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J. A. TALALAY

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PRODUCTION OF SPONGY RUBBER PRODUCTS

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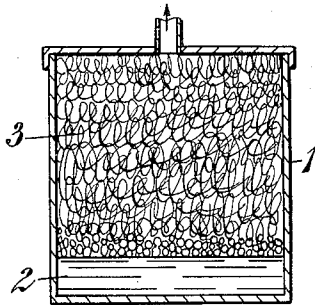


Fig. 1

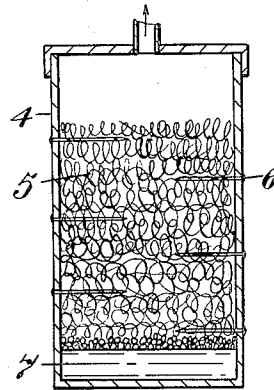


Fig. 2

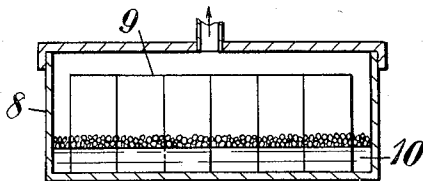


Fig. 3

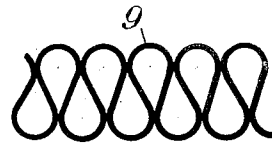


Fig. 4

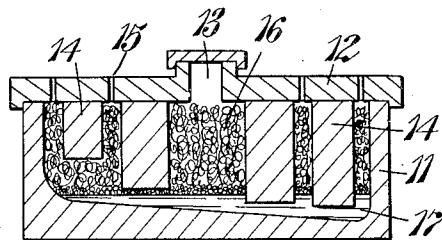


Fig. 5

J. A. Talalay
inventor

By: Glascof Downing & Seabold
Attys.

UNITED STATES PATENT OFFICE

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PRODUCTION OF SPONGY RUBBER
PRODUCTS

Josef Anton Talalay, Bedford, England, assignor
of one-third to The Moulded Hair Company
Limited and one-third to Joseph Arthur
Howard, both of London, England

Application March 10, 1937, Serial No. 130,192
In Germany March 13, 1936

4 Claims. (Cl. 18—58)

This invention relates to the production of spongy products and articles of rubber and rubber-like material.

In my co-pending application No. 67,990, filed on March 9, 1936, a method of producing a porous or spongy rubber or rubber-like product is described which consists in converting into a froth an unfrothed dispersion or solution of rubber or rubber-like substances by subjecting it, either alone or in the presence of one or more substances capable of giving rise to a gas under the froth-producing conditions, to a reduced pressure whereby gas contained therein is caused to expand and possibly liquid contained therein to vaporise and so impart porosity to the material, and setting the material while still in the form of a froth. The incorporation of fibrous material, such as hair, coconut fibre, asbestos, with the spongy product provided by this process has also been described, the incorporation advantageously being effected by placing the fibrous material in a container and allowing the porous material to rise up over it under the influence of the sub-atmospheric pressure.

It has been found however that when making spongy products containing incorporated fibrous material like hair mass in the way mentioned there is a tendency for the fibrous mass to become disarranged by the buoyancy of the ascending froth to a greater or lesser extent, e. g., it tends to matt together and/or to rise with the froth, with the consequence that the spongy product obtained does not contain the fibre filler more or less evenly distributed where it is required, corresponding to its original disposition in the container, such as would be the case if the disarrangement referred to did not occur. Experiment has shown that the disarrangement of the fibrous mass in the frothing vessel can be prevented during the ascension of the froth if the fibres of the filler mass are bonded together in some way, e. g., interlocked and/or stuck together at crossing places, whereby a certain, maybe only temporary, rigidity is imparted to the mass which is sufficient to prevent the latter becoming disarranged and tending to ride upwardly on the froth. Of course the bonded or locked fibrous mass must be mechanically restrained as a whole in the frothing container or else it will rise as a whole with the froth.

