April 3, 1951 H. C. E. TILLISCH 2,547,060

PROCESS FOR THE TREATMENT OF RABBIT'S HAIR

Filed Feb. 3, 1947

Fig. 1.

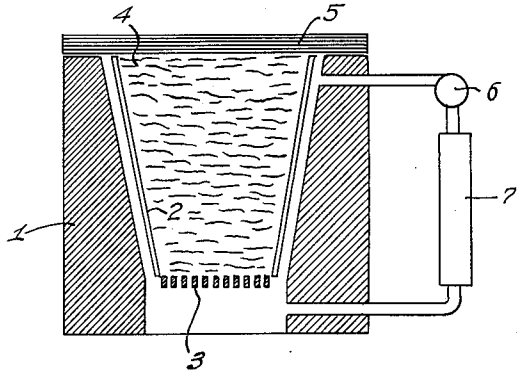


Fig. 2.

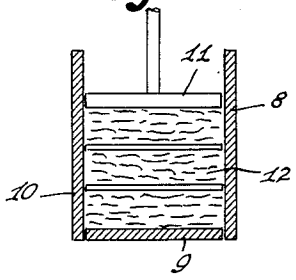


Fig. 3.

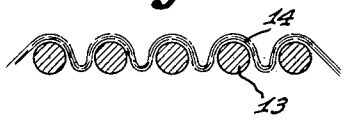
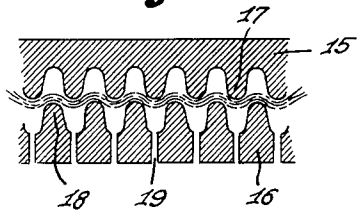


Fig. 4.



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PROCESS FOR THE TREATMENT OF RABBIT'S HAIR

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Rabbit's hair, particularly hairs from Angora rabbits, possess many properties which make them highly estimated in the textile industry and in ordinary use, but they suffer, however, from several drawbacks. They are difficult to spin, especially the short-hair qualities, in particular if not mixed with other fibres, and in wear—independently of their length—the hairs have a pronounced and very embarrassing tendency to fluff and adhere to other fabrics, for instance, woolen clothes. The hairs are furthermore inclined to move within the threads and even out of same, possibly into other fabrics.

These drawbacks can be considerably diminished by a treatment according to the invention. The result of the treatment is presumed to be due essentially to the fact that the surface qualities of the hairs are changed whereby, amongst other things, their tendency to become highly electric by friction is reduced. According to the invention the hairs may also be given a permanent curling which, i. a., will contribute to preventing any wanderings of the threads. By the treatment the hairs, if desired, may be made relatively stiff or elastic and "live." According to circumstances yarns spun of such material may be more voluminous than yarn of untreated hair, with a fine adhesive power of the fibres in the single threads and without pronounced tendency to felting with the adjoining threads or with other fabrics or to fluffing. In other embodiments of the process according to the invention the hairs can be made appreciably softer than natural hair, while at the same time they will fluff, move and become entangled in a less degree than untreated hairs.

It has been suggested to treat sheep's wool in various manners with diluted formaldehyde to make it more resistant to bacterial disintegration and to moths, cf. the literature cited in the ordinary handbooks, such as, J. Frederic Walker, Formaldehyde, New York, 1944, p. 368 and Anson and Edsall, Advances in Protein Chemistry, New York, vol. II, 1945, p. 326, and the older literature. Furthermore it has been suggested to treat sheep's wool with ordinarily greatly diluted solutions of the common, lower aliphatic acids or their anhydrides in, for example, petrol or with vapours of such substances. After this treatment the wool is said to be less liable to felting and shrinking, to be more easily spun and dyed, to receive a silk-like lustre, to become whiter, more elastic and curled and to seem softer, cf. for instance, the specification of Danish Patent No. 49,705. As far as is known this method, however, is not used in

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practice. From the specification of Swedish Patent No. 111,613 is also known a method for increasing the spinning capacity and felting power of protein fibres by treating coarse hairs, such as human hair, cow's hair and goat's hair with various chemicals at very high pressures, for example, 500 kg./sq. cm. This method is, however, not applicable to rabbit's hair, particularly Angora rabbit's hair, as the fine hairs will burst at the pressures required.

