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⑤ **Electroconductive articles and a method of preparing them.**

⑥ Electroconductive articles such as paper have a coating consisting essentially of (1) a barrier coating comprising a copolymer of ethylene and vinyl acetate, a styrene-butadiene latex, sodium alginate or a fluorocarbon with starch or a modified starch; and (2) an electroconductive coating. Such articles are made by applying the barrier coating to a substrate, allowing it to dry, applying the electroconductive coating over the barrier coating and allowing it to dry.

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**TITLE MODIFIED**  
**see front page**

ELECTROCONDUCTIVE ARTICLES

This invention relates to electroconductive paper and other electroconductive articles.

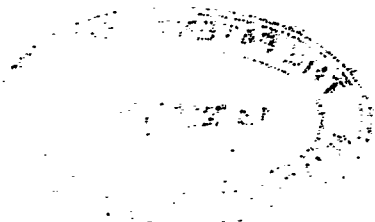
In the coating art, as currently practised for electroconductive papers, barrier coatings usually consist of only starch, starch that has been chemically modified in a known manner, or a combination of starch and a resin, such as a copolymer of styrene and maleic anhydride. The barrier-coated sheet is subsequently overcoated with a coating that has electroconductive properties and is then referred to in the trade as conductive base stock. Using the preceding manufacturing process, frequent problems occur with the base stock in obtaining the required degree of solvent holdout, conductivity and low tackiness. Particularly at high relative humidities, tackiness of the conductivized paper causes numerous production problems on the coating machine and calender stacks, resulting in reel-blocking and processing difficulties.

Our unique barrier coating for electroconductive paper, when used in combination with a suitable conductive polymer formulation, will provide a finished conductive base

stock that has improved solvent holdout and conductivity, and a low degree of tackiness at high relative humidities.

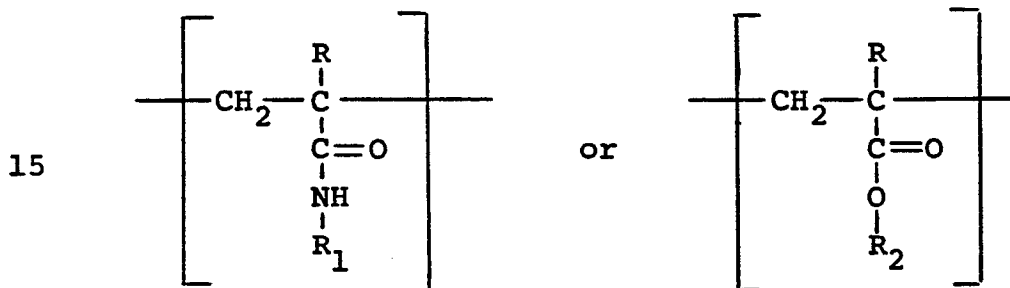
In accordance with the present invention, a barrier coating consists essentially of from 5 to 50 percent by weight of a copolymer of ethylene and vinyl acetate, a styrene-butadiene latex, sodium alginate or a fluorocarbon, together with from 95 to 50 percent by weight of a modified starch. This coating may be applied to the paper raw stock by conventional coating techniques in amounts ranging from 0.8 to 3.5 g/m<sup>2</sup>. The conductive coating may contain from 10 to 90 percent by weight, preferably 70 to 90 percent by weight, of an electroconductive polymer and from 10 to 90 percent by weight of a combination of pigments and/or binders. This coating may also be applied to one or both sides of the barrier-coated paper by conventional coating techniques, such as blade, air knife or reverse roll methods in amounts ranging from 0.8 to 6.0 g/m<sup>2</sup> per side of the paper.

The preferred copolymer of ethylene and vinyl acetate is an aqueous latex product marketed by Air



Products and Chemicals, Inc., as Airflex 110 and the preferred modified starch is a hydroxyethylated, acetylated, oxidized or cationic starch.

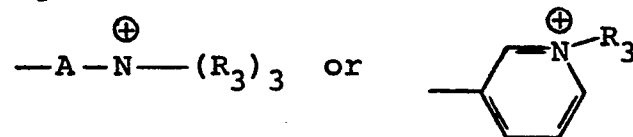
The nature of the electroconductive polymer component of the improved coating formulations of this invention is not critical. Any of a variety of electroconductive polymers, both cationic and anionic, may be employed provided that the conductive polymer selected is capable of imparting adequate surface resistivity to the base raw stock. As cationic electroconductive polymers, there may be employed any water-soluble cationic polymer containing quaternary ammonium functional groups. Included in such cationic polymers are those of the formula:



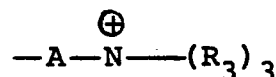
wherein:

R stands for hydrogen or lower alkyl;

R<sub>1</sub> represents a member of the class composed of

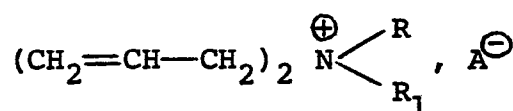


20 R<sub>2</sub> stands for



wherein, in turn, A represents a lower alkylene, an hydroxy-lower alkylene or lower-alkyl-substituted

lower alkylene group, and  $R_3$  stands for a lower alkyl group. These polymers include those wherein the quaternary ammonium functional group is carried as a pendant group to the principal polymer chain, such as, for example, polyvinyl benzyl trimethyl ammonium chloride, poly-[alpha-(methylene trimethyl ammonium chloride)ethylene oxide] and poly(methacryloyloxyethyl trimethyl ammonium chloride). Also useful are those polymers wherein the quaternary ammonium functional group is incorporated in a cyclic structure which comprises a portion of the polymer backbone, such as, for example, polymers containing repeating units of the formula:



where R is an alkyl group of 1 to 18 carbon atoms and  $R_1$  is R or  $\beta$ -propionamido and A is an anion. A preferred polymer of this class is poly-(dimethyldiallylammonium chloride); and those wherein the quaternary ammonium functional group forms a part of the polymer chain, such cationic polymers being commonly designated as "ionenes".

