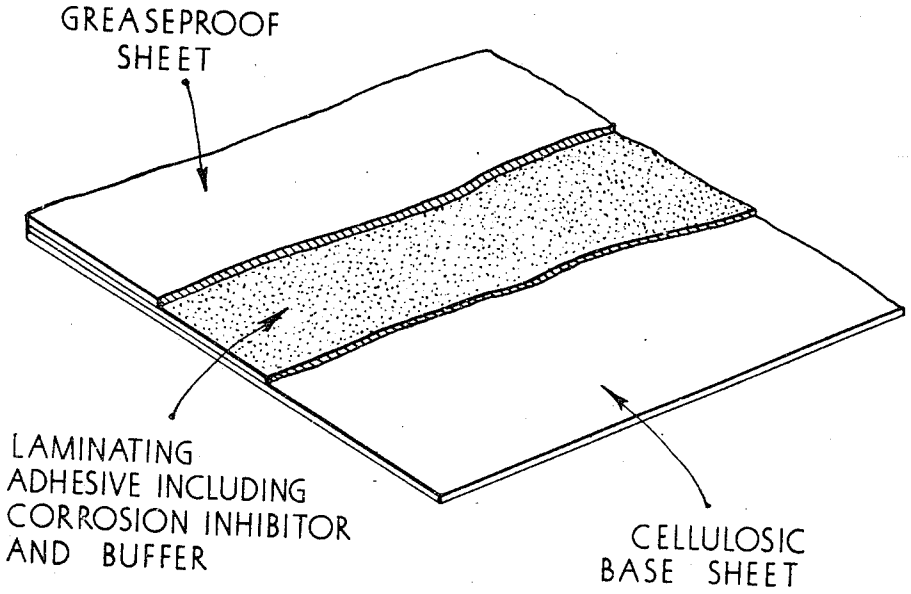
March 4, 1947. J. K. BOGGS ET AL 2,416,734

GREASEPROOF PAPER

Filed June 10, 1943



INVENTORS
JESSE KENNETH BOGGS
GEORGE H. SULLIVAN
By Robert M. Dunning
H. S. Johnson
Attorney

Patented Mar. 4, 1947

2,416,734

UNITED STATES PATENT OFFICE

2,416,734

GREASEPROOF PAPER

Jesse Kenneth Boggs, Wilmington, Del., and George H. Sullivan, Minneapolis, Minn., assignors to Rapinwax Paper Company, Minneapolis, Minn., a corporation of Minnesota

Application June 10, 1943, Serial No. 490,310

9 Claims. (Cl. 154—50)

1

Our invention relates to an improvement in grease-proof papers, wherein it is desired to provide a paper which is grease-proof and which is stable within predetermined limits of hydrogen ion concentration and total acidity, and which has no corrosive action on steel.

Considerable difficulty has been experienced in the wrapping of articles and parts formed of steel and other corrodible materials. In the wrapping of articles and parts used for the Army and Navy, for example, definite limits are placed upon the hydrogen ion concentration in the paper, and also upon the total acidity in the paper. For instance, regulations state that in the packing of precision parts where contact of the packaging material with a critical surface of the part may cause corrosion, the pH value of the finished paper must be between 6.5 and 7.5. At the same time the water-soluble acidity must be less than .10% equivalent sulfur trioxide.

Considerable trouble has been experienced in maintaining the proper pH range in the paper. We have found that the pH of the paper varies considerably in different climatic conditions. It is therefore an object of the present invention to provide a product capable of maintaining a predetermined pH range over varying climatic conditions.

An object of the present invention lies in the provision of a substantially neutral non-corrosive wrapping material comprising a cellulosic base containing a minor amount of a water-soluble buffer and corrosion inhibitor. We have found that certain products act both in the capacity of a buffer to prevent variation in the hydrogen ion concentration of the finished sheet and also as a corrosion inhibitor to prevent a corrosive action on the wrapped material. We therefore desire to embody such products in small amounts in a cellulosic base wrapping material in order to provide a grease-proof sheet which will be non-corrosive in contact with precision parts of steel or other corrodible material.

