

UNITED STATES PATENT OFFICE

2,279,501

YARN CONDITIONING PROCESS AND COMPOSITIONS THEREFOR

Joseph B. Dickey and James G. McNally, Rochester, N. Y., assignors to Eastman Kodak Company, Rochester, N. Y., a corporation of New Jersey

No Drawing. Application October 9, 1940,
Serial No. 360,450

18 Claims. (Cl. 252-8.8)

This invention relates to the treatment of cellulose organic derivative filaments, fibers, threads and the like and more particularly to a method of eliminating the tendency of such materials to accumulate charges of static electricity in twisting, winding and spinning. The invention also relates particularly to the treatment of cellulose organic derivative cut staple fibers to adapt them for the manufacture of spun yarns.

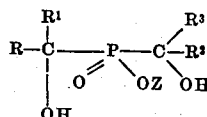
As is well known, cellulose organic derivative materials, particularly in filament, yarn, or sheet form, are particularly subject to the accumulation on their surfaces of charges of static electricity from frictional and other influences. In the case of filaments and yarns in which the surface area of the material (per unit of weight) is enormously greater as compared to sheets or films, the problem of static often assumes serious proportions. In the manufacture of yarns of various types from artificial filaments, numerous steps in which the yarn is subjected to frictional influences may be necessary, as for example, twisting, winding, warping, carding, combing, drawing, spinning and the like, all of which operations tend to produce large accumulations of static on the filaments. This is particularly aggravated in the utilization of cut staple, as for example, in the making of spun yarn, since in carding and combing considerable friction is developed and as a result sufficient charges accumulate on the fibers to make the formation of the web difficult, if not impossible; furthermore, even if a web is formed with some degree of success, the subsequent drafting operation produces a very uneven spun yarn or intermediate roving due to the presence of the static charge. In addition, there is the ever-present fire hazard.

Cellulose derivative yarn, particularly in the form of cut staple, is extremely difficult to handle in the various operations involved in making spun yarn, not only because such material is composed of filaments having smooth, glass-like surfaces without natural kink or irregularity, but also because it has relatively negligible moisture content at normal humidities, as compared to natural fibers such as cotton and wool, making it inherently far more susceptible to the accumulation of static. The charges accumulating on cellulose derivative cut staple fibers are, under some circumstances, even sufficient to separate the individual fibers a distance of inches, notwithstanding their relatively minute size.

This invention has as its principal object to provide an improved method for the treatment of cellulose organic derivative yarns to reduce or eliminate the tendency of such yarns to accumulate charges of electricity under frictional and other influences. A further object is to provide

a method of facilitating the handling and employment of cellulose organic derivative cut staple fibers in the various operations involved in the manufacture of spun yarns. A still further object is to provide a method of treating cellulose organic derivative yarns in either filament or cut staple form, wherein the material is simultaneously softened and lubricated and the accumulation of static charges thereon is prevented. Another object is to provide an improved type of cellulose organic derivative cut staple having little or no tendency toward accumulation of static electrical charges. Other objects will appear hereinafter.

These objects are accomplished by the following invention which in its broader aspects comprises applying to cellulose organic derivative yarns either in the form of filaments, threads or staple fibers, an antistatic composition containing as its essential anti-static component a hydroxy alkyl aryl phosphonate having the general formula:



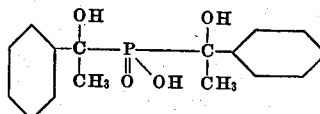
wherein R is an aromatic group; R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, aryl and heterocyclic groups including cycloalkyl, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals, and wherein R² and R³ may be part of a cyclic system of carbon atoms. Of the above groups the alkyl group may be methyl, ethyl, butyl, amyl, cetyl, alkoxyalkyl, allyl, methallyl and cycloalkyl, etc., and the aromatic may be phenyl, naphthyl, tetrahydronaphthyl, furyl, zenyl and the like.

These compounds may be prepared as described in Compt. rend., 134, 847; Ann. chim. phys., 8 3, 347; Compt. rend. 133, 219; Compt. rend., 136, 234.