The present invention comprises a treatment of rabbit's hair, particularly of the Angora rabbit type, in natural state, or alternatively after the hairs have been curled, crisped or ondulated. The curling is especially of importance in the case of the mostly straight and comparatively stiff bristles or coating hairs, as a rule about 35–85 μ thick, whereas the fine hairs have a thickness of about 5–20 μ, besides possessing beforehand wavy ondulations.

The chemical treatment is performed at a pH value lower than 12 by means of chemicals which in reacting with the hair substances give rise to in water insoluble combinations and entail a permanent alteration in the chemical composition or constitution and the physical properties of the hairs, particularly the surface qualities of same, inter alia their electric qualities. It is presumably the featureless layer on the cuticles and the cement between the inner layers of keratin cells which above all are affected. In practice the chemicals—possible with the addition of humidifiers—are preferably used at a pH value lower than 9–7. This is of importance especially if the treatment extends over a long period, if employing an excess of chemicals, or if working at elevated temperatures, since the quality of the hairs otherwise would suffer too much. Thus in the case of elevated temperatures it will as a rule not suit the purpose to employ concentrations of acid higher than about $n/5$, whereas at room temperature the concentration may be considerably higher, e. g., up to normal strength, or even several times normal strength. If the chemicals are added at extreme pH values, or high concentrations, it is important to employ only the necessary quantity of the chemicals.

As chemicals may be employed tanning or mordant agents which, however, must not spoil the natural colour of the hairs unless it is expressly intended to affect same. The process may, for example, be carried out by means of aldehydes, possibly in conjunction with substances which will secure pH values preferably

below 7, or aldehyde acids or such substances as are able to form aldehydes.

Examples of such chemicals are: formaldehyde and its condensation products, homologues or derivatives of any kind, such as, furfurol which may act colouring, glyoxal or homologues or derivatives of such substances. These substances may be used together or possibly simultaneously with inorganic acids or acid salts, or organic acids or acid organic compounds of any suitable kind, for example, aliphatic acids, such as acetic acid, its homologues or derivatives thereof, such as halogenated acids. Furthermore may be used aldehyde acids, such as formic acid, its homologues or derivatives and compounds which are able to form such acids.

As mordant agents may be used soluble compounds of elements of the groups II, III, IV, V and metals of the iron group, particularly magnesium, calcium, zinc, boron, aluminium, tin and chromium. Metals of the iron groups may, however, produce a colouring effect.

Furthermore may be used halogenated, organic acids, such as trichlor acetic acid or sulphonated substances, such as Turkey-red oil or naphthaline sulphonic-acids. Also may be used such chemicals which can be employed for permanent-waving of human hair, or for the improvement of other keratin fibres, for example, for making curled horsehair, including also reducing and oxydizing chemicals.

Another way of treating the hairs consists in a halogenation. It is necessary to give a mild treatment only to hinder the fine hairs from being effected too much before the coarser hairs have been altered sufficiently by the halogenation. For this reason bromine should be preferred to chlorine.

According to the invention several of the aforesaid chemicals may be employed together or one after another.

Highly concentrated solutions may often with advantage be supplied in the form of drops, e. g. when they are added by spraying, and possible with a subsequent careful mixture of the mass of hair or—for the volatile matters—possible in gaseous state.

If the chemicals are added by immersing the hairs into, e. g., an aqueous solution or by allowing the flow of such solution through the hairs, it is preferable to use solutions which are not too highly concentrated.

The chemicals may furthermore be added in solution in fatty substances of the kind frequently used in the textile industry for the greasing of yarns, or in emulsions containing such fats.