We have found that when orthophosphoric acid reacts with certain organic amines a product is formed which is suitable for use both as a buffer and a corrosion inhibitor. As a result through the use of such products we have been able to not only buffer the wrapping material to the desired pH range, but also to provide in the paper a corrosion inhibitor which will definitely inhibit the corrosion of metallic parts which contact the wrapping sheet.

A further feature of the present invention lies in the fact that our buffering material may make the pH range of a wrapping sheet stable at a substantially neutral point with a sufficiently small amount of the product to give a total acidity in the wrapping sheet of less than .1%. As a result our buffering material may be used in wrapping

2

sheets for wrapping precision parts within the present Government specifications for a grade A ordnance paper. This small amount of buffering material is also sufficient to inhibit substantially the corrosion of metal parts wrapped.

A feature of the present invention lies in the fact that diamylamine phosphate for example, is capable of buffering wrapping paper to a pH range of between 6.5 and 7.5 when desired. At the same time in the amount of diamylamine phosphate used, the total acidity of the product is less than the maximum acidity permitted in Government specifications for such a product. Not only will diamylamine phosphate act to buffer the paper, but also this product acts as corrosive inhibitor for the protection of metal parts wrapped.

A feature of the present invention lies in the fact that our buffer is capable of stabilizing neutral paper so as to retard its tendency to become acid or basic upon aging. By use of this invention it is a relatively simple task to change the pH of a wrapping paper which is outside of the proper pH range, to a pH which is satisfactory. An even greater task is to protect a paper so that it will remain within this pH range for an extended period of time. However, when this invention is practiced by one skilled in the art this advantage can readily be accomplished. We have found that wrapping papers including our buffering and corrosion inhibiting compounds will remain stable for an extended period of time and under a considerable range of climatic conditions.

Another very desirable feature of the present invention lies in the fact that our buffering and corrosion inhibiting ingredients may be embodied in plasticized paper. Plasticized paper is to be highly preferred for wrapping purposes as such paper is soft, pliable, very easy to handle and less likely to crack in folding or bending. It also retains its grease-proof properties, even when creased severely. However, plasticized paper is ordinarily considered to be too corrosive to use for wrapping materials which are easily corroded. For this reason plasticized wrapping papers have hitherto been considered impractical for this purpose. In practicing our invention, however, we have found that when plasticized paper contains our buffering and corrosion inhibiting materials this paper is no more corrosive than untreated or unplasticized paper. Thus we have found that it is possible to use paper containing hygroscopic plasticizers such as glycerin, for example, without danger of corroding the parts wrapped. It thus becomes apparent that our invention has resulted in great improvement in the finished wrapping material.

A further feature of this invention lies in the fact that the paper is quite stable in pH during the processing operations after the corrosion in-

hibitor has been added. Thus if our inhibiting ingredient is used, ordinary non-technical operators can follow various normally used procedures common to processing of paper without the necessity of changing the processes. This results in a much cheaper operating cost and a lower priced finished wrapping material.

Still a further feature of the present invention lies in the use of an inhibited, plasticized starch solution as a laminating agent in the formation of grease-proof papers. Such papers have usually been formed of sheets of cellulosic material such as ordnance kraft and ordnance grease-proof paper laminated with wax. We have found that after a period of time a contacting oil film will penetrate the grease-proof sheet and creep into the wax lamination from the edges sufficiently to actually dissolve the wax between the sheets. As a result, the lamination will separate very easily, and the kraft sheet on the outside will be saturated with oil. However, where the sheets are laminated with a starch solution containing a hygroscopic material such as glycerol and our buffering and corrosion inhibiting material, the oil or grease cannot dissolve the laminating film, and little of the oil film will be absorbed in the outer kraft sheet.

These and other objects and novel features of our invention will be more clearly and fully set forth in the following specification and claims.