PREPARATION OF COMPOUNDS

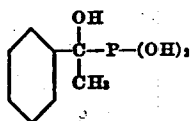
Example 1

360 g. acetophenone and 66 g. hypophosphorus acid are heated at 60-100° for one day or more. The product on cooling crystallizes to give

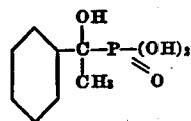


(Bis-alpha-hydroxy-alpha-phenyl ethane-beta-phosphonic acid)

There is also formed



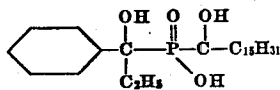
which is easily oxidized with air to give



The salts are prepared by neutralizing the acid with the desired base. Some of the salts we may prepare are the sodium, potassium, calcium, magnesium, ammonium, mono-, di-, and triethanolamine, diethyl-cyclohexylamine, cyclohexylamine, furfurylamine, difurfurylamine, ditetrahydrofurfurylamine, amylamine, dibutylamine, di-beta-methoxyethylamine, trimethylbenzyl ammonium hydroxide etc.

Example 2

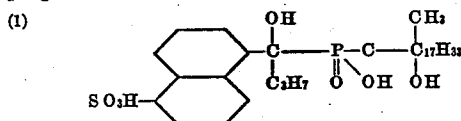
134 g. phenyl ethyl ketone are heated at 60–150° with 66 g. hypophosphorus acid for 1 day or more and then with 200 g. hexadecane aldehyde for an additional 12 hours. The reaction product has the formula:



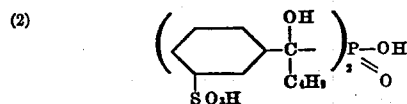
(Bis-alpha-hydroxy-alpha-phenyl propane-alpha-hydroxy hexadecane-alpha-phosphonic acid)

Salts of the type mentioned in Example 1 are prepared.

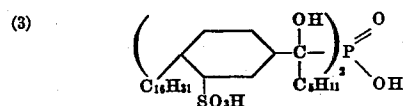
Using the methods illustrated above we have prepared:



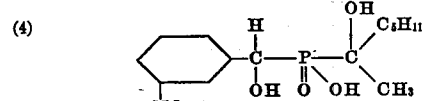
(Alpha-(1-naphthyl-5 sulfonic acid)-alpha-hydroxy butane-alpha-hydroxy-alpha-methyl octadecane-beta-phosphonic acid)



(Bis alpha (meta-sulfo) phenyl-alpha-hydroxy pentane-alpha-phosphonic acid)



(Bis-alpha-hydroxy-alpha-(paracetyl-meta-sulfo)phenyl hexane-alpha-phosphonic acid)

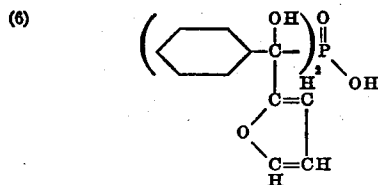


(Meta-nitro-phenyl hydroxy methane beta-hydroxy-heptane-beta-phosphonic acid)

The nitro group may be reduced, diazotized and coupled to give water-soluble azo dyes.



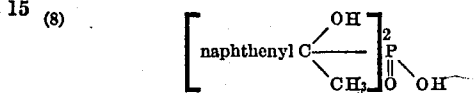
(Alpha-hydroxy-alpha-phenyl decane-alpha-hydroxy cyclo-hexane-alpha-phosphonic acid)



(Bis-hydroxy-phenyl-furyl-methane phosphonic acid)

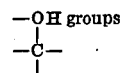


(Bis(para-sulfo)phenyl-hydroxy octadecylmethane phosphonic acid)



(Bis-alpha-hydroxy-alpha-naphthyl ethane-alpha-phosphonic acid)

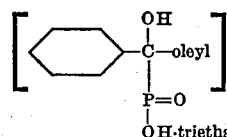
Any of the above compounds may be reacted with acid anhydrides to give ester of the



In accordance with our invention the above-mentioned phosphonate salts may be applied to the yarn in any convenient manner, for example, by roll, wick, immersion, spraying or the like. Inasmuch as these compounds are soluble in oil they may be dissolved or dispersed in oils such as mineral oil, blown and unblown, drying, and semi-drying, vegetable and animal oils, examples of which are light mineral, neat's-foot olive, tea-seed, castor, soya bean, rapeseed oils, etc. and other lubricants.

