

Patented Jan. 12, 1937

2,067,219

UNITED STATES PATENT OFFICE

2,067,219

TREATMENT OF FILAMENTS, FILMS, AND
TEXTILE FABRICS

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No Drawing. Application November 2, 1933,
Serial No. 696,381

7 Claims. (Cl. 28—1)

This invention relates to the treatment of fila-
ments, threads, yarns, tapes, straws, ribbons,
bristles and like textile materials, (hereafter re-
ferred to as "yarns"), films, slabs, sheets and
other flat, cast or rolled surfaces (hereafter re-
ferred to as "films") and textile fabrics woven,
netted, knitted, braided, knotted or otherwise
formed from yarns.

The principal object of the invention is to ren-
der yarns, films and textile fabrics more amena-
ble to textile operations, as by rendering them
free from the trouble occasioned by electrifica-
tion.

Another object of the invention is to render
yarns, films and textile fabrics more pliant, more
soft and better able to withstand the stresses en-
countered in many textile operations and in use
as wearing apparel. Other objects of the inven-
tion will be apparent from the following detailed
description.

I have found that if the alkylol amine salts of
hydroxy carboxylic acids are applied to or in-
corporated in artificial materials, many advan-
tageous results are obtained.

The treatment of yarns according to this in-
vention produces yarns which will not take a
charge of electricity upon friction with like
yarns, yarns of other materials, glass rods, metal
rods etc., as the yarns become conductors of elec-
tricity and the electric charge is carried off as
soon as it is formed. Once the yarns have been
treated this property of conducting electricity is
not reduced upon ageing but is carried through
the processing to the finished fabrics.

The yarns, films and fabrics treated according
to this invention have no corrosive action on
metal and metal alloys with which they contact
or upon which they may rest for days in the
processing steps. The treating material contains
no free chlorine and is neutral in action. Fur-
thermore, the yarns and films are not tacky nor
gummy and they therefore pass through all the
guide means without difficulty or without build-
ing up a ridge or drop of the treating material
about the guides.

Yarns treated for anti-static properties ac-
cording to this invention that are formed into
staple fibers by cutting etc., need not be retreated
to remove the anti-static finish after cutting to
prevent trouble by rusting or corrosion of card
machines and further packing and snarling up
of the staple so that it would be difficult to open
and card. Also the property of not taking an
electric charge is of advantage in the carding,
drawing, and other subsequent processes.

Yarns so treated may be warp knitted without
any static charge being generated and the yarn
may be allowed to stand on the machine over
the week end or other periods of time without
rusting or corroding the metals of the machine.

Fabrics treated according to this invention or
made from yarns so treated are also conductors
of electricity and do not retain a charge of static
electricity. A great source of annoyance caused
by static electricity is found in women's wearing
apparel. For example, when a fabric of arti-
ficial silk or a fabric containing derivatives of
cellulose and/or regenerated cellulose is used as
an outer garment over silk or wool under gar-
ments the outer garment, if untreated, takes on
a static charge which causes the outer garment
to tend to adhere or cling to the wearer's body
destroying the lines and design of the garment.

Fabric treated according to this invention is
free from static electricity and does not tend to
adhere to the wearer's body but hangs free. The
fabric so treated is not off-odor nor tacky and
retains its electrical conducting properties re-
gardless of its age.

Another source of annoyance in fabrics which
are non-conductors for electricity is that they,
after becoming charged, attract dust particles,
both vegetable and metallic. Brushing to remove
such particle merely increases the electric charge
and the particles appear to cling to the fabric
with even more tenacity. Fabrics treated ac-
cording to this invention allow the static charge
of electricity to leak out as fast as it is formed
and the fabric therefore does not attract dust
particles and, further, any dust particles thereon
may be easily removed by brushing or shaking as
there is no electrical force attracting them
thereto and there is no moist or tacky substance
tending to hold them cemented to the fabric.

The treating material here described has a
special applicability to films and foils as the ma-
terial is not absorbed into the body of the films
to any great extent but remains on or near the
surface. Films therefore are not discolored or
made cloudy. Furthermore the static charge of
electricity is a surface charge and conducting
material not on the surface does not allow for the
fast discharge of developed charges.

In accordance with my invention, then, I treat
or incorporate in yarns, films, foils and fabrics
with a small amount of an alkylolamine salt of a
hydroxy carboxylic acid with or without lubricat-
ing materials.

The yarns, films and fabrics to be treated may
be made from regenerated cellulose, inorganic de-

derivatives of cellulose with plasticizers, wool, cotton, silk, flax, or other fibers. This invention is, however, most applicable to yarns, films, foils, fabrics and other artificial materials formed at least in part of organic derivatives of cellulose which yarns, films and fabrics are normally either non-conductors or weak conductors of electricity depending upon the effect materials used with the organic derivatives of cellulose. The most common of the organic derivatives of cellulose are the esters and ethers of cellulose. Examples of organic esters of cellulose are cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate, while examples of organic ethers of cellulose are ethyl cellulose, methyl cellulose and butyl cellulose.

