to the molten wax of the bottom half.

The next stage in the formation of the Fig 1 mould is to electroplate the top half and this is achieved by graphite coating the top half as well as the chamfered surface of flange 13, and then electroplating the top half. The graphite on the surface 13 will provide both a conductive surface for a matching flange 15 to be formed on the top half by electroplating, and the electroplating also provides the required metal for the rotational mould. The entire metal mould is then heated and the halves separated and the wax is emptied from the two hollow halves, which are then cleaned. This process provides an excellent hard surface seal between the top and bottom halves which will eliminate or almost eliminate a flash.

Utilizing the rotational mould, a plurality of formers can then be formed by pouring a quantity of polyvinylchloride with additional reinforcing fibres (if required) into the mould, closing the upper end of the mould and moulding on a rotational mould in accordance with prior art. The former is removed from the rotational mould whilst it is still warm, because the PVC material is then very flexible and the former is quite easily removed. After is has been allowed to cool, the PVC former is then sanded in the presence of a solvent thinner to carefully and accurately remove all trace of any flash which may have formed.

The former 18 is then conditioned while washing externally in trichlorethylene or other suitable degreasant and allowed to dry. It is provided with a water conduit 19 extending through the wall of the annular necked extension 20 of the former 18, entering near the top of the neck extension 20 and opening at 21, that is, at a location immediately below a collar of an elastomeric stem which is referred to below. The necked extension 20 is reinforced by an inner metal tube 16.

It will be noted that as moulded, the former 18 has a relatively thick but pliable wall, the legs are divergent and the arms outstretched. This is to provide a natural appearance to creases which will form in a skin which is foam filled as described in some of my aforesaid co-pending applications.

In Fig 3 the former 18 is immersed in a calcium nitrate solution 22 which may also contain a very small amount of methanol and detergent. The solution is contained in an open top container 23. Since the former is filled with hot water, calcium nitrate solution will penetrate the surface of the polyvinylchloride, and it will be noted that the calcium nitrate coagulant extends some distance up the neck extension 20.

In many instances a single dip is all that is required, but the coagulant may be dried in oven set at about 100°C, and the dipping process can be repeated if required.

Fig 4 illustrates the next stage wherein the former 18 with its calcium nitrate surface is dipped into rubber latex 25 contained in the container 26. The former either retains its hot water or has new hot water added before this dipping occurs. It is desirable but not essential for the lower end of the water conduit 19 to be closed by a bung or valve during both dipping operations, to avoid the conduit becoming closed by the dipping material. The function of the coagulant is to improve gather of latex over the former and

an even coagulation of the latex solution, resulting in the ability to produce over an irregular shaped former, a smooth thin skin with little or no runs and a very high degree of definition, with a minimum bridging effect over fine detail of recesses or protuberances.

Still containing the hot water, after dipping to the depth illustrated in Fig 4 the former 18 is removed and the latex is allowed to set, being assisted by the temperature imparted to it through the wall of the former 18 by the hot water contained therein. Since some of the neck extension 20 will be coated with latex, and the neck extension 20 is annular in shape the latex can be rolled down as a collar which terminates just above the outlet of the water conduit 19.

When the latex skin has been sufficiently set and at least partially cured, the next stage illustrated in Fig 5 is applied, that is, a pump 28 is sealably engaged in the open end of the neck extension 20 and the air and water within the former 18 is evacuated, thereby allowing atmospheric pressure to reduce its dimension and the set skin 29 to be freed from the outer shape forming surface of the former 18. The calcium nitrate penetration of that surface avoids adhesion. Water or calcium nitrate solution is then injected through the conduit 19 and enters the space between the reduced size former 18 and the very flexible and resilient latex skin 29. In some instances it is desirable that the former 18 be inverted from the position shown in Fig 5 and then repositioned as shown in Fig 5, the weight of water or solution then assisting the skin to drop away from the collapsed former 18, and functions as a lubricant to assist in this action. Calcium nitrate also reduces any tendency of the skin to adhere to itself. It will be appreciated that the diameter of collar 30 formed by rolling down the set skin 29 from the neck extension 20 is very much smaller than the maximum transverse dimension D of the former 18 even when the former is in its collapsed state, but when a former is in its collapsed state as shown in Fig 5 the shape forming surfaces