In the drawing the figure illustrates a portion of a laminated sheet showing the corrosion inhibitor and buffer incorporated in the laminating adhesive.

In the formation of grease-proof papers to be used in wrapping corrosive materials, it is desirable that the paper have a pH range of 6.5 and 7.5 and a total acidity of not more than 0.1% by weight as sulphur trioxide. We have found that while it is readily possible to manufacture a paper which comes within these specifications, the pH of the paper will vary widely upon aging. As the result, a paper which meets the specifications when manufactured may not come within the desired pH range after being exposed to atmospheric conditions for a time.

A further difficulty experienced with such wrappings lies in the corrosive effect of the papers upon the parts wrapped. These papers will allow corrosion of metal parts after contact therewith for a period of time. Accordingly, a means for inhibiting the corrosive effect of the paper upon the metal is of the greatest importance.

We have found that a certain class of materials may be used to act both as a buffer to maintain the pH within the proper range and also to inhibit corrosion of the metallic part in contact with the paper. Thus, by the practice of this invention and the use of these compounds in paper, the paper may not only be rendered resistant to change of pH, but also relatively non-corrosive to metal parts.

When a selected organic amine is reacted with orthophosphoric acid, a reaction product is formed which not only acts as a buffer, but also as a corrosion inhibitor. While other organic amines may form successful corrosion inhibitors and buffers when reacted with orthophosphoric acid, we have found the following organic amines successfully operable for the purpose:

(*a*) Primary alkyl amines containing from 2 to 7 carbon atoms.

(*b*) Primary alkanol amines containing from 1 to 8 carbon atoms.

(*c*) Secondary amines of the formula:



in which D and E may each be any alkyl or alkanol group from 1 to 6 carbon atoms.

(*d*) Tertiary amines of the formula:



in which F, G, and J may each be any alkyl group of from 1 to 2 carbon atoms, and/or any alkanol group of from 1 to 3 carbon atoms.

(*e*) Water soluble quaternary amines.

(*f*) Morpholine (a cyclic amine).

(*g*) Ethylene diamine and polyamines with the formula:

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3.

(*h*) Benzyl amine.

As examples of primary alkyl amines containing from 2 to 7 carbon atoms with which the reaction product with orthophosphoric acid is suitable, we might name the following:

Primary amine	Manufacturer	Ml. used	Ml. of 85% H_3PO_4
Monoethyl amine (70%)	Sharples	100	50
Mono-isobutyl amine	do	100	40
Benzyl amine	Eastman	100	33
Monoethanol amine	Carbide & Carbon	100	60
Ethylene diamine	do	230	164
Tetraethylene pentamine	do	200	130

As examples of secondary amines whose orthophosphate is suitable, we might use:

Secondary amine	Manufacturer	Ml. used	Ml. of 85% H_3PO_4
Diethyl amine	Sharples	130	50
Diamyl amine	do	250	55
Diethanol amine	Carbide & Carbon	100	48
Morpholine	do	300	180

As examples of the tertiary amines which may be reacted to form the orthophosphate and used satisfactorily we give:

Tertiary amine	Manufacturer	Ml. used	Ml. of 85% H_3PO_4
Triethyl amine	Sharples	180	65
Tri-isopropanol amine	Carbide & Carbon	200 grams.	32
Di n-butyl amino-ethanol.	Sharples	100	20

As examples of the quaternary amines whose orthophosphates are desirable combined corrosion inhibitors and buffers we give:

Quaternary amine	Manufacturer	Ml. used	Ml. of 85% H_3PO_4
Tetraethanol ammonium Hydroxide (40% solution)	Carbide & Carbon	200	60

In the above table the manufacturer's name is not given in full. The name "Sharples" refers to Sharples Chemicals. The name "Eastman" refers to the Eastman Kodak Co. The name "Carbide & Carbon" refers to the Carbide & Carbon Chemical Co.