Accordingly, the method of making a porous or spongy rubber or rubber-like product provided by the present invention consists in frothing at ordinary or elevated temperature a fluid bearing rubber or rubber-like material by any method,

but preferably by a method involving the use of sub-atmospheric pressure, allowing the froth ascending under the action of the sub-atmospheric pressure to permeate a mass of natural or artificial fibres or fibrous material which has its fibres bonded or locked together and consequently possesses a certain rigidity, and which is mechanically restrained as a whole from rising with the froth, and then setting the froth permeating the fibrous mass.

Any method of froth formation may be employed for carrying out the method of this invention, but preferably the froth is formed by the use of vacuum at some stage or other in the procedure. The starting fluid may be a solution or dispersion of rubber or rubber-like material, and this may be frothed by direct subjection to the action of a vacuum, at ordinary or elevated temperature, whereby gas that may be contained therein is caused to expand, and possibly liquid contained therein to vaporise, with formation of a froth. If desired the said solution or dispersion may previously be admixed with substances which evolve gas under the froth-forming conditions, e. g., volatile liquid or solid (e. g., petrol, liquid or solid carbon dioxide), gases or volatile liquids adsorbed on a solid adsorbent, compounds which irreversibly decompose with evolution of gas (such as hydrogen peroxide, ammonium carbonate), etc. The solution or dispersion, with or without any of the said gas producing substances admixed therewith, may first have air or gas mechanically entrained therein, e. g., by whipping or beating, and this pre-frothed dispersion may be subjected to subatmospheric pressure in order to enhance the froth formation and produce a much lighter structure. These known methods of frothing are mentioned merely by way of example, the method of producing spongy products according to this invention contemplating the employment of any method of froth formation or enhancement, but preferably one which involves the use of a vacuum at some stage or other. The preferred frothing procedure however, is that disclosed in the specification of my U. S. application No. 67,990.

The fibrous material to be incorporated in the spongy structure has its fibres locked or bonded together, whereby the mass acquires a certain rigidity which, however, may be only temporary. This bonding may be effected, for example, with any bonding agent or adhesive whatsoever; it may or may not be elastic in nature. For example, natural or artificial aqueous dispersions of unvulcanised or of vulcanised rubber or rub-

bed-like material may be employed. Another suitable adhesive is casein. If an adhesive is employed which is soluble in a suitable solvent, such as gelatin or rosin, then the adhesive can later be washed out of the spongy structure, if necessary or desired, by means of a suitable solvent (e. g., water in the case of gelatin and spirit in the case of rosin), for the function of the adhesive is to bond the individual fibres to one another so as to form a light structure or framework, so to speak, the individual fibres of which can withstand the buoyancy effect of the ascending froth during the permeation of the fibre mass.

Fibrous material bonded with adhesive which is suitable for use in carrying out the invention may be made by treating suitable hair material, e. g., natural or artificial horsehair, cellulose fibre, asbestos, coconut fibre, or a mixture of two or more kinds of hair material with the desired adhesive or bonding agent, e. g., by spraying or dipping. For example, the hair may be continuously turned over and over whilst being sprayed with the desired adhesive. Other methods of treating the hair are also available, however. For example the treatment may take the form of a wet carding operation, the hair being torn apart by a carding operation and being treated with bonding agent in liquid form before, during or after the carding operation.

Other bonded hair material may be used of course, and the invention is not wholly limited to material bonded with adhesive and prepared by the methods just described. Bonded hair and fibre material available on the open market may, of course, be used such as rubberised hair or the material sold under the name "Hairlock;" and in particular the bonded material prepared by the process described and claimed in my co-pending U. S. application Serial No. 126,480, filed on or about February 20, 1937, is suitable for use in carrying out the process.

Fibrous structures or masses may also be used in which the bonding of the fibre is effected without employment of adhesive or special bonding agent, and is brought about by the matting, weaving or interlocking of the fibres, or other disposition or arrangement of the fibres which causes them mutually to restrain one another's disarrangement sufficiently during the frothing operation for an adhesive or bonding agent to be dispensed with. Material of this kind which can be used includes woven fabric of all kinds, canvas, felt, like wool felt or hair felt, knitted material, and broadly fibrous structures containing interlocked or interwoven fibres.