of the arms of the former 18 are much more easily deflected, and tend to lower alongside the torso, and the skin will be found to be easily removed with a minimum of extension of the collar 30. It should be noted that the maximum possible extension of a thin natural rubber skin is six times original, but it is of course most desirable that this should be reduced as much as possible.

The skin is subsequently used to receive a skeleton and to have a polyurethane foam injected thereinto, desirably to provide a "soft" feel although in some instances this is not required. Details of these further stages are contained in the specifications of my aforesaid Patent applications.

Reference is now made to Fig 6 which is a second embodiment applicable more to a much larger doll or mannequin. In Fig 6 those elements which are common to the other drawings bear the same designation numerals, and the processes heretofore described are applicable. However, although the torso portion 32 of the former 18 is substantially rigid, the arms 33 are without reinforcement and can be difficult to control dimensionally. Accordingly, there is provided a support 36 which comprises two hinged reinforcing arms 37 of metal which can be varied in their relationship to each other between the outstretched positions shown in Fig 6 and positions where they lie alongside the torso 33. This is achieved by a spiral 38 which engages teeth 39 extending part-way around the periphery of a quadrant 40, and when it is necessary for the skin 29 to be removed, the arms can be changed in their position to facilitate the removal without excessive distension of the collar 30.

To provide still further stability, a polyurethane foam filling 42 may be inserted into the hollow of the former 18 of Fig 6, the foam filling 42 being of the interconnecting cell type, and can be further processed to make the former 18 pliable by the following steps:-

A vacuum is first established by a pump as in Fig 5 and this removes the majority of the air and gas from within the former 18. A caustic soda solution is injected into the cell structure within the former and the "windows" in the foam formulation are removed by the corrosive affect of the caustic soda. The caustic soda is then removed and the former is rinsed out using water to dilute any residual caustic soda solution. The reinforcing foam matrix which is left behind will allow hot water to readily flow into or taken from the former 18, and this facilitates the above described dipping and drying operations for the formation of a skin, and also makes the former 18 more pliable.

It is believed that the additional features illustrated in the second embodiment are required only for relatively large mannequins and not for smaller dolls.

The claims defining the invention are as follows:-

1. A moulding method for moulding an elongate article of polymeric material having an extending limb, comprising:

(a) moulding a former (18) of polymeric material to have a relatively thick wall with an outer shape forming surface and an inner surface defining a hollow, and a hollow extension (20) which extends from one end,

(b) applying a liquid coagulant (22) to said shape forming surface,

(c) immersing the shape forming surface of the former into a liquid latex (26) without allowing latex (26) to flow into the hollow,

(d) removing the former (18) from the liquid latex and allowing the latex adhering to the former to set as a skin (29) over the shape forming surface,

(e) evacuating (28) the former (18) through the hollow extension (20) sufficiently to cause its volume to reduce, and

(f) separating the set skin (29) and former (18) by applying a force to the skin while the former volume is reduced.

2. A moulding method according to claim 1 wherein said liquid coagulant (22) is applied to said shape forming surface while said surface is hot.

3. A moulding method according to claim 1 wherein said shape forming surface is hot when immersed in said liquid latex (26).

4. A moulding method according to claim 2 comprising heating said shape forming surface by containing hot water in the hollow of the former (18).

5. A moulding method according to claim 1 wherein said coagulant (22) is applied to said shape forming surface by immersing that surface into a coagulant solution (22), and

drying that surface before said immersion into the liquid latex (26).

6. A moulding method according to claim 1 wherein said separation of skin (29) from former (18) comprises injecting one of water and calcium nitrate solution between the skin and former.