In the following examples and description, we have set forth several of the preferred embodiments of our invention, but they are included merely for purposes of illustration and not as a limitation thereof.

Example 3

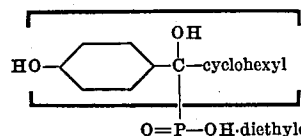


(Bis-phenyloleoyl hydroxy methane phosphonic acid triethanolamine salt)

is applied to textile materials (silk, wool, viscose, cellulose acetate, wool) by means of a wick, bath, roller, spray, etc., to facilitate their knitting, weaving, spinning and the like. Yarns lubricating with the above types of lubricants are of special value in the preparation of cut staple fibers. These fibers may be oiled before or after cutting.

Example 4

A conditioning liquid is made up as follows:
90–95 parts butyl naphthenate
10–5 parts



(bis-hydroxy phenyl cyclohexyl methane phosphonic acid diethylcyclohexylamine salt)

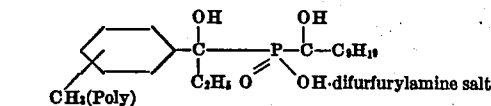
and applied to textile materials such as silk, wool, cotton, viscose, cellulose acetate, etc., as described

in Example 3. If the yarn is intended primarily for knitting, the amount of conditioning liquid applied may vary from 2-25% by weight of the yarn and if for weaving between 1-5% by weight.

Conditioning liquids particularly useful for the treatment of various types of yarns in accordance with our invention particularly those composed of or containing cellulose acetate, cellulose acetate propionate, cellulose acetate butyrate, and similar organic acid esters, and especially adapted for the deelectrification or anti-static treatment of cellulose organic derivative cut staple yarns are as follows:

Example 5

1-10 parts

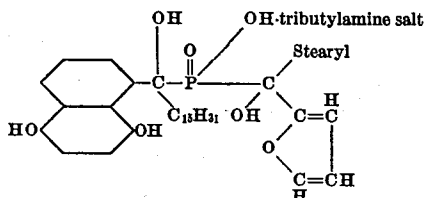


(Alpha-polymethyl phenyl-alpha-hydroxy propane-alpha hydroxy decyl phosphonic acid difurfurylamine salt)

99-90 parts olive oil

Example 6

1-20 parts

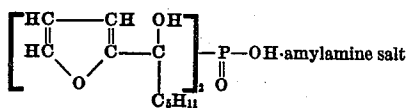


(Alpha-5,8-dihydroxy naphthyl-alpha-hydroxy hexadecyl-alpha-stearyl-alpha-hydroxy-alpha-furyl methane phosphonic acid tributylamine salt)

99-80 parts blown olive oil

Example 7

1-10 parts



(Bis-alpha-furyl-alpha-hydroxy hexane phosphonic acid amylamine salt)

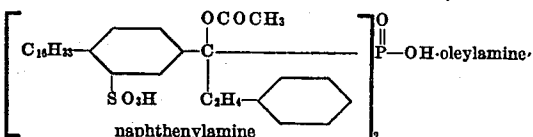
99-90 parts mineral oil

Example 8

10 parts butyl stearate

89-80 parts mineral oil

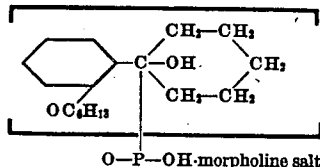
1-10 parts



(Bis-para-cetyl - meta - sulfophenyl - alpha-acetoxy-gamma-phenyl propane phosphonic acid oleylamine naphthethylamine salt)