Included in this group, for example, are ionene polymers prepared from halo alkyl dialkyl amine monomer units, such as 3-ionene (poly-(dimethyl propyl)ammonium chloride), prepared by the polymerization of 3-chloropropyl dimethyl amine, and ionene polymers prepared from di-tertiaryamines and dihalides, such as 3,4-ionene which is prepared from 1,3-bis-dimethylamino propane and 1,4-dichlorobutene. Other ionene polymers, of course, which are prepared similarly,

may be employed as the electroconductive component of the coating formulations of this invention.

In addition to the cationic electroconductive polymers mentioned above, water-soluble cationic phosphonium and sulfonium polymers also may be employed as the electroconductive component in the coating formulations of this invention. Included among these are polymers, such as, for example, poly-(2-acryloxyethyl dimethyl sulfonium chloride) and poly-(glycidyltributyl phosphonium chloride) and the like.

It should be noted that the typical cationic and anionic polymers mentioned above may contain one or more other mer units. For example, copolymers such as the copolymer of dimethyl diallyl ammonium chloride and diacetone acrylamide or the reaction product of dimethyl diallyl ammonium chloride and the copolymer of styrene and maleic anhydride also can be used as the electroconductive component of the coating formulations of this invention. The ratio of mer units in such copolymers will be determined by the quantity of cationic or anionic necessary to impart the desired surface resistivity to the base sheet.

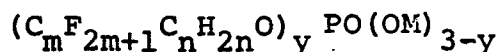
Although any of the electroconductive polymers noted above, or other electroconductive polymers capable of imparting the necessary degree of surface resistivity to the base sheet, may be employed as the electroconductive component in the improved coating formulations of this invention, the preferred electroconductive polymers are the cationic

polymers and copolymers and especially cationic quaternary ammonium polymers and copolymers. Of these, the most preferred polymers are poly-(dimethyldiallylammonium chloride), copolymers of dimethyl diallyl ammonium chloride and diacetone acrylamide containing from 70 to 98% diallyl monomer, polyvinylbenzyl trimethyl ammonium chloride, polymethacryloyloxyethyl trimethyl ammonium chloride, polymethacryloyloxytrimethylammonium methosulfate polyepiclorohydrin 80 to 100% quaternized with trimethylamine, copolymers of acrylamide and methacryloyloxyethyl trimethyl ammonium chloride containing from 90 to 99.5% methacryloyloxyethyl monomer units, poly-methacryloyloxyethyl dimethyl hydroxyethyl ammonium chloride) and poly-(dimethylpropylammonium chloride).

As noted above, the binders employed in the improved coating formulations of this invention can be of great variety and do not constitute a critical aspect of the instant invention. Any of the water-soluble, film-forming polymers conventionally employed for this purpose may be used in the coating formulations of this invention. Suitable binders will include, for example, polyvinylalcohols, polyvinyl acetates, styrenebutadiene latices, polyethylene-polyvinyl acetate copolymers, unmodified starches, acetylated starches, hydroxyethylated starches, enzyme converted starches, oxidized starches, proteins, caseins, and the like or mixtures thereof. Similarly, any of the variety of pigments conventionally employed in coating formulations may be employed in the improved coating formulations of this invention including commercially available calcium carbonates, kaolin clays,

titanium dioxides, aluminas or combinations of these materials.

The electroconductive coating formulation utilized in this invention may also contain certain mono- and bis-(1H,1H,2H,2H-perfluoroalkyl)-phosphate esters, when incorporated into electroconductive coating formulations in the quantities specified below, are effective in imparting to such formulations improved solvent holdout properties. In general, useful perfluoroalkyl phosphate esters will have the formula,



wherein m is an integer between 4 and 10, n is an integer between 1 and 11, y is 1 or 2 and M is a water-solubilizing cation, such as, for example, an alkali metal (Li, K, Na and the like), ammonium or substituted ammonium including methylamine, dimethylamine, diethylamine, monoethanolamine, diethanolamine, triethanolamine or morpholine and the like. Preferred salts generally are the diethanolamine salts. Desirably, C<sub>m</sub> and C<sub>n</sub> taken together, constitute a straight chain of at least 8 carbon atoms. Such perfluoroalkyl phosphate esters are well-known materials and are available commercially or readily prepared by methods fully described in the art. Particularly preferred is the perfluoroalkyl phosphate ester manufactured by E. I. du Pont de Nemours Company, Inc., Wilmington, Delaware, under the Trademark, ZONYL RP, which contains diethanolamine salts of mono- and bis-(1H,1H,2H,2H-perfluoroalkyl) phosphates where the alkyl group is even numbered in the range C<sub>8</sub>-C<sub>18</sub> and the salts have

a fluorine content of 52.4% to 54.4% as determined on a solids basis or ammonium bis(N-ethyl-2-perfluoro-alkylsulfonamido ethyl) phosphates, containing not more than 15% ammonium mono(N-ethyl-2-perfluoroalkyl-  
5 sulfonamido ethyl) phosphates, where the alkyl group is more than 95% C<sub>8</sub> and the salts have a fluorine content of 50.2% to 52.8% as determined on a solids basis. Materials of this type are sold by 3M Co., Inc., under the Trademark SCOTCHBAN.