7. A moulding method according to claim 6 wherein said application of liquid coagulant (22) and immersion also comprises coating the hollow extension (20) with said latex skin (29), and further comprising rolling the latex skin (29) downwardly over the hollow extension (20) to form a resilient collar (30) which seals against the hollow extension (20) during said injection.

8. A moulding method according to claim 1 wherein said elongate article is a doll and said moulding of the former (18) is effected in a rotational mould (10) which comprises an upper die part (11) and a lower part (12) divided across the torso in an equatorial plane (14), and said die parts when assembled have abutting tapered surfaces (13, 15) which comprise a hard surface seal.

9. A moulding method according to claim 1 wherein said elongate article is a doll and wherein said hollow extension (20) contains a reinforcing tube (16) which carries hinged reinforcing arms (37) which extend into said hollow within the doll arms, and control means extend outwardly of said hollow and are operable to deflect said reinforcing arms (37) and thereby deflect said doll arms between outstretched and lowered positions said method comprising moulding the former (18) with its arms outstretched but lowering the arms before said separation of the skin (29) from the former (18).

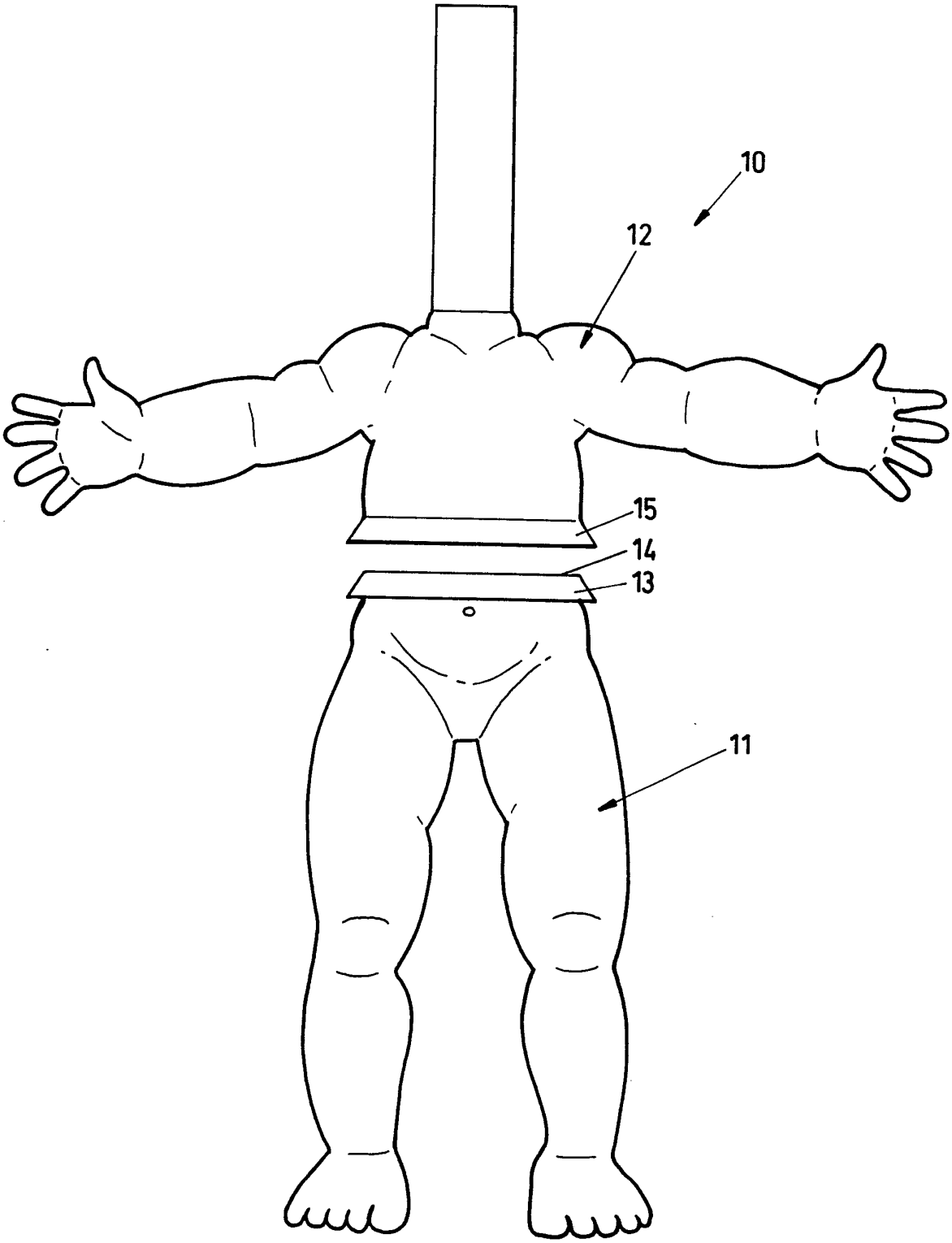


FIG 1

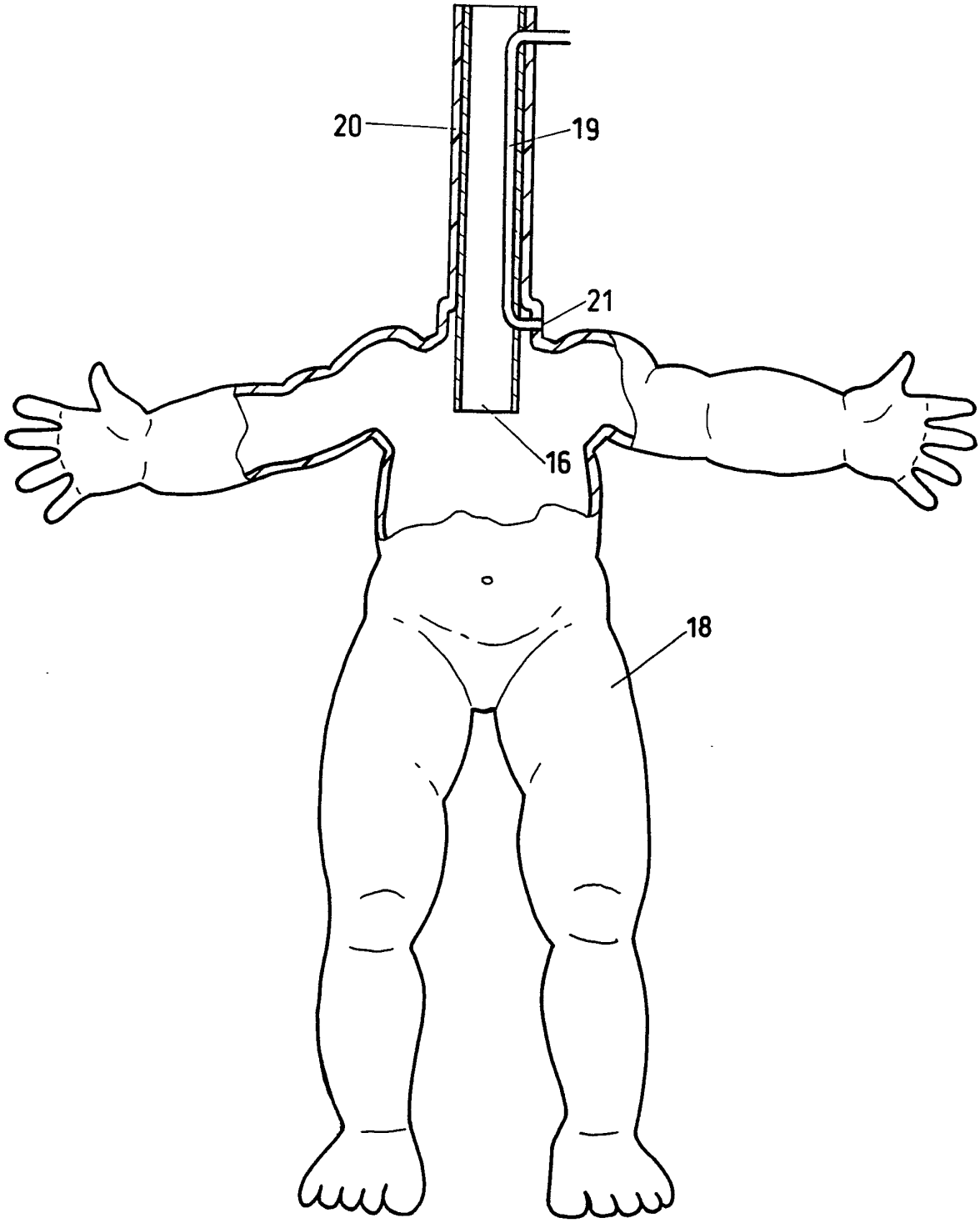