Example 9

1-10 parts

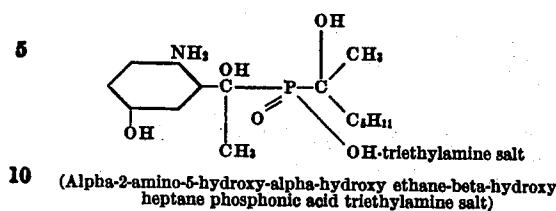


(Alpha-o-hexylphenylether-alpha-hydroxy cyclohexane phosphonic acid morpholine salt)

99-90 parts neat's-foot oil

Example 10

1-10 parts



99-90 parts blown neat's-foot oil

Example 11

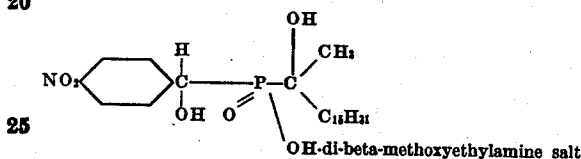
15

55 parts sperm oil

20 parts butyl naphthenate

20 parts mineral oil

5 parts



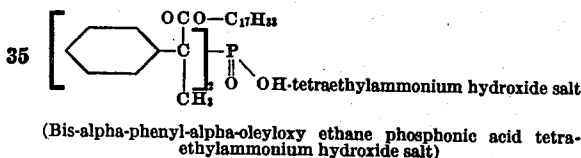
(Para-nitrophenyl hydroxy methane-beta-hydroxy heptadecane phosphonic acid di-beta-methoxy ethylamine salt)

Example 12

30

68 parts blown sperm oil

10 parts



(Bis-alpha-phenyl-alpha-oleloxy ethane phosphonic acid tetraethylammonium hydroxide salt)

40

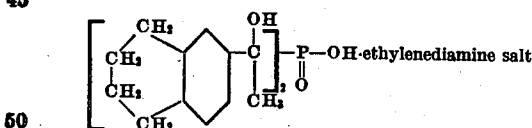
2 parts water

20 parts di-beta-methoxyethyl succinate

Example 13

45

1-10 parts



(Bis-alpha-(beta-tetralin) phosphonic acid ethylene diamine salt)

99-90 parts teaseed oil

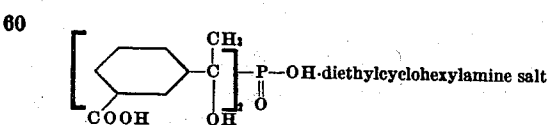
Example 14

55

38-20 parts teaseed oil

60-70 parts glycerol acetone acetate

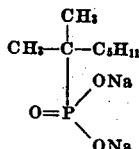
1-5 parts



(Bis-alpha-meta-carboxy phenyl ethane phosphonic acid diethylcyclohexylamine salt)

1-5 parts

70

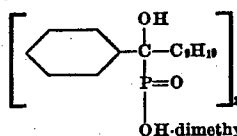


75

(Beta-methyl heptane-beta-phosphonic acid disodium salt)

Example 15

1-10 parts



OH-dimethylcyclohexylamine salt

(Bis-alpha-phenyl-alpha-hydroxy decane phosphonic acid dimethyl cyclohexylamine salt)

30-40 parts blown olive oil

69-50 parts blown neat's-foot oil

Example 16

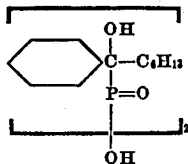
55-50 parts olive oil

10 parts sulfonated castor oil

20 parts mineral oil

10-15 parts oleic acid

5 parts



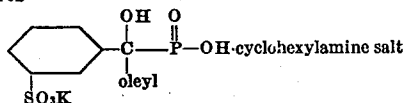
(Bis-alpha-phenyl-alpha-hydroxy phenyl heptane phosphonic acid)

Example 17

70 parts water

15 parts water soluble cellulose ester

5 parts

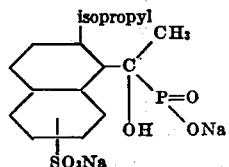


(Bis-potassium sulfo phenyl oleyl hydroxy methane cyclohexylamine salt)

10 parts sulfonated olive oil

Example 18

One pound of 1-methylamino-4-ethylamino anthraquinone is ground with 1/4 pound



(2-isopropyl-alpha-sodium naphthyl (1)-alpha-hydroxy ethane phosphonic acid sodium salt)

and 3 pounds sugar. The resulting finely divided mixture is then added to 100 gallons water heated to 60-85° and the aqueous suspension is used to dye about 100 pounds of cellulose acetate blue.

