

## UNITED STATES PATENT OFFICE.

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## TREATING SHEEP'S WOOL.

SPECIFICATION forming part of Letters Patent No. 787,923, dated April 25, 1905.

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*To all whom it may concern:*

Be it known that I, ALBERT KANN, doctor of philosophy, chemist, residing at Burgweg 12, Heidelberg, in the Grand Duchy of Baden, Germany, have invented new and useful Improvements in Treating Sheep's Wool, (for which I have applied for Letters Patent in Germany, application K.20,699 IV<sup>8k</sup>, of January 25, 1901,) of which the following is a specification.

The object of the invention is to provide certain new and useful improvements in the treatment of sheep's wool removed from the hide and in the form of threads, fibers, or woven goods by formaldehyde; to cause a chemical reaction of the wool fiber; to render the wool non-sensitive to the action of an alkali and at the same time retaining the natural elasticity of the wool; to permit subsequent effective washing, bleaching, dyeing, printing, and like operations by the use of caustic alkali or other substances of a somewhat strong alkaline reaction in a hot condition without injuring or weakening the fiber.

The invention consists of a process for treating wool and also of the wool so treated and having hardened elastic fibers, non-sensitive to the action of an alkali, to permit the subsequent use of hot strong alkaline solutions.

Up to this date it was impossible to treat sheep's wool or other keratinic fibers especially for the purposes of washing, bleaching, dyeing, printing, and the like with caustic alkalies or other substances of a somewhat strong alkaline reaction in a hot condition without injuring or weakening the fiber. Therefore it has been necessary in the application of alkalies to wool to use lukewarm solutions of soap, soda, ammonium carbonate, or the like. Even by boiling in water of neutral reaction the wool will be injured after some time. I have found that by a suitable treatment the properties of the wool may be altered in such a manner that without impairing its valuable characteristics it becomes hardened to any chemical influence and may be treated with stronger and hotter alkali lyes than hitherto. This is achieved by treating the wool with formic aldehyde.

I am aware that for the purpose of sterilizing animal hair aldehyde, especially acetaldehyde, has been tried, and I am also aware that formaldehyde has been used on skins, furs, hides, and pelts for the purpose of tanning the hides and skins, and such use of formaldehyde I do not claim. It is, however, new to treat wool removed from the hide and in the form of threads, fibers, or woven goods with formaldehyde for the purpose of rendering the wool practically non-sensitive to the action of an alkali.

If sheeps' wool or other keratinic fibers—that is to say, any kind of animal hair—are treated with a solution of formic aldehyde of the formula  $\text{CH}_2\text{O}$  for some time in the cold, or better in the heat, or by the vapors of formaldehyde and are afterward dried without preliminary washing, it will be found that by this treatment the fiber has become much less liable to be affected by the action of strong bases in the heat—as, for instance, caustic alkalies, carbonates of alkali, alkali sulfids, alkaline earths, &c.—as well as by the action of steam and of boiling in water of neutral reaction without diminishing in the whole the useful properties of the wool. The fiber so treated will resist better the action of the said chemicals and will not be shortened or shrunk. If the wool is treated in the heat, the treatment may be stopped at an earlier moment, and a more dilute solution may be employed. This will be obvious by the following experiment: If a solution of caustic soda is allowed to act upon a thread of ordinary untreated wool and upon a thread of wool which has been treated with formaldehyde, it will be found that the untreated thread will be entirely dissolved, while the treated thread will still clearly show its structure. The result of hardening the fiber may be obtained by treating the fiber with warm vapors of formaldehyde. If the duration of the reaction is extended, cold vapors may also be used. The same applies to solutions of formaldehyde, and even a cold solution as weak as 0.03 per cent. formaldehyde is sufficient if applied for a long time. The solutions are best neutral or weakly acid. An alkaline solution of formaldehyde, though by



no means without useful influence on the fiber, is soon decomposed into formic acid and methylic alcohol. If, therefore, alkaline lyes used in the treatment of wool are mixed with  
 5 a very small quantity of formaldehyde, they will affect and weaken the wool less than pure lye will do. Still the action of the formaldehyde in this case will be only temporary and very incomplete. Both methods of treating  
 10 the wool with formaldehyde, preliminary to the action of alkaline lyes and by making the formaldehyde an ingredient of the lye, may be employed simultaneously.

My new process enables me to employ so-  
 15 lutions of a considerably stronger concentration of substances of an alkaline reaction—as, for instance, caustic alkalies, alkali sulfids, alkali carbonates, alkali silicates, alkaline earths—in the operation of dyeing, printing,  
 20 washing, bleaching, or the like. Also it is possible to treat the wool for a longer time and at a higher temperature than hitherto without injuring the fiber.