10 In order to illustrate the advantages derived from the present invention, the barrier coating and conductive coating formulations were applied to raw stock by drawdowns with the appropriate wire-wound rod and also ran a Keegan Pilot Coater. The coated  
15 sheets were conditioned overnight at 20% and 50% relative humidity (RH) and 72°F. after which they were weighed to obtain coatweight and evaluated for conductivity by using a Keithley 610B Electrometer to measure surface resistivity. Solvent holdout was  
20 determined by measuring dyed toluene penetration after 10 seconds contact time. Tackiness of the paper was determined by hand feel. The results of these tests are set forth in the following tables.

TABLE I

Coating Composition	Barrier	Conductive	Total Coat Weight (g/m <sup>2</sup> )	% Toluene Penetration
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Barrier	Conductive	Barrier	Conduc- tive	Total	Top	Back	
5	90% Starch 10% Scripset 100%	90% PCL-7513 10% CaCO <sub>3</sub> 100%	2.3	4.6	6.9	20-30	40
	90% Starch 10% Scripset 100%	80% PCL-7513 20% CaCO <sub>3</sub> 100%	2.2	4.5	6.7	20-30	40
			2.2	4.8	7.0	40	50
10	90% Starch 10% Scripset 100%	70% PCL-7513 30% CaCO <sub>3</sub> 100%	2.1	4.2	6.3	20	95
15	90% Starch 10% Scripset 100%	70% CP-261 30% CaCO <sub>3</sub> 100%	2.2	4.3	6.5	10	50
	90% Starch 10% Scripset 100%	80% PCL-7513 20% Clay 100%	2.2	4.2	6.4	10	70
			2.2	4.9	7.1	10	60
			2.3	4.3	6.6	10	60
			2.0	4.7	6.7	6	15
			2.0	5.9	7.9	6	40
			2.1	4.5	6.6	6	15

TABLE I (Continued)

<u>Coating Composition</u>		<u>Total Coat Weight (g/m<sup>2</sup>)</u>			<u>% Toluene Penetration</u>	
<u>Barrier</u>	<u>Conductive</u>	<u>Barrier</u>	<u>Conduc- tive</u>	<u>Total</u>	<u>Top</u>	<u>Back</u>
5	90% Starch	80% CP-261	4.5	6.7	30	50
	10% Scripset	20% Clay				
	100%	100%				
10	90% Starch	30% CP-261	3.8	6.0	30	50
	10% Scripset	25% Airflex 110				
	100%	45% Clay				
10	90% Starch	80% ECR-77	4.1	6.1	50	70
	10% Scripset	20% Clay				
	100%	100%				
15	85% Starch	90% PCL-7513	4.8	7.0	30	40
	15% Scripset	10% CaCO <sub>3</sub>				
	100%	100%				
15	85% Starch	80% PCL-7513	4.6	6.6	15	40
	15% Scripset	20% Clay	4.1			
	100%	100%				

TABLE I (Continued)  
Coating Composition      Total Coat Weight (g/m<sup>2</sup>)      % Toluene Penetration

	<u>Barrier</u>	<u>Conductive</u>	<u>Barrier</u>	<u>Conduc-</u> <u>tive</u>	<u>Total</u>	<u>Top</u>	<u>Back</u>
5	85% Starch	70% CP-261	2.3	4.2	6.5	20	50
	15% Scripset	30% CaCO <sub>3</sub>					
	100%	100%					
10	80% Starch	90% PCL-7513	2.1	4.3	6.4	20	70
	20% Scripset	10% CaCO <sub>3</sub>					
	100%	100%					
10	80% Starch	80% PCL-7513	2.0	4.3	6.3	30	70
	20% Scripset	20% CaCO <sub>3</sub>					
	100%	100%					
15	80% Starch	80% PCL-7513	2.1	4.1	6.2	20	90
	20% Scripset	20% Clay					
	100%	100%					
15	80% Starch	70% CP-261	2.1	4.2	6.3	20	70
	20% Scripset	30% CaCO <sub>3</sub>					
	100%	100%					

TABLE I (Continued)  
 Total Coat Weight (g/m<sup>2</sup>)      % Toluene Penetration

	Coating Composition		Barrier	Conduc- tive	Total	% Toluene Penetration	
	Barrier	Conductive				Top	Back
5	80% Starch	40% CP-261	2.2	3.7	5.9	40	80
	20% Scripset	25% Airflex 110	2.0	5.5	7.5	15	50
	100%	35% Clay	2.0	4.0	6.0	40	90
		100%					
10	80% Starch	30% CP-261	2.0	4.0	6.0	90	90
	20% Scripset	25% Airflex 110	2.0	5.2	7.2	70	90
	100%	45% Clay	2.0	5.6	7.6	40	80
		100%					
15	80% Starch	80% PCL-7513	2.3	5.0	7.3	10	20
	20% Airflex	20% Clay					
	100%	100%					
20	80% Starch	80% CP-261	2.5	4.9	7.4	50	70
	20% Airflex	20% Clay					
	100%	100%					
20	80% Starch	80% ECR-77	2.3	4.2	6.5	10	30
	20% Airflex	20% Clay					
	100%	100%					

TABLE I (Continued)  
Total Coat Weight (g/m<sup>2</sup>)      % Toluene Penetration

<u>Coating Composition</u>		<u>Barrier</u>	<u>Conductive</u>	<u>Barrier</u>	<u>Conduc- tive</u>	<u>Total</u>	<u>Top</u>	<u>Back</u>
5	80% Starch	2.4	70% CP-261	4.0	6.4	60	90	
	20% Airflex		10% Airflex					
	100%		20% Clay					
			100%					
10	100% Starch	2.2	80% PCL-7513	4.5	6.7	50	100	
			20% Clay					
			100%					
15	100% Starch	2.2	30% CP-261	4.3	6.5	70	90	
			25% Airflex 110					
			45% Clay					
			100%					

15 Scripset is a styrene/maleic anhydride latex.

Airflex is a ethylene/vinylacetate latex.