Any of the above compositions may be applied to the yarn intended for use in circular knitting by means of a bath, wick, spray, roller, pad or any suitable means. The amounts of conditioning liquid applied may vary between 5-25% by weight of the yarn. Usually, however, the amount of conditioning liquid applied is about 10-15% by weight of the yarn. Yarn composed of cellulose acetate conditioned as described above gives excellent results when used in the circular knitting process.

As will be apparent from the above examples and description the conditioning agents of our invention may be applied by a wide variety of methods. For example, we may employ the agent as an ingredient of the spinning dope from which the filaments are formed, the amount of the agent so employed depending upon a number of factors, such as the particular cellulose deriva-

tive used in making the yarn, the solvent or solvent combination used in making up the spinning solution, and properties desired in the finished yarn, etc.

- 5 If the conditioning agent is to be applied to the yarn after spinning, this may be done by bringing the yarn in contact with a wick, roll, or felt wet therewith, or the liquid may be applied by immersion, spray, or otherwise. The particular point at which the liquid is applied may vary.
- 10 It may, for example, be applied to the yarn inside or outside the spinning cabinet, between the guide and godet roll, between the godet or other roll or guide and the point of winding and/or twisting. In some cases, the liquid may even be applied to the yarn after winding onto cones, spools, bobbins, or the like or by the so-called "bobbin to bobbin" method. In the case of staple fiber manufacture, the liquid may be applied to the yarn prior to, or after cutting into staple lengths.
- 20 The amount of the agent so employed will vary widely depending upon the results desired, the specific nature of the material to which the agent is applied, the use to which the yarn is eventually to be put and other factors. For example, in a given case where a cellulose organic acid ester yarn such as a yarn composed of cellulose acetate, is intended for knitting, about 4 to 25% or more by weight, based on the weight of the dry yarn, may be satisfactory, while if the yarn is intended for weaving, the amount may vary between about 1 and 5%.
- 25 Although in the above examples we have referred primarily to yarn treating compositions containing only the conditioning agent and an oil, other ingredients such as solvents, non-solvents, emulsifying agents, blending agents and the like, may be added within the scope of our invention. Likewise, various dyes or other coloring matter may be included in case it is desired to permanently or fugitively tint or dye the material undergoing treatment.
- 30 Although we have found it convenient to illustrate our invention by reference to compositions containing specific percentages of the various ingredients, these percentages may vary widely depending upon the particular purpose for which the composition is intended. For example, if it is desired to control the deelectrifying action of the conditioning agent, the amount of the agent may be adjusted as, for example, by reducing the amount of the agent and correspondingly increasing the amount of oil or other ingredient.
- 35 While we have described our invention with particular reference to the treatment of yarns composed of organic derivatives of cellulose such as cellulose acetate, the conditioning agents and formulas described herein are applicable to the conditioning of many other types of cellulose derivative yarns such as those composed of or containing cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate, ethyl cellulose, methyl cellulose, benzyl cellulose and others, as well as to the conditioning of silk, wool, cotton, viscose and other natural or artificial materials.
- 40 The term "yarn" as used herein and in the claims is to be understood as including a single filament, a plurality of filaments associated into the form of a thread, either of high or low twist, single or multiple threads associated or twisted together, composite threads composed of a mixture of natural and artificial filaments or a composite thread formed by twisting together indi-
- 45
- 50
- 55
- 60
- 65
- 70
- 75

vidual strands of natural or artificial materials, as well as cut staple fibers produced from natural and/or artificial filaments or threads and spun yarn produced from such staple fibers.