The above amines are reacted with ortho-

phosphoric acid in the proportions mentioned to prepare the amine phosphate salts. These salts are incorporated into grease-proof papers by any of the methods well known to the trade and producing a high grade grease-proof oil-proof, anti-corrosive, neutral paper.

In testing the foregoing alkyl and alkanol primary, secondary, tertiary and quaternary amine phosphates, solutions were made up with distilled water having a pH of 6.7 to 7.0 after boiling. Tests were made to determine the pH of the solution when it was made in concentrations of 10%, 1.0%, 0.1% and of 0.01% respectively. Tests were also made to determine the number of ml. of 0.01n NaOH required to bring 250 cc. of the 0.1% solution of these amine phosphates to a pH of 8.4. As an empirical test, steel panels were immersed in 1% aqueous solutions of the amine phosphates in order to test the corrosion properties thereof. The results of these tests are tabulated as follows:

	pH of solutions at concentrations of[1]—				Titrable acidity [2]	Corrosion of steel [3]
	10%	1.0%	0.1%	0.01%		
PRIMARY AMINE PHOSPHATES						
					Ml.	
Mono-ethyl amine phosphate	6.7	6.6	6.7	6.8	74	No corrosion or pitting.
Mono-isobutyl amine phosphate	6.9	6.9	7.0	6.9	64	Do.
Benzyl amine phosphate	6.6	6.8	6.9	6.8	105	Do.
Mono-ethanol amine phosphate	6.9	7.0	7.1	7.1	56	Do.
Ethylene diamine phosphate	7.1	6.9	6.8	6.8	66	Do.
Tetraethylene pentamine phosphate	6.9	6.6	6.7	6.7	145	Do.
SECONDARY AMINE PHOSPHATES						
					Ml.	
Diethyl amine phosphate	6.8	6.6	6.8	6.8	70	No corrosion or pitting.
Diamyl amine phosphate	6.8	6.9	7.0	6.9	56	Do.
Diethanol amine phosphate	6.9	6.9	7.1	7.1	136	Do.
Morpholine phosphate	6.8	6.9	6.8	6.8	60	Do.
TERTIARY AMINE PHOSPHATE						
					Ml.	
Triethylamine phosphate	6.7	6.6	6.7	6.7	72	No corrosion or pitting.
Tri isopropanol amine phosphate	6.9	6.9	7.0	7.0	70	Do.
Di-n-butyl ethanol amine phosphate	7.0	7.1	7.3	7.2	54	Do.
QUATERNARY AMINE PHOSPHATE						
					Ml.	
Tetraethanol ammonium phosphate	6.8	7.1	7.3	7.2	140	No corrosion or pitting.
DISTILLED WATER						
					Ml.	
	7.0	7.0	7.0	7.0	0.8	Badly corroded and pitted.

[1] All solutions made up with distilled water having a pH equal to 6.7 to 7.0 after boiling.
[2] Ml. or .01n NaOH required to bring 250 c. c. of 0.1% solution of compound to pH equal 8.4.
[3] Immersed in 1% solution of compound for 16 hours at 70 degrees F.

From the foregoing table it will be obvious that the amine phosphates of the various classes described actually reduce corrosion when in contact with steel plates and that distilled water alone is very corrosive to such metal parts.

As a result it is evident that not only will paper containing such amine phosphates be buffered to the proper pH range, but in addition the paper will inhibit corrosion in the product which is wrapped. This is extremely important, particularly in the wrapping of precision or ordnance parts where corrosion must not take place if these parts are to be in proper condition when unwrapped for use.

We have found that it is commercially feasible to buffer paper and make it stable at a substantially neutral point in the pH range with a sufficiently small amount of corrosion inhibiting material to give a total acidity by titration not exceeding 0.1% by weight as sulphur trioxide (SO_3). We have also found that this amount of corrosion inhibiting compound is also sufficient to inhibit the corrosion of metal parts which are wrapped in it. Good results both with respect to buffering the pH of the paper and inhibiting the corrosive properties thereof have been obtained with as little as .01% amine phosphates. On the other hand as much as .65% of suitable amine phosphates may be used in the paper without increasing the total acidity by titration to exceed .1% by weight as sulfur trioxide (SO_3). Accordingly from .01% to 6.5% suitable amine phosphates may be used in the paper without going beyond the limits specified for a grade A ordnance paper by present Government specifications.