CP-261 is a homopolymer of dimethyl diallyl ammonium chloride.

PCL-7513 is a physical blend of a homopolymer of dimethyl diallyl ammonium chloride and a fluorosurfactant.

20 ECR-77 is a homopolymer of benzyl trimethyl ammonium chloride.

TABLE II

	Coating Composition		Total Coat Weight (g/m <sup>2</sup> )	Surface Resistivity (ohms/sq.)					
	Barrier	Conductive		at 50% R.H.	at 17.5% R.H.	Top	Back	Top	Back
5	90% Starch	90% PCL-7513	2.3	4.6	6.9	2.8 x 10 <sup>7</sup>	1.9 x 10 <sup>7</sup>	4.1 x 10 <sup>8</sup>	3.8 x 10 <sup>8</sup>
	10% Scrip-set	10% CaCO <sub>3</sub>							
	100%	100%							
10	90% Starch	80% PCL-7513	2.2	4.5	6.7	3.0 x 10 <sup>7</sup>	1.5 x 10 <sup>7</sup>	4.9 x 10 <sup>8</sup>	3.1 x 10 <sup>8</sup>
	10% Scrip-set	20% CaCO <sub>3</sub>							
	100%	100%							
15	90% Starch	70% PCL-7513	2.1	4.2	6.3	3.0 x 10 <sup>7</sup>	1.9 x 10 <sup>7</sup>	4.5 x 10 <sup>8</sup>	3.3 x 10 <sup>8</sup>
	10% Scrip-set	30% CaCO <sub>3</sub>							
	100%	100%							
20	90% Starch	70% CP-261	2.2	4.3	6.5	2.1 x 10 <sup>7</sup>	1.7 x 10 <sup>7</sup>	4.5 x 10 <sup>8</sup>	3.0 x 10 <sup>8</sup>
	10% Scrip-set	30% CaCO <sub>3</sub>							
	100%	100%							

TABLE II (Continued)

Coating Composition	Barrier	Conductive	Bar-rier	Conduc-tive	To-tal	Surface Resistivity (ohms/sq.)			
						Weight (g/m <sup>2</sup> )	at 50% R.H.	at 17.5% R.H.	at 17.5% R.H.
5	90% Starch	80% PCL-7513	2.2	4.2	6.4	3.1 x 10 <sup>7</sup>	2.2 x 10 <sup>7</sup>	4.1 x 10 <sup>8</sup>	3.3 x 10 <sup>8</sup>
	10% Scrip-set	20% Clay	2.2	4.9	7.1	4.5 x 10 <sup>7</sup>	1.7 x 10 <sup>7</sup>	4.5 x 10 <sup>8</sup>	3.1 x 10 <sup>8</sup>
	100%	100%	2.3	4.3	6.6	3.1 x 10 <sup>6</sup>	1.8 x 10 <sup>6</sup>	4.5 x 10 <sup>8</sup>	3.6 x 10 <sup>8</sup>
10	90% Starch	80% CP-261	2.0	4.7	6.7	6.4 x 10 <sup>7</sup>	9.4 x 10 <sup>7</sup>	4.9 x 10 <sup>8</sup>	4.5 x 10 <sup>8</sup>
	10% Scrip-set	20% Clay	2.0	5.9	7.9	5.6 x 10 <sup>7</sup>	1.1 x 10 <sup>7</sup>	4.5 x 10 <sup>9</sup>	3.1 x 10 <sup>8</sup>
	100%	100%	2.1	4.5	6.6	2.0 x 10 <sup>7</sup>	1.4 x 10 <sup>7</sup>	1.0 x 10 <sup>9</sup>	6.1 x 10 <sup>8</sup>
15	90% Starch	30% CP-261	2.2	4.5	6.7	3.8 x 10 <sup>7</sup>	2.0 x 10 <sup>7</sup>	6.6 x 10 <sup>8</sup>	4.1 x 10 <sup>8</sup>
	10% Scrip-set	25% Airflex 110	2.2	3.8	6.0	7.2 x 10 <sup>8</sup>	2.5 x 10 <sup>8</sup>	1.8 x 10 <sup>10</sup>	4.1 x 10 <sup>9</sup>
	100%	45% Clay	2.0	4.1	6.1	2.1 x 10 <sup>7</sup>	1.7 x 10 <sup>7</sup>	9.8 x 10 <sup>8</sup>	7.6 x 10 <sup>8</sup>
20	90% Starch	80% ECR-77	2.0	4.1	6.1	2.1 x 10 <sup>7</sup>	1.7 x 10 <sup>7</sup>	9.8 x 10 <sup>8</sup>	7.6 x 10 <sup>8</sup>
	10% Scrip-set	20% Clay	2.0	4.1	6.1	2.1 x 10 <sup>7</sup>	1.7 x 10 <sup>7</sup>	9.8 x 10 <sup>8</sup>	7.6 x 10 <sup>8</sup>
	100%	100%	2.0	4.1	6.1	2.1 x 10 <sup>7</sup>	1.7 x 10 <sup>7</sup>	9.8 x 10 <sup>8</sup>	7.6 x 10 <sup>8</sup>

TABLE II (Continued)