As indicated above, the yarn conditioning agents of our invention are exceptionally good solvents for a wide variety of mineral, blown and unblown, drying and semi-drying animal and vegetable oils such as cottonseed, olive, castor, neat's-foot, sperm and other oils. This enables them to be used with any of such oils in making up a variety of yarn treating formulas of varying composition.

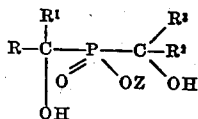
The yarn conditioning agents of our invention also have exceptional value as surface active compounds and as such may be employed as wetting agents, emulsifying and dispersing agents, textile assistants, dye dispersing agents and the like.

The yarn conditioning method and compositions of our invention possess many outstanding advantages. The fundamental and outstanding characteristic of the agents employed in accordance with the invention is their ability to deelectrify yarns, especially those composed of or containing organic derivatives of cellulose such as cellulose acetate and render them amenable to various textile operations, especially operations such as those involved in the manufacture of cut staple fibers, as well as in weaving and knitting. Another outstanding characteristic of these compounds is their exceptional solvent power for a wide variety of mineral, animal, and vegetable oils and their ability to act as lubricating assistants in conjunction with these oils when applied to such yarns. In addition, due to their solubility in water, they may be readily removed from yarns and fabrics by means of the usual aqueous scour baths.

Of the above compositions we have found that bis-alpha-(meta-sulfo) phenyl-alpha-hydroxy pentane-alpha-phosphonic acid, bis-alpha-phenyl-alpha-hydroxy-decane phosphonic acid dimethyl cyclohexylamine salt, and bis-alpha-phenyl-alpha-hydroxy phenyl heptane phosphonic acid are outstanding in their ability to reduce or eliminate the tendency of yarns composed of or containing organic derivatives of cellulose to accumulate charges of static electricity.

What we claim and desire to secure by Letters Patent of the United States is:

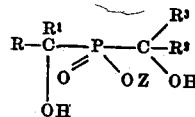
1. The method of eliminating the tendency of yarns, filaments or fibers to accumulate charges of static electricity, which comprises applying thereto a composition containing as its essential anti-static component a hydroxy alkyl aryl phosphonate having the general formula:



wherein R is an aromatic group; R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substitute selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

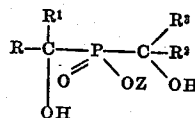
2. The method of eliminating the tendency of yarns, filaments or fibers composed of or containing organic derivatives of cellulose to accumulate charges of static electricity, which com-

prises applying thereto a composition containing as its essential anti-static component a hydroxy alkyl aryl phosphonate having the general formula:



wherein R is an aromatic group, R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

3. The method of eliminating the tendency of yarns, filaments or fibers composed of or containing cellulose acetate to accumulate charges of static electricity, which comprises applying thereto a composition containing as its essential anti-static component a hydroxy alkyl aryl phosphonate having the general formula:



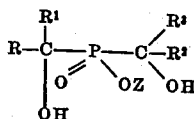
wherein R is an aromatic group; R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

4. The method of eliminating the tendency of yarns, filaments or fibers composed of or containing organic derivatives of cellulose to accumulate charges of static electricity, which comprises applying thereto a composition containing as its essential anti-static component bis-alpha-(meta-sulfo) phenyl-alpha-hydroxy pentane-alpha-phosphonic acid.

5. The method of eliminating the tendency of yarns, filaments or fibers composed of or containing organic derivatives of cellulose to accumulate charges of static electricity, which comprises applying thereto a composition containing as its essential anti-static component bis-alpha-phenyl-alpha-hydroxy-decane phosphonic acid dimethyl cyclohexylamine salt.

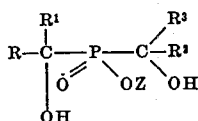
6. The method of eliminating the tendency of yarns, filaments or fibers composed of or containing organic derivatives of cellulose to accumulate charges of static electricity, which comprises applying thereto a composition containing as its essential anti-static component bis-alpha-phenyl-alpha-hydroxy phenyl heptane phosphonic acid.