For actual use we have found that the total acidity in the paper may be increased substantially beyond 1.7% without injurious effects on corrosive material wrapped. Apparently the increased cost and odor of the paper would be the limiting factors on the percentage of amine phosphates which may be used in the paper.

Example I.—Diamylamine phosphate is used as a buffer and corrosion inhibitor in a 25 pound (24 x 36—480 ream) sheet of grease-proof paper. The dry grease-proof sheet is impregnated with 1.9 pounds of a 5.3% water solution of diamylamine phosphate. Impregnation is accomplished by passing the sheet through a Mayer coater with the diamylamine phosphate solution in the pan. The sheet is then dried on ordinary steam roll dryers, leaving the diamylamine phosphate in the sheet. The following shows the effect of this

compound on the pH, total acidity, and corrosive properties of the sheet:

	pH	T. A.	Corrosion of steel plates wrapped in paper
		Per cent	
25 lb. grease-proof untreated	7.8	0.006	Corrodes steel plates badly.
25 lb. grease-proof treated with diamylamine phosphate.	7.0	.030	No corrosion of steel plates.

Because of the highly corrosive action of papers containing hygroscopic materials such as glycerin, it is present practice to prohibit the use of such hygroscopic materials in paper. On the other hand such materials are commonly used as plasticizing agents and when so used render the wrapping sheet much more flexible and pliable than when such material is omitted. The use of a plasticizing agent in paper is extremely desirable when the paper is to be folded and flexed, but it has been thought impossible to produce such a plasticized sheet for the wrapping of corrosive materials.

We have found that when amine phosphates selected from the class specified are embodied in the paper containing hygroscopic material such as glycerin, the corrosive effect of the paper upon the material wrapped is greatly decreased. As a result by the use of our corrosion inhibiting and buffering compound we have been able to produce a plasticized wrapping sheet, which is relatively non-corrosive to materials wrapped. As the result an improved wrapping sheet may be provided which is extremely stable, which is non-corrosive, and which may be folded and flexed without injuring the fibrous structure of the sheet.

Example II.—Diamylamine phosphate is used as a buffer and corrosion inhibitor in a laminated, glycerine plasticized sheet of grade A ordnance greaseproof paper. A sheet of 40 pound greaseproof is laminated to a sheet of 30 pound kraft with microcrystalline wax on the Mayer coater. The greaseproof side of this sheet is then impregnated with 8 pounds of solution made up as follows:

	Per cent
Glycerine by weight	50
Distilled water by weight	49.5
Diamylamine phosphate	0.5

The sheet thus impregnated is wound into a roll and allowed to stand so as to complete the impregnation of the above solution and thereby produce a tough, flexible laminated sheet.

The following test results show a comparison between the sheet produced as described in this Example II and similar sheets, one of which was plasticized with glycerine without diamylamine phosphate, and the other of which was not plasticized or inhibited with diamylamine phosphate.

	pH	T. A.	Corrosion of steel cylinders wrapped in paper
		Per cent	
Laminated sheet, plasticized containing diamylamine phosphate.	7.0	0.004	No corrosion or pitting.
Laminated sheet, plasticized. No diamylamine phosphate.	6.6	.002	Very bad corrosion.
Laminated sheet, not plasticized. No diamylamine phosphate.	6.5	.002	Bad corrosion.

In the formation of grease-proof papers it has been common practice to laminate sheets of paper such as kraft paper and a grease-proof paper, or a grease-proof regenerated film with a waterproofing material such as wax and the like. We have found that when oil seeps through or around the grease-proof film and/or paper this oil has a tendency to dissolve the wax and thereby causes easy separation of the laminations. We therefore prefer to laminate the paper and grease-proof film and/or paper with a material insoluble in oil such as starch or modified starch solution as illustrated in the drawing. As a result should oil contact the laminating material separating the grease-proof film and the outer kraft sheet no tendency for separation of the laminations is provided.