	Coating Composition		Barrier	Conductive	Bar-rier	Conduc-tive	To-tal	Total Coat Weight (g/m <sup>2</sup> )		Surface Resistivity (ohms/sq.)			
								at 50% R.H.		at 17.5% R.H.			
								<u>Top</u>	<u>Back</u>	<u>Top</u>	<u>Back</u>	<u>Top</u>	<u>Back</u>
5	85% Starch	100%	90% PCL-7513	10% CaCO <sub>3</sub>	2.2	4.8	7.0	1.8 x 10 <sup>7</sup>	1.1 x 10 <sup>7</sup>	3.1 x 10 <sup>8</sup>	2.1 x 10 <sup>8</sup>		
	15% Scrip-set	100%											
10	85% Starch	100%	80% PCL-7513	20% Clay	2.0	4.6	6.6	2.3 x 10 <sup>7</sup>	3.0 x 10 <sup>7</sup>	4.9 x 10 <sup>8</sup>	4.5 x 10 <sup>8</sup>		
	15% Scrip-set	100%			2.1	4.1	6.2	1.3 x 10 <sup>7</sup>	1.9 x 10 <sup>7</sup>	4.1 x 10 <sup>8</sup>	3.0 x 10 <sup>8</sup>		
15	85% Starch	100%	70% CP-261	30% CaCO <sub>3</sub>	2.3	4.2	6.5	3.3 x 10 <sup>7</sup>	1.9 x 10 <sup>7</sup>	4.1 x 10 <sup>8</sup>	3.3 x 10 <sup>8</sup>		
	15% Scrip-set	100%											
20	80% Starch	100%	90% PCL-7513	10% CaCO <sub>3</sub>	2.1	4.3	6.4	1.4 x 10 <sup>7</sup>	1.4 x 10 <sup>7</sup>	3.3 x 10 <sup>8</sup>	3.0 x 10 <sup>8</sup>		
	20% Scrip-set	100%											

TABLE II (Continued)

Coating Composition	Barrier	Conductive	Bar-rier	Conduc-tive	To-tal	Surface Resistivity (ohms/sq.)			
						at 50% R.H.	at 17.5% R.H.	Top	Back
5	80% Starch 20% Scrip-set 100%	80% PCL-7513 20% CaCO <sub>3</sub> 100%	2.0	4.3	6.3	1.8 x 10 <sup>7</sup>	3.0 x 10 <sup>7</sup>	3.3 x 10 <sup>8</sup>	1.2 x 10 <sup>8</sup>
10	80% Starch 20% Scrip-set 100%	80% PCL-7513 20% Clay 100%	2.1 2.2 2.2 2.2	4.1 4.3 4.1 4.7	6.2 6.5 6.3 6.9	2.8 x 10 <sup>7</sup> 2.3 x 10 <sup>7</sup> 2.1 x 10 <sup>6</sup> 6.3 x 10 <sup>6</sup>	2.8 x 10 <sup>7</sup> 2.1 x 10 <sup>7</sup> 2.5 x 10 <sup>6</sup> 6.3 x 10 <sup>6</sup>	4.1 x 10 <sup>8</sup> 3.6 x 10 <sup>8</sup> 3.6 x 10 <sup>8</sup> 4.5 x 10 <sup>8</sup>	3.8 x 10 <sup>8</sup> 4.1 x 10 <sup>8</sup> 3.8 x 10 <sup>8</sup> 6.4 x 10 <sup>8</sup>
15	80% Starch 20% Scrip-set 100%	70% CP-261 30% CaCO <sub>3</sub> 100%	2.1	4.2	6.3	1.9 x 10	1.9 x 10	3.8 x 10	3.1 x 10
20	80% Starch 20% Scrip-set 100%	40% CP-261 25% Airflex 110 35% Clay 100%	2.2 2.0 2.0	3.7 5.5 4.0	5.9 7.5 6.0	1.3 x 10 <sup>7</sup> 3.1 x 10 <sup>8</sup> 1.3 x 10 <sup>8</sup>	3.1 x 10 <sup>7</sup> 2.7 x 10 <sup>7</sup> 8.2 x 10 <sup>7</sup>	1.9 x 10 <sup>9</sup> 9.2 x 10 <sup>9</sup> 2.1 x 10 <sup>9</sup>	1.1 x 10 <sup>9</sup> 9.5 x 10 <sup>9</sup> 1.8 x 10 <sup>9</sup>

TABLE II (Continued)

	Coating Composition		Bar-rier	Conduc-tive	To-tal	Surface Resistivity (ohms/sq.)			
						Weight (g/m <sup>2</sup> )	at 50% R.H.	at 17.5% R.H.	
5	80% Starch	30% CP-261	2.0	4.0	6.0	2.2 x 10 <sup>8</sup>	2.5 x 10 <sup>8</sup>	6.5 x 10 <sup>9</sup>	6.7 x 10 <sup>9</sup>
	20% Scrip-set	25% Airflex 110	2.0	5.2	7.2	1.3 x 10 <sup>7</sup>	1.3 x 10 <sup>7</sup>	4.1 x 10 <sup>9</sup>	4.5 x 10 <sup>9</sup>
		45% Clay	2.0	5.6	7.6	3.1 x 10 <sup>7</sup>	2.7 x 10 <sup>7</sup>	4.1 x 10 <sup>9</sup>	4.1 x 10 <sup>9</sup>
10	100%	100%							
	80% Starch	80% PCL-7513	2.3	5.0	7.3	4.1 x 10 <sup>7</sup>	4.5 x 10 <sup>7</sup>	1.9 x 10 <sup>9</sup>	6.6 x 10 <sup>8</sup>
	20% Airflex	20% Clay							
15	100%	100%							
	80% Starch	80% CP-261	2.5	4.9	7.4	1.4 x 10 <sup>8</sup>	3.0 x 10 <sup>7</sup>	2.7 x 10 <sup>9</sup>	8.3 x 10 <sup>8</sup>
	20% Airflex	20% Clay							
20	100%	100%							
	80% Starch	80% ECR-77	2.3	4.2	6.5	1.2 x 10 <sup>8</sup>	7.0 x 10 <sup>7</sup>	1.0 x 10 <sup>9</sup>	8.2 x 10 <sup>8</sup>
	20% Airflex	20% Clay							
20	100%	100%							
	80% Starch	70% CP-261	2.4	4.0	6.4	9.4 x 10 <sup>7</sup>	4.5 x 10 <sup>7</sup>	2.4 x 10 <sup>9</sup>	8.9 x 10 <sup>8</sup>
	20% Airflex	10% Airflex 20% Clay							
	100%	100%							