As examples the following operations may  
 25 be mentioned: dyeing wool with sulfur dyes and sulfid of soda in an alkaline solution, dyeing half-wool (wool and cotton) in an alkaline solution, washing raw sheep's wool with hot soda-lye instead of lukewarm soap-and-soda  
 30 solution, as hitherto, employment of alkalies in "discharging" and "reserving" for printing wool, preventing fusting stains in fulling, preventing bright spots in the fabric from becoming yellow in steaming printed woolen  
 35 fabrics, washing wool in a similar manner as cotton without shortening the same, dyeing on half-wool with azo dyes produced on the fiber, &c.

The new process may also be used for the  
 40 treatment of finished and colored fabrics, especially half-woolen fabrics. Ready-made clothes may for cleaning purposes be treated with formic aldehyde and afterward with alkalies instead of the expensive and inflammable benzin. In this case also the preliminary  
 45 treatment of the wool with formaldehyde may be combined with the addition of formaldehyde to the alkaline lye.

The following are two examples for carrying  
 50 out my invention:

*I. Dyeing wool with sulfur dyes in an alkaline solution.*—The wool or half-wool is treated for several hours with a hot solution containing about four per cent. of formic aldehyde.  
 55 Then the wool is preferably washed with water containing a little ammonia to facilitate dyeing and may then be colored with sulfur dyes in an alkaline solution—for instance, with cachou de Laval—in the following manner, the parts being by weight: Fifty parts of wool are treated with a solution of six parts  
 60 cachou de Laval, ten parts sulfid of soda, four parts soda in eight hundred parts of water for one hour at a temperature of, say, 90°  
 65 centigrade. The dyeing-bath will not be ex-

hausted, and even if the wool should not be thoroughly washed after the dyeing operation the fiber will not be injured while drying.

*II. Washing wool with alkali lyes of stronger concentration.*—Raw sheep's wool is  
 70 treated for several hours with the vapors of formic aldehyde or with a solution containing, say, four per cent. of formic aldehyde. After thus being treated the wool is washed for removing the grease with a solution containing,  
 75 say, 0.4 per cent. caustic soda at a temperature of 40° centigrade or with a solution of, say, one per cent. soda at, say, 90° centigrade.

Formic aldehyde may be replaced by other aldehydes; but it has been found that formic  
 80 aldehyde will give the best result. It will be understood that the claims cover the use of any aldehyde as equivalents.

It may be observed that the wool will be  
 85 colored more quickly and thoroughly with sulfur dyes and other dyestuffs by oxidizing or chlorinating the same before or after treating with formic aldehyde. For this purpose the wool is passed, for instance, through a  
 90 solution of bleaching-lime of 1.0035 specific weight, to which is added hydrochloric acid. After passing through this solution the wool is pressed and dried. This chlorinating process may be carried out before or after the  
 95 treatment with formaldehyde.

It may be observed that the wool treated in the above-mentioned manner will likewise become less liable to be affected by the action  
 of alkalies.

Now what I claim, and desire to secure by  
 100 Letters Patent, is the following:

1. The process of treating wool or keratinic fiber in any form which consists in subjecting the fiber to the action of formaldehyde, and subsequently subjecting it to an alkaline  
 105 solution containing formaldehyde, for substantially the purposes set forth.

2. In treating wool or keratinic fiber the process which consists in subjecting the fiber to the action of formaldehyde, and subsequently  
 110 subjecting it to an alkaline solution, for substantially the purposes set forth.

3. In treating wool or keratinic fiber, the process which consists in subjecting the fiber to the action of formaldehyde and subsequently  
 115 subjecting it to a hot alkaline solution which would be injurious to the wool not treated with formaldehyde, for substantially the purposes set forth.

4. In treating wool or keratinic fiber, the  
 120 improvement which consists in treating the fiber to the action of formaldehyde and an alkaline solution, for substantially the purposes set forth.

5. In treating wool or keratinic fiber, the  
 125 improvement which consists in treating the fiber to the action of formaldehyde and an alkaline heated solution, for substantially the purposes set forth.

6. As a new article of manufacture, a wool  
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product characterized by its having hardened fibers which retain substantially their natural elasticity, and are substantially insoluble in an alkaline solution such as will dissolve ordinary wool, and further characterized by the fact that when the product is treated with hot hydrochloric acid and dried and then heated, it has a peculiar sharp formaldehyde odor.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT KANN.

Witnesses:

AUGUST NALL,  
JOACHIM STERN.