7. An anti-static composition adapted, when applied to textile yarns, filaments or fibers to eliminate the tendency of such materials to accumulate charges of static electricity, said composition containing as its essential anti-static component a hydroxyl alkyl aryl phosphonate having the general formula:



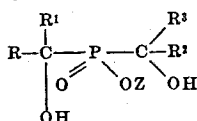
wherein R is an aromatic group, R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

8. An anti-static composition adapted, when applied to cellulose organic derivative yarns, filaments or fibers, to eliminate the tendency of such materials to accumulate charges of static electricity, said composition containing as its essential anti-static component a hydroxy alkyl aryl phosphonate having the general formula:



wherein R is an aromatic group, R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

9. An anti-static composition adapted, when applied to cellulose acetate yarns, filaments or fibers, to eliminate the tendency of such materials to accumulate charges of static electricity, said composition containing as its essential anti-static component a hydroxy alkyl aryl phosphonate having the general formula:



wherein R is an aromatic group, R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

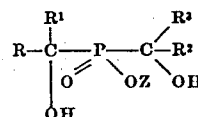
10. An anti-static composition adapted, when applied to cellulose organic derivative yarns, filaments or fibers to eliminate the tendency of such materials to accumulate charges of static electricity, said composition containing as its essential anti-static component bis-alpha-(meta-sulfo) phenyl-alpha-hydroxy pentane-alpha-phosphonic acid.

11. An anti-static composition adapted, when applied to cellulose organic derivative yarns, filaments or fibers, to eliminate the tendency of such materials to accumulate charges of static electricity, said composition containing as its essential anti-static component bis-alpha-phenyl-alpha-hydroxy-decane-phosphonic acid dimethyl cyclohexylamine salt.

12. An anti-static composition adapted, when applied to cellulose organic derivative yarns, filaments or fibers, to eliminate the tendency of such materials to accumulate charges of static electricity, said composition containing as its essential anti-static component bis-alpha-phenyl-alpha-hydroxy phenyl heptane phosphonic acid.

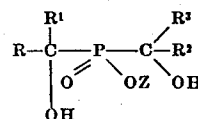
13. Textile yarns having a lessened tendency

to accumulate charges of static electricity, said yarns containing a hydroxy alkyl aryl phosphonate having the general formula:



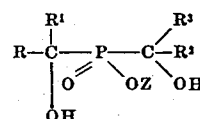
wherein R is an aromatic group; R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

14. Textile yarns composed of or containing organic derivatives of cellulose having a lessened tendency to accumulate charges of static electricity, said yarns containing a hydroxy alkyl aryl phosphonate having the general formula:



wherein R is an aromatic group; R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

15. Textile yarns composed of or containing cellulose acetate having a lessened tendency to accumulate charges of static electricity, said yarns containing a hydroxy alkyl aryl phosphonate having the general formula:



wherein R is an aromatic group; R¹ and R² are substituents selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl and heterocyclic groups, wherein R³ is a substituent selected from the group consisting of hydrogen, alkyl, cycloalkyl; Z is a substituent selected from the group consisting of hydrogen and salt-forming radicals.

16. Textile yarns composed of or containing organic derivatives of cellulose having a lessened tendency to accumulate charges of static electricity, said yarns containing bis-alpha-(meta-sulfo) phenyl-alpha-hydroxy pentane-alpha-phosphonic acid.

17. Textile yarns composed of or containing organic derivatives of cellulose having a lessened tendency to accumulate charges of static electricity, said yarns containing bis-alpha-phenyl-alpha-hydroxy-decane-phosphonic acid dimethyl cyclohexylamine salt.

18. Textile yarns composed of or containing organic derivatives of cellulose having a lessened tendency to accumulate charges of static electricity, said yarns containing bis-alpha-phenyl-alpha-hydroxy-phenyl heptane phosphonic acid.

JOSEPH B. DICKEY.
JAMES G. McNALLY.