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TABLE II (Continued)

Coating Composition		Total Coat Weight (g/m <sup>2</sup> )	Surface Resistivity (ohms/sq.)								
Barrier	Conductive		Bar-rier	Conduc-tive	TO-tal	at 50% R.H.	at 17.5% R.H.	Top	Back	Top	Back
100% Starch	80% PCL-7513 20% Clay 100%	4.5	2.2	4.5	6.7	4.5 x 10 <sup>7</sup>	7.2 x 10 <sup>7</sup>	7.3 x 10 <sup>9</sup>	1.0 x 10 <sup>9</sup>		
100% Starch	30% CP-261 25% Airflex 110 45% Clay 100%	4.3	2.2	6.5	6.5	5.8 x 10 <sup>8</sup>	4.1 x 10 <sup>8</sup>	9.1 x 10 <sup>9</sup>	8.2 x 10 <sup>9</sup>		

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Scripset is a styrene/maleic anhydride latex.

Airflex is a ethylene/vinylacetate latex.

15 CP-261 is a homopolymer of dimethyl diallyl ammonium chloride.

PCL-7513 is a physical blend of a homopolymer of dimethyl diallyl ammonium chloride and a fluorosurfactant.

ECR-77 is a homopolymer of benzyl trimethyl ammonium chloride.

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TABLE III

	Coating Composition		Total Coat Weight (g/m <sup>2</sup> )		Tack (0-5)	% Toluene Penetration	
	Barrier	Conductive	Barrier	Conductive		Top	Back
5	90% Starch 10% Scripset 540 100%	80% PCL-7513 20% Clay 100%	2.4	5.8	4-5	20-30	20-30
10	80% Starch 20% Scripset 540 100%	70% CP-261 10% Airflex 20% Clay 100%	2.4	3.6	5	30-40	40-60
15	80% Starch 20% Airflex 110 100%	70% CP-261 10% Airflex 20% Clay 100%	2.4	5.4	2-3	40-50	60-70
5	80% Starch 20% Airflex 110 100%	80% ECR-77 20% Clay 100%	2.4	4.1	1	40-50	60-70
20	80% Starch 20% Airflex 110 100%	80% PCL-7513 20% Clay 100%	2.4	5.3	2	10	10
	Raw Stock		---	---	0	100	100

Scripset is a styrene/maleic anhydride latex.

Airflex is a ethylene/vinylacetate latex.

CP-261 is a homopolymer of dimethyl diallyl ammonium chloride.

PCL-7513 is a physical blend of a homopolymer of dimethyl diallyl ammonium chloride and a fluorosurfactant.

ECR-77 is a homopolymer of benzyl trimethyl ammonium chloride.

TABLE IV

	Coating Composition		Barrier	Conductive	Bar-rier	Total Coat Weight (g/m <sup>2</sup> )	Surface Resistivity (ohms/sq.)				
							at 50% R.H.		at 17.5% R.H.		
						Conduc-tive	To-tal	Top	Back	Top	Back
5	90% Starch	80% PCL-7513			2.4	5.8	8.2	1.1 x 10 <sup>7</sup>	1.1 x 10 <sup>7</sup>	4.5 x 10 <sup>8</sup>	4.5 x 10 <sup>8</sup>
	10% Scrip-set 540	20% Clay									
10	100%	100%									
	80% Starch	70% CP-261			2.4	3.6	6.0	1.2 x 10 <sup>7</sup>	1.2 x 10 <sup>7</sup>	4.1 x 10 <sup>8</sup>	4.1 x 10 <sup>8</sup>
	20% Scrip-set 540	10% Airflex									
	100%	20% Clay									
15	80% Starch	70% CP-261			2.4	5.4	7.8	2.5 x 10 <sup>7</sup>	2.8 x 10 <sup>7</sup>	6.5 x 10 <sup>8</sup>	6.7 x 10 <sup>8</sup>
	20% Airflex	10% Airflex									
	110	20% Clay									
	100%	100%									
20	80% Starch	80% ECR-77			2.4	4.1	6.5	3.3 x 10 <sup>7</sup>	2.8 x 10 <sup>7</sup>	6.7 x 10 <sup>8</sup>	7.7 x 10 <sup>8</sup>
	20% Airflex	20% Clay									
	110										
	100%	100%									
25	80% Starch	80% PCL-7513			2.4	5.3	7.7	2.1 x 10 <sup>7</sup>	2.3 x 10 <sup>7</sup>	6.7 x 10 <sup>8</sup>	6.7 x 10 <sup>8</sup>
	20% Airflex	20% Clay									
	110										
	100%	100%									
	Raw Stock				----	----	----	1.1 x 10 <sup>12</sup>	1.7 x 10 <sup>12</sup>	4.1 x 10 <sup>14</sup>	4.5 x 10 <sup>14</sup>

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TABLE IV (Continued)

Scripset is a styrene/maleic anhydride latex.

Airflex is a ethylene/vinylacetate latex.

CP-261 is a homopolymer of dimethyl diallyl ammonium chloride.

PCL-7513 is a physical blend of a homopolymer of dimethyl diallyl ammonium chloride and  
5 a fluorosurfactant.

ECR-77 is a homopolymer of benzyl trimethyl ammonium chloride.

The following tables (Tables V, VI and VII) illustrate the formulation and performance of other representative barrier and conductive coating formulations.