The hair treated with the adhesive is placed in the frothing vessel before or after the adhesive has dried and/or set and/or been vulcanised. The fluid to be frothed is also introduced into the vessel, before or after the introduction of the hair. Mechanical means are employed, as described below, to prevent rise of the hair mass as a whole during the frothing operation. If the treated hair is introduced into the said vessel before the adhesive has dried and/or set of course the froth ascension must not be effected until the hair mass has acquired sufficient rigidity (by drying and/or setting and/or vulcanisation) to withstand the buoyancy effect of the froth. By withdrawing air from the vessel containing the bonded or locked fibrous material restrained in position by mechanical means the fluid is caused to froth up, the froth ascending and permeating the fibrous mass.

Before being permeated with the froth the bonded or locked fibrous material may be given any desired shape. The shaping, which may be carried out before or after setting and/or drying and/or vulcanisation, can be effected by bending, cutting, rolling, moulding, pressing, or in any other desired manner. For example, bonded fibrous filler, such as fabric, or rubberised fibre, or felt, in sheet form may be bent or curled into a suitable configuration, e. g., into a serpentine or sinuous form (the loops of which if desired may be filled with fibrous filler), and then permeated with froth in order to make a spongy body with filler. The invention is not wholly limited to the manner or form of shaping, but any structures of bonded or locked fibrous material may be employed. Further, the configuration or shape of the filler placed in the container does not necessarily have to conform in any way to the final shape of the desired article.

It will be clear that, unless steps are taken to prevent it, the bonded or locked fibrous structure, possessing a certain rigidity, may ride as a whole on the ascending froth to the top of the frothing vessel. When the fibrous filler is placed in the said vessel, therefore, mechanical means preferably is adopted to prevent this. Several ways of doing this are available. For example, wires can be passed across the mould at one or more levels for the purpose, passing over or through the bonded or locked filler structure. These wires will have to be cut, or otherwise released from the mould walls, to enable the finished product to be removed from the mould. The lengths of wire remaining in the product may either be withdrawn therefrom or left therein; if the wire used is fine it may often be left in the reinforced structure without harm or disadvantage. Other mechanical restraining means which may be employed are nails, spikes, needles or the like projecting from the sides of the frothing vessel into the fibrous filler, or even blocks provided in the vessel for forming cavities in the finished structure. Such projections must of course be removed before the final product can be taken out of the vessel. If the fibrous filler structure fills the whole vessel from the bottom to the top, then the lid of the vessel will itself prevent the structure from rising as a whole, and additional mechanical restraining means as mentioned above are then not necessary, although they may be used if desired.

The porous product with incorporated hair structure is of course set, and if desired vulcanised in the usual way. If the setting is not to take place under vacuum, but only after atmospheric pressure has been wholly or partly restored, the fluid from which the froth is formed must contain one or more substances which will decompose under the froth-forming conditions with formation of gas, as well as a stabiliser such as saponin, in order that the froth produced shall not collapse when the vacuum is wholly or partly released.

It will of course be appreciated that vulcanising agents, accelerators, and any of the other additions known to the rubber art may be present in the liquid being subjected to reduced pressure.

While the invention is intended more particularly for the production of spongy products and articles of rubber, in which a rubber-bearing fluid, unfrothed or pre-frothed, will form the starting substance, it may also be used for making spongy products of rubber-like materials, e. g., Duprene and Thiokol, when the starting fluid

will comprise an unfrothed or pre-frothed liquid bearing such material in dispersed or dissolved form. The manner of carrying out the invention is the same, although it must be remembered that Duprene is deposited from solution and dispersion in the vulcanised state, and that accordingly slight modification of the procedure may be necessary. Duprene is non-inflammable and spongy products made therefrom are consequently particularly valuable for use in places where especial care has to be taken to avoid possibility of conflagrations, e. g., in aircraft.