It is preferable to employ the chemicals in such quantities that they will be completely, or almost completely, absorbed by the hairs, since a too pronounced excess may impair the hairs and be difficult to remove. Any washing, aerating or drying of the hairs, which often will be necessary if excessive amounts of chemicals are used, is thereby avoided.

The treatment may take place, for example, at ordinary temperature. At higher temperatures, e. g. 30–100° C., the process must not be of long duration since the hairs will suffer thereby.

At ordinary temperature the treatment may last for days or weeks. At higher temperatures, e. g. 30–100° C., the process can be finished in much shorter time, for instance, considerably less than 1 hour and up to a few hours. 1–4 hours are often used. At higher temperatures than those mentioned, pressure must be applied.

In selecting substances or mixtures of same, the concentrations and the manner in which they are applied together with the temperature, it is possible to vary the quantities of substance which directly affect or become absorbed by the hairs, and thereby the qualities of the hairs.

After the treatment any excess of aldehydes or acids may be eliminated by the addition of ammonia, if an efficient washing, as mentioned above, with subsequent drying for the removal of the said substances, has not been resorted to.

The colour of the hairs need not suffer by the treatment supposed this is performed at suitable temperatures and the substances are applied in suitable concentrations and in suitable surroundings—for instance, without the presence of oxygen. The treatment can be performed at any stage during the preparation of the hairs for textiles: on the unprepared, or more or less worked-up hairs, on the yarns during or after their spinning and dyeing, etc.

By carding the prepared hairs, a far smaller loss is suffered than by carding the unprepared rabbit's hair, and if the treatment is carried out before the spinning process it will facilitate the same considerably. Thus it becomes possible without difficulties to spin on the machine, or by hand, the short Angora rabbit qualities, often designated as qualities II and III without addition of other fibres, such as long Angora rabbit hairs of quality I, sheep wool or other natural or artificial fibres. It is possible to spin exceedingly thin yarns of pure Angora fibres, for example, of fineness No. 40 or even finer.

The mechanical treatment comprises a gentle pressing or stretching of the hairs imparting to same, particularly the coarse coating hairs, a curling which becomes fixed by the above mentioned chemical treatment. As mentioned above the hairs will thereby be still less inclined to move in the yarns and out of them, than the natural ones. This holds good especially for coating hairs which by nature are straight. The curled fibres can be spun particularly fine.

The mechanical treatment according to the invention may suitably take place, in whole or in part, simultaneously with the chemical and thermo-chemical treatment, the hairs in their curled condition being submitted to a tension or a soft pressure by which the fine hairs will suffer no damage, nor burst to any extent worth mentioning. In order to prevent a too great felting of the hairs it would be appropriate according to the invention that during the compression the hairs possess a suitable degree of humidity preferably with a pH value between 4 and 8, and their temperature must differ appreciably from the optimal felting temperatures. Also it is possible to add to the hairs certain anti-felting agents, such as the so-called Perminal NF.

For the treatment of the hairs—the chemical as well as the mechanical, or both—may be selected different apparatuses dependent upon the result desired.

A treatment with chemical solutions, in which the hairs are immersed, may take place in ordinary, open or closed containers, for example, pressure containers, making it possible to apply also higher temperatures than 100° C.

Chemical solutions may also be applied by spraying while the hairs are spread out in a thin layer, with a subsequent thorough mixing, for example, by passing the hairs through a devil. If desired the hairs may be warmed before or

during the mechanical treatment, for instance, by causing hot air or another gaseous medium, such as carbon dioxide or hot vapour, to flow through the mass of hair, or electrically by induction or di-electric heating, etc., according to circumstances.

The mechanical treatment may comprise a soft compression in a container or, e. g. be brought about thereby that the hairs in the form of a carding veil, in some suitable manner, are given an ondulating shape, e. g. by being conveyed against or pressed down into a relief-formed, possibly perforated plate, such as, a wire-screen, or they may be curled by being pressed between two parallel, relief-formed plates, whereby they will also be somewhat stretched.