TABLE V

COMPOSITION OF CONDUCTIVE COATING COLORS  
AND BARRIER COATING COLORS

Barrier Coatings				
5	Component	Wt. % in Dry Coating	Wt. "as rec'd" in Color (g)	Dry Wt. in Color (g)
5	Kofilm 80 (25%) 1	80	96.0	24.0
	Airflex 110 (55%)	20	10.9	6.0
	Water	--	193.1	--
		100	300.0	30.0
10	Kofilm 80	80	96.0	24.0
	Dylex K-55E (50%)	20	12.0	6.0
	Water	--	192.0	--
		100	300.0	30.0
15	Kofilm 80	90	108.0	27.0
	Kelgin XL2	10	3.0	3.0
	Water	--	179.0	--
		100	300.0	30.0
20	Kofilm 80	98	117.6	29.4
	Zonyl RP (33%)	2	1.8	0.6
	Water	--	180.6	--
		100	300.0	30.0

TABLE V (Continued)

		Conductive Coatings			
	Component	Wt. % in Dry Coating	Wt. "as rec'd" in Color (g)	Dry Wt. in Color (g)	
5	PCL-7513 (20%)	70	140.0	28.0	
	Nuclay (50%)	30	24.0	12.0	
	Water	--	36.0	--	
		100	200.0	40.0	
10	Polymer E-949 (40%)	70	70.0	28.0	
	Nuclay	30	24.0	12.0	
	Water	--	106.0	--	
		100	200.0	40.0	
15	CP-261 LV (40%)	68.6	68.6	27.4	
	Scotchban FC-809 (33%)	1.4	1.7	0.6	
	Nuclay	30.0	24.0	12.0	
	Water	--	105.7	--	
		100.0	200.0	40.0	
20	CP-261 LV	70	70.0	28.0	
	Nuclay	30	24.0	12.0	
	Water	--	106.0	--	
		100	200.0	40.0	

TABLE V (Continued)

	Component	Wt. % in Dry Coating	Wt. "as rec'd" in Color (g)	Dry Wt. in Color (g)
5	Dow ECR-77 (34%)	70	82.4	28.0
	Nuclay	30	24.0	12.0
	Water	--	<u>93.6</u>	--
10		100	200.0	40.0
	CP-261 LV	68.6	68.6	27.4
	Scotchban FC-809	1.4	1.7	0.6
	Albaglos (50%)	30.0	24.0	12.0
	Water	--	<u>106.8</u>	--
		100.0	200.0	40.0

<sup>1</sup>Kofilm 80 was added as a 25% solution to the formulations

<sup>2</sup>Kelgin XL was dissolved in the available water before mixing with the Kofilm solution.

<sup>3</sup>Nuclay was added as a 50% solids slurry to the formulations.

Kofilm 80 is an acetylated starch.

Airflex 110 is an ethylene/vinylacetate latex.

Dylex K-55E is a styrene/butadiene latex.

Kelgin XL is sodium alginate.

PCL-7513 is a physical blend of a homopolymer of dimethyl diallyl ammonium chloride and a fluorosurfactant.

TABLE V (Continued)

- Nuclay is kaolin clay.
- Polymer E-949 is a copolymer of 90% by weight dimethyldiallylammonium chloride and 10% by weight acrylamide.
- 5 Scotchban FC-809 is a fluorosurfactant.
- Albaglos is precipitated calcium carbonate.

TABLE VI

SOLVENT HOLDOUT AND SURFACE RESISTIVITY  
PROPERTIES OF DRAWDOWNS COATED WITH  
VARIOUS CONDUCTIVE COATINGS  
ON THE SAME TYPE

Paper Substrate: raw stock coated with a starch/Scripset  
barrier coating applied in paper mills

10	Conductive Coating Composition	Coatweight on Top Side (g/m <sup>2</sup> )	% Toluene Penetration on Top Side	Surface	
				Resistivity at 15% R.H. (top side)	Resistivity at 15% R.H. (top side)
10	70% PCL-7513	4.2	10-20	1.8 x 10 <sup>8</sup>	1.8 x 10 <sup>8</sup>
	30% Clay	4.5	10	1.8 x 10 <sup>8</sup>	1.8 x 10 <sup>8</sup>
		4.9	0	1.5 x 10 <sup>8</sup>	1.5 x 10 <sup>8</sup>
15	70% E-949	4.2	50	4.1 x 10 <sup>8</sup>	4.1 x 10 <sup>8</sup>
	30% Clay	4.4	50	4.5 x 10 <sup>8</sup>	4.5 x 10 <sup>8</sup>
	68.6% CP-261LV 1.4% Scotchban FC-809 30.0% Clay	4.4 4.8	20-30 30	2.0 x 10 <sup>8</sup> 1.6 x 10 <sup>8</sup>	2.0 x 10 <sup>8</sup> 1.6 x 10 <sup>8</sup>
20	70% CP-261LV	4.2	50-60	1.3 x 10 <sup>8</sup>	1.3 x 10 <sup>8</sup>
	30% Clay	4.4	50-60	1.2 x 10 <sup>8</sup>	1.2 x 10 <sup>8</sup>
	70% ECR-77 30% Clay	3.9 4.1	40 30-40	2.5 x 10 <sup>8</sup> 2.8 x 10 <sup>8</sup>	2.5 x 10 <sup>8</sup> 2.8 x 10 <sup>8</sup>

TABLE VI (Continued)

	Conductive Coating Composition	Coatweight on Top Side (g/m <sup>2</sup> )	% Toluene Penetration on Top Side	Surface Resistivity at 15% R.H. (top side)
5	68.6% CP-261LV 1.4% Scotchban FC-809 30.0% Calcium Carbonate	4.4 4.7	30-40 40	1.8 x 10 <sup>8</sup> 1.7 x 10 <sup>8</sup>

10 PCL-7513 is a physical blend of a homopolymer of dimethyl diallyl ammonium chloride.

E-949 is a copolymer of 90% by weight dimethyldiallylammonium chloride and 10% by weight acrylamide.