The yarns and films of derivatives of cellulose may contain incorporated as a part thereof or as coating thereon, effect materials such as pigments, filling materials, dyes or lakes, fire retardants, plasticizers, sizes and lubricants. Examples of fire retardants are beta chlornaphthalene, triphenyl phosphate and tricresyl phosphate. Examples of plasticizers are glycol and glycerol oleates, stearates, etc. and triethanolamine oleates and stearates. Examples of lubricants are mineral oil, olive oil and neat's-foot oil. Examples of filling materials are powdered metal, oxides of metal or fibres of other materials. Examples of sizes are wax, gelatins, starches, gums, salts of resin acids and glycerides. These effect materials may be incorporated as a part of the filaments or films by adding them to the spinning solution from which the filaments or films are formed or by softening or swelling the formed filaments or films with a swelling agent, such as thiocyanates of ammonia, sodium, potassium and calcium and ethyl ether of ethylene glycol, and adding the effect materials to the filaments and films while they are in the swollen condition.

Under the term yarns are included threads, assemblies or bundles of a number of continuous filaments which may be in parallel relationship or which may be twisted together, artificial bristles, straws, short lengths of staple fibres, or yarn spun from such staple fibres.

While the alkylol amine salts of a hydroxy carboxylic acid are preferably applied to the yarns, filaments, foils, films and the like after their formation, they may be incorporated in the solution of the derivative of cellulose from which such artificial products are formed.

The fabrics to be treated may be formed of a single type of yarn, say one formed by twisting together fine filaments of an organic derivative of cellulose, or the fabric may be formed of a plurality of types of yarn, as a warp of silk and weft of a cellulose acetate. The fabrics may be coated, after treatment according to this invention, with coating materials such as rubber, latex, resins, lacquers, etc. for making rain coats etc. The anti-static finish does not interfere with the chemical make-up of such coating and furthermore it is not an impervious coating which would allow any future coating applied to the fabric to peel off.

The yarn, films or fabric are rendered completely effective in anti-static properties by the application of $\frac{1}{2}\%$ by weight, of the treated material, of an alkylolamine salt of an hydroxy carboxylic acid. When it is desired to treat yarn and carry the effect into the fabric a slightly larger percent say 2% will be found sufficient. Even as small as 0.1% of alkylolamine hydroxy car-

boxylic acid may be used if it is to be applied to the yarn, films, foils or filaments along with a lubricant such as olive oil, blown olive oil, sulphonated castor oil, light mineral oils, rape seed oil and animal oils or glycol and glycerol or their oleates and stearates.

For example a mixture of 10% alkylolamine salt of a hydroxy carboxylic acid and 90% blown olive oil or diethylene glycol may be applied to yarn, at the spinning cabinet of artificial yarns, by means of wicks or rollers such that there is applied to the yarn 2% of the mixture based on the weight of yarn.

Either blown olive oil or sulphonated castor oil are exceptionally well adapted to be applied with the anti-static material as both are similar to the anti-static material in that they do not discolor or give off off-odors upon ageing. By employing a coating of blown oil and an alkylolamine salt of a hydroxy carboxylic acid old or aged yarn may be made pliable, anti-static and sufficiently lubricated to stand circular knitting which was heretofore extremely difficult. Such a mixture of lubricants and anti-static material permits the application thereof to yarn at the warping machine without the usual annoyance of warp streaks, and also at the spinning cabinet without the usual annoyance of allowing uneven stretching of the filaments because of uneven wetting.

In treating fabrics made from yarn without the anti-static material it is preferable to apply about 0.5% of the anti-static material, after dyeing and before tentering. This may be done by passing the fabric over rollers which dip into a trough containing a solution or suspension of the anti-static material or by passing the fabric through a bath of about 1% anti-static material either in a solution or emulsion and then through the tenter machine.

The anti-static material may be dissolved up to 50% concentration in aliphatic polyhydric alcohols and their substitution products. Emulsions of the anti-static material may be made with water and oil or modified oils.

A further advantage of the treated yarns, and particularly continuous filament yarns, is that a separate application of lubricants may be rendered unnecessary in many textile operations, for example in the operation of winding or twisting and winding artificial yarns continuously with their production. The anti-static and lubricant may be applied simultaneously if desired or necessary, however, as stated above, a lubricant may also be applied to the yarn either in the same liquid as the one in which the anti-static material is applied or separately, the lubricant acting externally of the yarn to facilitate flexing, and enables it to withstand hard treatment, such as encountered in fine gauge knitting.