FIG 2

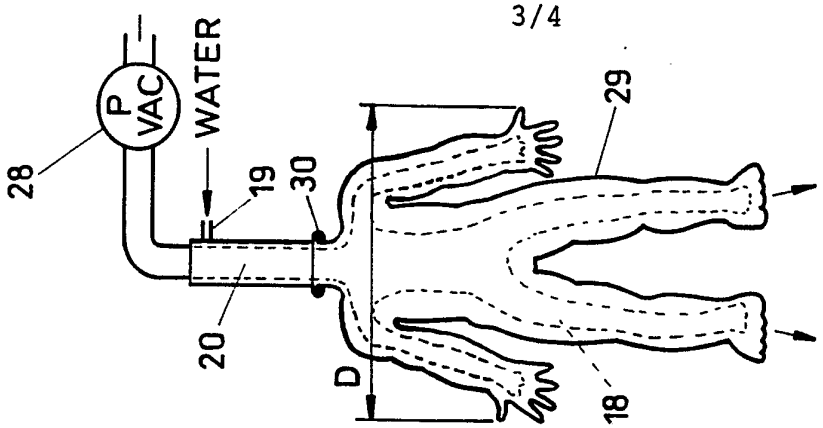


FIG 5

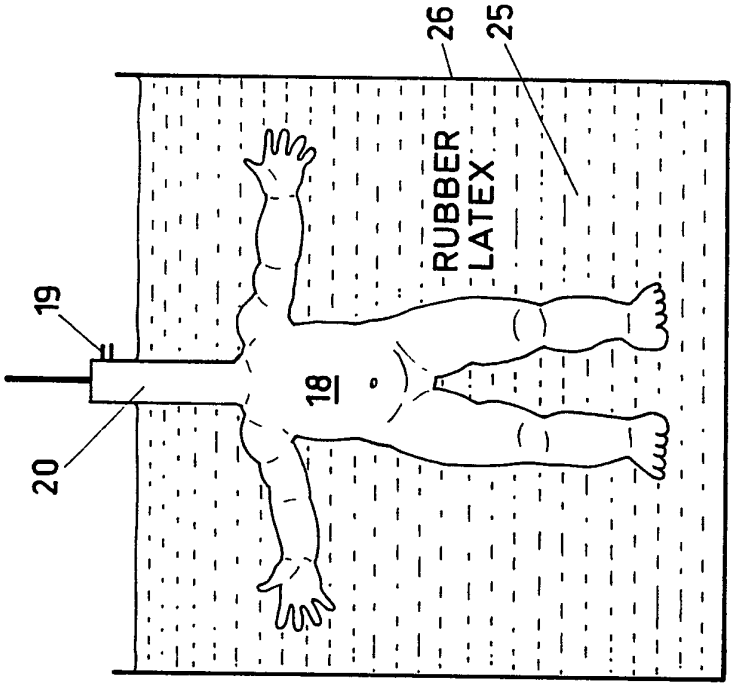


FIG 4

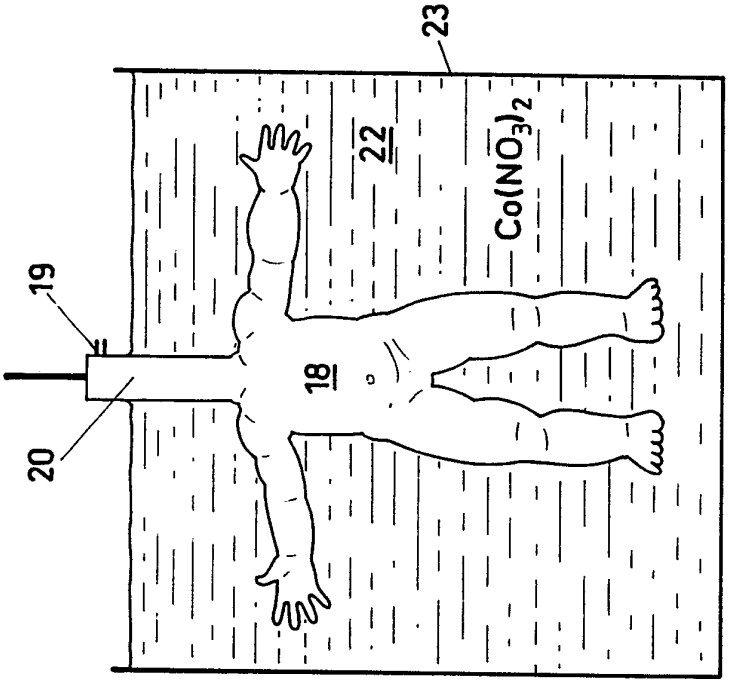


FIG 3

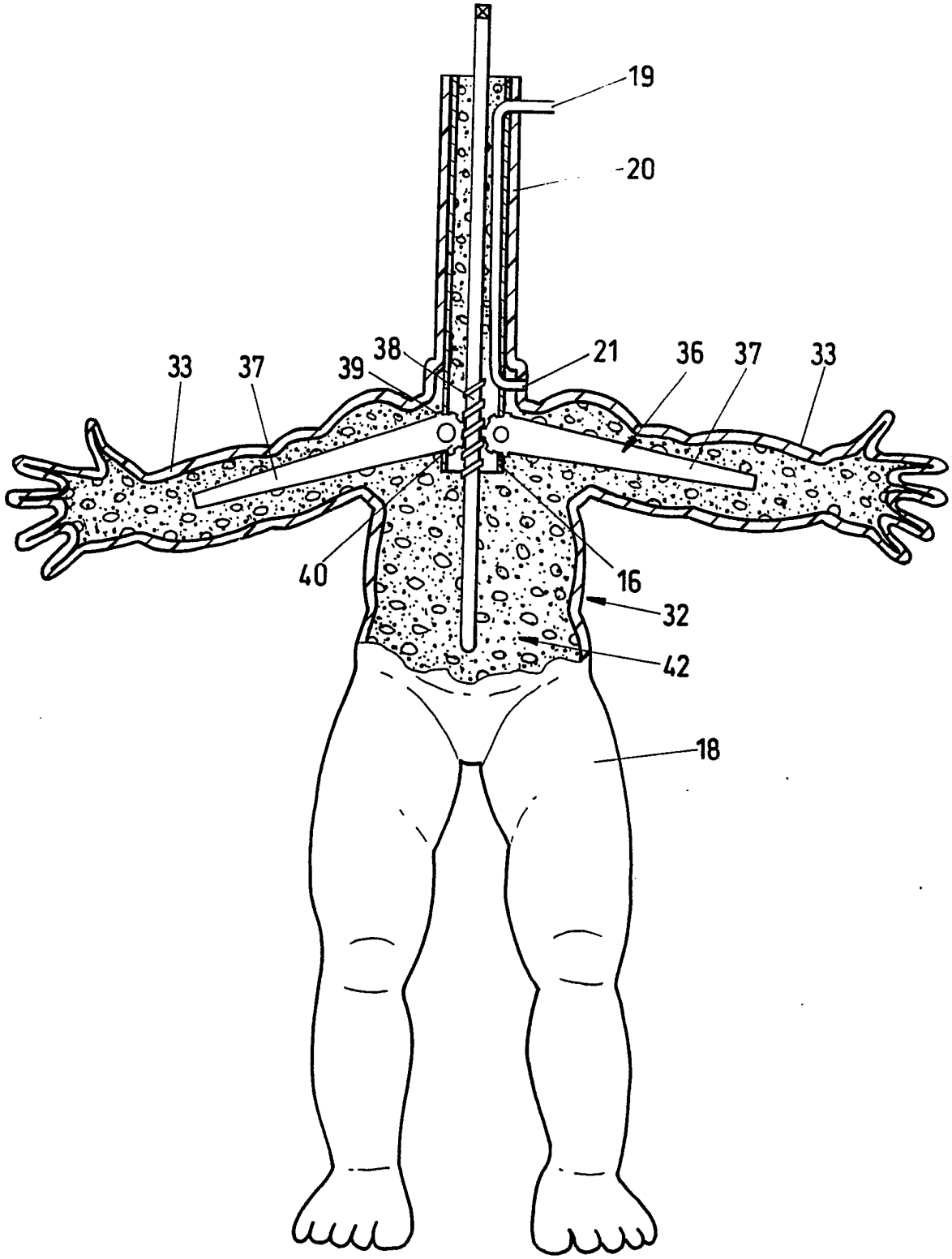


FIG 6

INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 90/00388

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 41/42, 33/48 // B29K 7:00, 27:06, B29L 22:00, 31:52

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC	B29C 41/42, 33/48, 33/50, 1/12, 13/04, B29H 3/044

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU : IPC as above

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
Y	US,A, 3689613 (TALALAY) 5 September 1972 (05.09.72) See the figure and col.1 line 43 - col.2 line 63	(1-9)