The products made by the present invention may of course be shaped in any way, e. g. by moulding or cutting, to desired articles, such as upholstery seating. Most conveniently the vessel in which the fluid is subjected to vacuum itself forms a mould for the article desired. If desired, however, the article may be made more or less to shape, e. g., by forming in a mould (which may be the frothing vessel itself) and/or cutting, and finally shaped during vulcanisation by a mould curing operation.

Fig. 1 is a vertical section of a vessel and the working materials therein, illustrating a preferred form of the process.

Fig. 2 is a similar view showing a modification.

Fig. 3 is a similar view showing another modification.

Fig. 4 is a sectional view of a sheet of fibrous material bent to a sinuous form, in which form it is employed in the procedure that is illustrated in Fig. 3.

Fig. 5 is a sectional view illustrating still another modification, as adapted to the production of a molded product.

The accompanying drawing shows diagrammatically the manner of carrying out the process of this invention. In Fig. 1 the frothing container 1 is filled completely from bottom to top with hair material 3 having its fibres bonded with casein or other adhesive. The vessel contains also latex 2. On withdrawing air from the vessel the latex froths and the froth ascends through the fibre mass to the top of the vessel. The resulting rubber froth with incorporated hair material is then set and vulcanised. In Fig. 2, the vessel 4 is only partly filled with bonded hair 5, and this is held in position by means of nails 6 projecting into it from the walls of the mould. In Fig. 3 a strip of sheet material 9, e. g. felt, or a sheet of rubberised hair, or fabric, which sheet may be provided with holes if desired, is bent into a sinuous form as shown in Fig. 4 and is then placed on edge in the mould 8 with latex 10. If desired the contacting places of the loops into which the strip is bent may be stuck together with adhesive before introducing the strip into the mould.

When the article being made is to possess cavities then the mould in which it is produced will

have to be provided with blocks or the like around which the frothed rubber can rise, so that when the blocks are removed cavities will be left in the finished structure. When such blocks are employed it is frequently not necessary to use spikes, needles and the like to hold the fibrous filler in position, for the blocks themselves will prevent rise of the fibre, even though the vessel may not be filled with fibre up to the lid. Fig. 5 illustrates schematically the production of an upholstery seat. In this figure 11 is the mould which is fitted with a close fitting lid 12 having an inlet opening 13. The lid 12 bears a number of blocks 14 and also fine holes 15. Locked or bonded hair 16 is packed around the blocks 14 as shown. Latex 17 is poured into the mould through the opening 13. The latter is then closed and the whole mould is subjected to reduced pressure. The latex froth rises but will not carry the hair material with it, even though the latter does not fill the mould, because the blocks themselves provide sufficient mechanical restraint. The latex froth eventually rises through the holes 15, where it contacts with the air and coagulates to form seals which seal up the said holes. Instead of employing the fine holes 15 in the lid 12 larger holes may be used covered with canvas or fabric.

In the appended claims the words "a substance having the pertinent characteristics of rubber" are to be understood as meaning a substance having such character that it can be in the form of an aqueous dispersion, of such character that the dispersion can be initially frothed by reduction of pressure, of such character that it can be set in its expanded form, and of such character that when set it will have resilience.

What I claim is:

1. The method of producing a resiliently deformable article which comprises providing a reticulated body of fibrous material having fibers thereof held to each other at their crossing positions, causing a dispersion of a substance having the pertinent characteristics of rubber to extend itself as a foam through the interstices of the said body, by subjecting the said body and the said dispersion to reduction of pressure, and then setting the said substance while it is in the said interstices and at least without fully collapsing the foam.

2. A method as defined in claim 1 in which the dispersion is caused to extend itself by subjecting it to sub-atmospheric pressure.

3. A method as defined in claim 1 in which the body is locally restrained by mechanical means against being excessively deformed by the extending foam.

4. A method as defined in claim 1 in which the dispersion is a dispersion of rubber.

JOSEF ANTON TALALAY.