CP-261LV is a homopolymer of dimethyldiallyl ammonium chloride.  
Scotchban FC-809 is a fluorosurfactant.

15 ECR-77 is a homopolymer of benzyl trimethyl ammonium chloride.

TABLE VII

SOLVENT HOLDOUT AND SURFACE REISISTIVITY  
 PROPERTIES OF DRAWDOWNS COATED WITH A  
 PCL-7513 CONDUCTIVE FORMULATION ON  
 VARIOUS TYPES OF BARRIER  
 COATED RAW STOCKS

5

Conductive Coating: 70% PCL-7513  
 30% Clay

10	Barrier Coating <sup>1</sup>		Conductive Coatweight (g/m <sup>2</sup> ) <sup>2</sup>	% Toluene Penetration on Top Side	Surface Resistivity at 15% R.H.
	Identity	Coatweight (g/m <sup>2</sup> )			
15	80% Kofilm	1.6	2.0	10	6.1 x 10 <sup>8</sup>
	20% Airflex				
15	80% Kofilm	1.5	2.3	10	4.5 x 10 <sup>8</sup>
	20% Dylex				
20	90% Kofilm	1.7	1.9	20-30	5.6 x 10 <sup>8</sup>
	10% Kelgin				
20	98% Kofilm	1.4	2.0	30	6.4 x 10 <sup>8</sup>
	2% Zonyl				
20	1 Applied to top side only				
20	2 Applied to top side only				

Kofilm is an acetylated starch.  
 Airflex is an ethylene/vinylacetate latex.

TABLE VII (Continued)

Dylex is a styrene/butadiene latex.

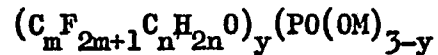
Kelgin is sodium alginate.

CLAIMS

1. An electroconductive article having improved solvent holdout and a low degree of tackiness, said article comprising a substrate coated on at least one side with a barrier coating and an electroconductive coating overlying the barrier coating, characterized by the barrier coating's consisting essentially of from 5 to 50 percent by weight of a copolymer of ethylene and vinyl acetate, a styrene-butadiene latex, sodium alginate or a fluorocarbon, together with from 95 to 50 percent by weight of a modified starch.
2. An article as claimed in Claim 1 in which both sides of the electroconductive article have an electroconductive coating.
3. An article as claimed in Claim 1 or 2 in which the electroconductive coating is poly-(dimethyl diallyl ammonium chloride), a copolymer of dimethyl diallyl ammonium chloride and diacetone acrylamide containing from 70 to 98% of diallyl monomer units, polyvinylbenzyl trimethyl ammonium chloride, polymethacryloyloxyethyl trimethyl ammonium chloride, polymethacryloyloxyethyl trimethyl ammonium methosulfate, polyepichlorohydrin 80 to 100% quaternized with trimethylamine, a copolymer of acrylamide and methacryloyloxyethyl trimethyl ammonium chloride containing from 90 to 99.5% methacryloyloxyethyl monomer units, poly-(methacryloyloxyethyl dimethyl hydroxyethyl ammonium chloride),

or poly-(dimethyl propyl ammonium chloride).

4. An article as claimed in Claim 1, 2 or 3, characterized by the electroconductive coating's also containing a fluorosurfactant of the formula :



where m is an integer between 4 and 10, n is an integer between 1 and 11, y is 1 or 2 and M is an alkali metal, ammonium or substituted ammonium cation, or an ammonium bis(N-ethyl-2-perfluoroalkylsulfonamido ethyl) phosphate containing not more than 15% ammonium mono(N-ethyl-2-perfluoroalkylsulfonamido ethyl) phosphates where the alkyl group is more than 95% by weight  $\text{C}_8$  and the fluorine content is 50.2 to 52.8% by weight as determined on a solids basis.

5. A method of preparing an article as claimed in any one of Claims 1 to 4, comprising applying the barrier coating to at least one side of the substrate, drying the barrier-coated substrate, applying the conductive coating over the barrier coating and drying the conductive coating.



DOCUMENTS CONSIDERED TO BE RELEVANT		CLASSIFICATION OF THE APPLICATION (Int. Cl.) 3
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	<p><u>US - A - 3 953 374</u> (WINDHAGER) ÷ Abstract; columns 2-4 + --</p> <p><u>US - E - 28 543</u> (BOOTHE) ÷ Columns 2,3,4 + --</p> <p><u>US - A - 3 900 319</u> (MILLER) ÷ Claim 1 + --</p> <p><u>US - A - 3 971 680</u> (SCHNEIDER) + Columns 1,2,3,4 + --</p> <p><u>DE - A1 - 2 551 018</u> (KONISHIROKU) + Pages 2 and 3 + --</p> <p><u>GB - A - 1 396 271</u> (AGFA) + Claims 1 to 8 + -----</p>	<p>1,3,4</p> <p>1,3</p> <p>1,3</p> <p>1,3</p> <p>1</p> <p>1,3</p>
		<p>G 03 G 5/14 C 08 K 5/01 C 08 K 5/02 C 08 L 3/00</p>
		<p>TECHNICAL FIELDS SEARCHED (Int.Cl.) 3</p>
		<p>C 08 L C 08 K C 03 G</p>
		<p>CATEGORY OF CITED DOCUMENTS</p> <p>X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons</p>
		<p>&amp;: member of the same patent family, corresponding document</p>
X	The present search report has been drawn up for all claims	
Place of search	Date of completion of the search	Examiner
VIENNA	14-02-1980	SALTEN