Y	US,A, 4102844 (SCHWINUM) 25 July 1978 (25.07.78) See col.1 lines 7-18, col.4 lines 19-25 and col.6 lines 43-53	(1-9)
Y	US,A, 3815863 (ANDEWEG) 11 June 1974 (11.06.74) See col.2 lines 20-38	(1-9)
Y	US,A, 2456513 (JOHNSON) 14 December 1948 (14.12.48) See col.5 lines 73-7 5 and col.6 line 49 - col.7 line 12	(1-9)
Y	AU,A, 48843/79 (TREVELYANS) 15 January 1981 (15.01.81) See the claims	(1-9)

(continued)

* Special categories of cited documents: 10

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"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.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1 November 1990 (01.11.90)	9 November 1990
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	A. WINCH

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	Patents Abstracts of Japan, M 144, page 6, JP,A, 57-57615 (ARON KASEI K.K.) 6 April 1982 (06.04.82)	(1-9)
Y	Patents Abstracts of Japan, M 69, page 55, JP,A, 56-25435 (NIIGATA TEKKOSHO K.K.) 11 March 1981 (11.03.81)	(1-9)
Y	Derwent Abstract Accession no. 19723c/11, Class A32, SU,A, 672057 (OSIPOV) 5 June 1979 (05.06.79)	(1-9)

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 90/00388

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 3689613	CA 961615		
US 4102844	BE 820146	BR 7407844	CA 1053869
	CS 202540	DE 2347755	ES 430285
	FR 2244787	GB 1480112	IN 142708
	IT 1019341	JP 50059440	NL 7412481
	PL 110067		

END OF ANNEX