Example III.—Diamylamine phosphate is used as a buffer and corrosion inhibitor in a starch laminating solution used to laminate a twenty-five pound grease-proof sheet to a thirty pound kraft sheet. The laminating solution is made up as follows:

	Per cent by weight
Starch	44
Glycerine (plasticizer)	44
Diamylamine phosphate	12

Substantially forty parts by weight of the above ingredients are mixed with substantially sixty parts by weight of water. The sheets of kraft and grease-proof are laminated together on a Mayer coater with the above solution and the resultant two ply sheet is dried to form a well laminated sheet.

The following test results show the effect of the diamylamine phosphate on the pH, total acidity and corrosive action on the finished sheet.

	pH	T. A.	Corrosion
		Per cent	
Sheet laminated with starch-glycerine. No diamylamine phosphate.	7.6	0.003	Bad corrosive effect.
Sheet laminated with starch-glycerine. With diamylamine phosphate.	6.9	.052	No corrosive effect.

We have found that when corrosive materials are wrapped in any of our grease-proof sheets, less corrosion is experienced on the contacted parts than with any other grease-proof sheet with which we are familiar. We have further found that the pH of the paper remains stable over wide variations of climatic conditions and upon aging.

To one skilled in the art it is obvious that the use of these amine phosphates as combined buffering and corrosion inhibiting compounds is not limited alone to paper base wrapping materials, but can be used with any base material where these properties are desired in the same product.

A non-corrosive tape may be made by slitting the paper of any of the above examples into suitable widths. Cartons or packages may likewise be formed of the various non-corrosive base stocks which may, obviously, be of any desired weight to serve the intended purpose.

In accordance with the patent statutes, we have described the principles of composition of our grease-proof sheet material and while we have endeavored to set forth the best embodiments thereof, we desire to have it understood that minor changes may be made within the scope of the following claims without departing from the spirit of our invention.

We claim:

1. A non-corrosive wrapping material comprising a cellulosic base containing a minor amount of a water soluble buffer and corrosion inhibitor which comprises the reaction product of orthophosphoric acid and an organic amine chosen from the class consistsing of:

(a) Primary alkyl amines containing from 2–7 carbon atoms,

(b) Primary alkanol amines containing from 1–8 carbon atoms,

(c) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms,

(d) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(e) Water soluble quaternary amines,

(f) Morpholine,

(g) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3,

(h) Benzyl amine.

2. A non-corrosive wrapping material comprising a cellulosic base containing a minor amount of a water soluble buffer and corrosion inhibitor which comprises a phosphate of an organic amine chosen from the class of amines consisting of:

(a) Primary alkyl amines containing from 2–7 carbon atoms,

(b) Primary alkanol amines containing from 1–8 carbon atoms,

(c) Secondary amines of the formula



in which D and E may each be an alkyl and/or alkanol group of from 1–6 carbon atoms,

(d) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(e) Water soluble quaternary amines,

(f) Morpholine,

(g) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3,

(h) Benzyl amine.

3. A non-corrosive wrapping material comprising a cellulosic base containing as essential ingredients a hygroscopic plasticizing material and a minor amount of a water soluble buffer and corrosion inhibitor which comprises the reaction product of orthophosphoric acid and an organic amine chosen from the class consisting of:

(a) Primary alkyl amines containing from 2–7 carbon atoms,

(b) Primary alkanol amines containing from 1–8 carbon atoms,

(c) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms,

(d) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group of from 1–3 carbon atoms,

(e) Water soluble quaternary amines,

(f) Morpholine,

(g) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3,

(h) Benzyl amine.