In their curled shape the hairs are retained in the said apparatus until the chemical process is so far advanced that they will not immediately tend to become straight again. A curing of the hairs need not take place in the apparatus.

The active plates of the apparatus may appropriately be covered with glass, porcelain or other substances, such as suitable alloys or plastics which are not attacked by the said chemicals, so that the hairs will not be affected in an undesirable manner. The walls of the apparatuses may be perforated so as to allow an introduction through the walls—possibly in direct flow of the said chemicals at a suitable temperature whereby the mass of hair can be heated at the same time. For the latter purpose the walls of the apparatuses may be provided with heating devices. The apparatuses may preferably be placed in a closed room at suitable temperature.

The drawing shows schematically different embodiments of the apparatuses according to the invention for the treatment of the hairs.

Fig. 1 shows an apparatus for the treatment of a bulk of hair tale quale, and

Figs. 2–6 different apparatuses for the curling of hairs.

Fig. 1 shows a cross section of an apparatus with acid-proof walls 1, which preferably are covered with sheets of glass or porcelain and which may be provided with heating devices. Above the bottom there is a grate 3 carrying the bulk of hair 4. The apparatus is closed with a lid 5 which in some suitable manner, e. g., by means of a sand trap or asbestos, provides a tight fit against the upper edge of the walls. 6 denotes a ventilator which draws the air from the interior of the apparatus and blows it through a heating device 7, back to the bulk of hair so as to establish a circulating, possibly hot flow of air. Prior to the filling or during same, the hairs may be heated and imbued with the chemicals or—as far as volatile chemicals are concerned—the air-circulating system may be provided with an evaporator for same.

Fig. 2 shows a curling apparatus comprising a container 8 with a loose bottom plate 9 and intermediate plates 10 together with a piston 11. The mass of hair is placed in layers in the container, the layers being separated by the intermediate plates and compressed softly by means of the piston.

Fig. 3 shows a perforated plate, e. g., a grate system or a wire 13, supporting a layer of ondulated hair, e. g., a carding veil 14.

In Fig. 4 are shown two ribbed plates 15 and 16 of which the one—16—or both is/are provided with perforations 19 for the introduction of chemicals. The ribbed plates are provided with ribs 17 and 18 displaced one in relation to the other. A layer of hairs, e. g., in the form of carding bands or carding veils, folded once or possibly several times, may be introduced between the ribbed plates, which thereafter are pressed together in such a way that the ribs on one plate will enter a little into the intermediate spaces between the ribs on the opposite plate, whereby the hairs will be curled. As mentioned above the chemicals, in liquid or gaseous state, may be introduced through the perforations 19 in the case the hairs have not been imbued with same prior hereto. If perforations are provided in both plates the chemicals may flow through them and possibly heat them at the same time. The ribbed plates may contingently be joined together into a conveyor band of arbitrary length.

Example 1

0.5 to 1 part by weight of an aqueous 30–40% formaldehyde solution of the ordinary merchantable quality, possibly with the addition of humdifiers, is used for the treatment of 10 parts of Angora rabbit's hair or other rabbit's hair, curled or not curled. The solution, e. g., in the shape of fine, or extremely fine, mist-like drops, may be sprayed upon the hairs, or the latter may be treated with vapours from such a solution. At room temperature the hairs should preferably be allowed to remain for a couple of days, e. g., 3–6 days, under the action of formaldehyde, whereupon a possible excess of same may be removed by aeration, or eliminated by means of a known formaldehyde neutralizing agent, such as ammonia. A too great excess of formaldehyde or ammonia may have a detrimental effect upon the hairs.

After this treatment the power of the hairs to become electric by friction is appreciably diminished. If working at higher temperatures than room temperature, e. g., 50–100° C.., the result, after e. g., 4 hours' treatment, will be a yarn which is easy to spin and which even at the roving stage of the spinning process exhibits a fine cohesive power and whose fibres show only a slight inclination to become matted with the adjoining threads.