The anti-static material may be applied from solutions or suspensions in liquids which are hygroscopic, for example, ethylene glycol, glycerol, etc. In order, however, to prevent change in volume, viscosity and concentration of such liquids during use, it is preferred to add a quantity of water substantially equal to the maximum amount which the liquids tend to absorb in the atmosphere. Thus ethylene glycol may receive added water to the extent of 13% its original weight, glycerol 33% and diethylene glycol up to 30%. The hygroscopic material may be dissolved in water before mixtures of them are formed. Although the anti-static materials forming a part of this invention are somewhat hygroscopic in themselves, they do not rely entirely upon this

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property as they permit the leading away of electric charges even in dry atmospheres.

The anti-static material with or without lubricants may be applied to running yarns at the spinning cabinet or any future winding operation by means of wicks or pads dipping in a solution or suspension of the anti-static material. Or it may be supplied by means of a drip tube or furnishing rollers supplied with a solution or suspension of the anti-static material. Whatever the means employed to apply the liquid, it is preferable to arrange that the liquid can be applied in a uniform manner and to a predetermined amount. Thus the concentration of solution and suspensions may be varied or the height of that part of the wick or rollers above the bath may be varied. A particular suitable wick device is the one described in U. S. application No. 538,484 filed May 19, 1931. Less care need be exercised in regards to uniformity of application in applying the anti-static material herein described than other anti-static materials as the one here described has a slight wetting action of its own which permits of a certain amount of spread on the yarns after application.

It is found that the alkylolamine hydroxy carboxylic acids, with or without lubricating materials, give an anti-static property to yarns, fabrics and films without rendering them tacky, do not give a harsh hand to fabrics, do not deteriorate on long standing to give off colors or odors and do not give rise to difficulties in future processing such as dyeing, coating, etc. Examples of alkylolamine salts of hydroxy carboxylic acids are triethanolamine tartrate, triethanolamine citrate, triethanolamine lactate, the mono- or di-ethanolamine tartrates, citrates and lactates, and dioxypentanolamine tartrates, citrates and lactates. The tartrates, citrates and lactates of the substituted alkylolamines may be employed, an example of such is hydroxyethyl-aniline lactate. Any of the above alkylolamine hydroxy carboxylic acids may be used alone or as mixtures. In place of or in connection with tartrates citrates and lactates similar carboxylic acid radicals may be used such as, for example, mesotartaric, saccharic and mucic acid and their isomers, gallic acid and salicylic acid.

To produce an anti-static material which allows for the readily conducting away of electric charges imposed by friction or other means, and which has no rusting or corrosive action on the metals with which it comes in contact, it is necessary to employ a neutral electrolyte. The electrolyte therefore must be composed of an acid and a base of substantially equivalent strengths. Upon hydrolysis the acids and bases must be such that neither leave the field of reaction as by precipitation, evaporation or reaction with adjacent material thus leaving an excess of the other present. Nor should the electrolyte be sensitive to

light and heat of ordinary strength and duration. All these features necessary to a good anti-static material are found in the alkylolamine salt of a hydroxy carboxylic acid. However the alkylolamine salts of other acids may be employed to form neutral salts which are applicable to yarn according to this invention. Examples of such other acids are tannic acid, where a little stiffness or size is desired on the yarn, anisic acid, benzoic acid, succinic acid, maleic acid and fumaric acid.

As an example:

The yarn of an organic derivative of cellulose is drawn from the spinning cabinet and is caused to pass across a wick which dips into a solution composed of 90% blown olive oil and 10% triethanolamine lactate. The wick is submerged in the solution such that at the rate of speed at which the yarn is spun and the area of the wick in contact with the yarn, it will apply to the yarn a coating of 2½% based on the weight of the yarn.

What I claim and desire to secure by Letters Patent is:

1. Method of treating filaments, yarn, film, foil or textile fabric containing a derivative of cellulose comprising applying thereto an alkylolamine salt of a hydroxy carboxylic acid containing not more than six carbon atoms.

2. Method of treating filaments, yarn, film, foil or textile fabric containing cellulose acetate comprising applying thereto an alkylolamine salt of a hydroxy carboxylic acid containing not more than six carbon atoms.

3. The method of treating filaments, yarn, film, foil or textile fabric containing an organic derivative of cellulose, comprising applying thereto an alkylolamine salt of a hydroxy carboxylic acid containing not more than six carbon atoms and a lubricant.

4. The method of treating filaments, yarns, films, foils or textile fabrics containing cellulose acetate, comprising applying thereto an alkylolamine salt of a hydroxy carboxylic acid containing not more than six carbon atoms, in a medium containing an alcoholic body.

5. The method of treating yarn, film or textile fabric containing an organic derivative of cellulose which comprises applying thereto a small amount of triethanolamine lactate.

6. Filaments, foil, film or textile fabric containing cellulose acetate, coated with a small amount of an alkylolamine salt of a hydroxy carboxylic acid containing not more than six carbon atoms.

7. Filaments, foil, yarn, film or textile fabric containing organic derivatives of cellulose coated with a small amount of an alkylolamine salt of a hydroxy carboxylic acid containing not more than six carbon atoms and a lubricant.

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