4. A non-corrosive wrapping material comprising a cellulosic base containing as essential ingredients a hygroscopic plasticizing material and a minor amount of a water soluble buffer and corrosion inhibitor which comprises the phosphate of an organic amine chosen from the class of amines consisting of:

(a) Primary alkyl amines containing from 2–7 carbon atoms,

(b) Primary alkanol amines containing from 1–8 carbon atoms,

(c) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms,

(d) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(e) Water soluble quaternary amines,

(f) Morpholine,

(g) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3,

(h) Benzyl amine.

5. A non-corrosive wrapping material which comprises a cellulosic base sheet and a greaseproof film laminated with a starch adhesive containing a minor amount of a water soluble buffer and corrosion inhibitor which comprises the reaction product of orthophosphoric acid and an organic amine chosen from the class consisting of:

(a) Primary alkyl amines containing from 2–7 carbon atoms,

(b) Primary alkanol amines containing from 1–8 carbon atoms,

(c) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms,

(*d*) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(*e*) Water soluble quaternary amines,

(*f*) Morpholine,

(*g*) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3,

(*h*) Benzyl amine.

6. A non-corrosive wrapping material which comprises a cellulosic base sheet and a greaseproof film laminated with a starch adhesive including a minor amount of a water soluble buffer and corrosion inhibitor comprising a phosphate of an organic amine chosen from the class of amines consisting of:

(*a*) Primary alkyl amines containing from 2–7 carbon atoms,

(*b*) Primary alkanol amines containing from 1–8 carbon atoms,

(*c*) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms.

(*d*) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(*e*) Water soluble quaternary amines,

(*f*) Morpholine,

(*g*) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3.

(*h*) Benzyl amine.

7. A non-corrosive wrapping sheet comprising a series of cellulosic base sheets laminated with a starch adhesive containing a minor amount of a water soluble buffer and corrosion inhibitor which comprises the reaction product of orthophosphoric acid and an organic amine chosen from the class consisting of:

(*a*) Primary alkyl amines containing from 2–7 carbon atoms,

(*b*) Primary alkanol amines containing from 1–8 carbon atoms,

(*c*) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms.

(*d*) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(*e*) Water soluble quaternary amines,

(*f*) Morpholine,

(*g*) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3.

(*h*) Benzyl amine.

8. A non-corrosive wrapping material comprising a series of cellulosic base sheets laminated with a starch adhesive containing a minor amount of a water soluble buffer and corrosion inhibitor which comprises a phosphate of an organic amine chosen from the class of amines consisting of:

(*a*) Primary alkyl amines containing from 2–7 carbon atoms,

(*b*) Primary alkanol amines containing from 1–8 carbon atoms,

(*c*) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms.

(*d*) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(*e*) Water soluble quaternary amines,

(*f*) Morpholine,

(*g*) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3.

(*h*) Benzyl amine.

9. A non-corrosive tape comprising a strip of cellulosic base material which contains a minor amount of corrosion inhibitor which comprises a water soluble buffer material and which is an orthophosphate of an organic amine chosen from the class consisting of:

(*a*) Primary alkyl amines containing from 2–7 carbon atoms,

(*b*) Primary alkanol amines containing from 1–8 carbon atoms,

(*c*) Secondary amines of the formula



in which D and E may each be any alkyl and/or alkanol group of from 1–6 carbon atoms.

(*d*) Tertiary amines of the formula



in which F, G, and H may each be any alkyl group of from 1–2 carbon atoms and/or any alkanol group from 1–3 carbon atoms,

(*e*) Water soluble quaternary amines,

(*f*) Morpholine,

(*g*) Ethylene diamine and polyamines with the formula

$$NH_2—(CH_2CH_2—NH)_x—CH_2CH_2NH_2$$

in which x is either 1, 2, or 3,

(*h*) Benzyl amine.

JESSE KENNETH BOGGS.
GEORGE H. SULLIVAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,208,619	Armor	July 23, 1940
2,181,811	Hughes	Nov. 28, 1939
2,196,261	Howland	Apr. 9, 1940