The yarn spun of hairs treated in this manner will be relatively voluminous.

Example 2

10 parts by weight of rabbit's hair, e. g. Angora rabbit's hairs, are treated in cold or hot state as indicated in Example 1 with 1 part of a mixture holding two thirds of 80% acetic acid and one third 30–40% formaldehyde.

A yarn similar to that of Example 1 with a reduced tendency to become matted can be obtained from hairs treated as above.

Example 3

0.5–1 part by weight of an aqueous 50–90% solution of formic acid is used for the treatment of 10 parts by weight of rabbit's hair as indicated in Example 1, and resulting in hairs with almost the same or even better qualities. The yarns, which are easily spun of these hairs possess only a slight tendency to become matted inter se, and are rather soft. Very thin threads can be spun of hairs treated in this way.

Example 4

Rabbit's hair, e. g. Angora rabbit's hairs, curled or not curled, are immersed for one day or several days at room temperature into $n/5$ to $n/100$

sulphuric acid containing some percentages of aldehydes, e. g. formaldehyde. Thereafter they are subjected to an efficient washing, possibly with the addition of ammonia, and dried.

If performing this process at higher temperatures, e. g., 50–100° C. for about 1 hour, the result will be resilient hairs with a pronounced silk-like lustre well suited for being spun either unmixed, particularly in a curled state, or, e. g., mixed with soft hairs, such as hairs treated according to the procedure indicated in Example 3.

Hereby are obtained "effect yarns" which by the touch present themselves as yarns of untreated rabbit's hair, besides possessing the qualities stated in the specification.

Example 5

Rabbit's hair, for example, Angora rabbit's hairs, curled or not curled, are soaked in a solution of magnesium acetate—possibly with addition of aldehydes—for a couple of days at room temperature, or, e. g., for 20 minutes up to several hours at temperatures from 50° to 100° C. When washed and dried as above the tendency of the hairs to become electric by friction is considerably diminished. They are excellently suited for the spinning of fine yarns.

By using calcium acetate or zinc acetate instead of magnesium acetate is obtained hair of a similar kind and also with a reduced tendency to become electric by friction.

If the hairs are treated in their curled state they will preserve their curling well.

Example 6

Rabbit's hair, for example, Angora rabbit's hairs, curled or not curled, are treated in a similar manner as indicated in Example 5 with a solution of aluminium sulphate at a pH value of 3.5–4. If moreover aldehydes are added, the hairs will have an even less tendency to become electric by friction, whereas hairs without the addition of aldehyde often become somewhat easier to spin into fine yarns.

Example 7

Rabbit's hair, for example, Angora rabbit's hairs, curled or not curled, are treated with boric acid at a pH value of 7–9, regulated by means of sulphuric acid, for 1 hour at 95° C. After the treatment the hairs are washed and dried. The hairs will not be essentially impaired by the relatively high pH value.

The curled hairs will preserve their curling well.

I claim:

1. In a process of preparing spun yarn containing rabbit hair, the step of reducing the tendency of the rabbit hair to become electric by friction by treating such rabbit hair, at a temperature between room temperature and 100° C., with a fluid rich in a volatile aldehydic substance of the class consisting of lower aldehydes and lower aldehyde-acids, at a pH between 1 and 7, to produce a reaction of such treating fluid with the surface portion of the rabbit hairs.

2. The process as set forth in claim 1, in which the rabbit hair is subsequently treated with sufficient ammonia to substantially neutralize any excess of the aldehydic substance.

3. The process as set forth in claim 1, in which the aldehydic substance is formaldehyde.

4. The process as set forth in claim 1, in which the aldehydic substance is a mixture of a volatile lower aliphatic acid and a volatile lower aldehyde.

5. The process as set forth in claim 1, in which the aldehydic substance is a mixture of acetic acid and formaldehyde.

6. The process as set forth in claim 1, in which the aldehydic substance is formic acid.

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