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ELECTRICAL INSULATING MATERIAL

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1 Claim. (Cl. 260—41)

This invention relates to electrical insulating materials, and particularly to insulating materials for use in electrical condensers, e. g. high frequency condensers, an object being to produce an insulating material of high specific inductive capacity (hereinafter referred to as permittivity), and low dielectric angle of loss (hereinafter referred to as power factor).

It is well known that many hydrocarbon polymers particularly vinyl compounds have satisfactory electrical properties, e. g. satisfactory dielectric breakdown strength low power factor and so on; such materials are also flexible or are capable of being rendered flexible, and polystyrene may be mentioned as a well-known example of such a material. On the other hand, pure polymerised materials such as polystyrene are not in general suitable for use in condensers in view of their low permittivity, and in view of the fact that their softening point is in general relatively low.

According to the present invention there is provided an insulating material comprising polymerised material in which are embedded finely comminuted inorganic particles, selected in order to produce an insulating material having a permittivity at least 10% greater than that of the original polymerized material without raising the power factor of the resulting insulating material above 0.0025. The original polymerised material may be an aromatic mono-olefine such as polystyrene, or an aliphatic olefine such as polyisobutylene or poly-ethylene. Alternatively a mixture of polymers may be employed, e. g. polystyrene blended with polyisobutylene or polyethylene, as described in our British Patent No. 507,323. Fillers and plasticisers may be added as desired, provided that the permittivity, power factor and other properties of the resulting insulating material are not thereby unduly impaired. For example, the polymerised material such as polystyrene may be blended with rubber or the like, with or without the addition of rubber plasticisers such as a ceresin wax, in accordance with British Patent No. 357,624. Alternatively the polystyrene may be blended with a plasticiser in accordance with United States application, Serial No. 190,032, filed February 11, 1938 and assigned to the present assignee.

The finely comminuted inorganic particles may be of crystalline form, whether in two dimensions such as mica, or three dimensions such as marble, Iceland spar or load chloride.

Particulars are given in the following table of results obtained by admixing various proportions of mica, Iceland spar, commercial rutile and load chloride with a mixture consisting of 63% polystyrene, 30% rubber and 7% ceresin wax (i. e. a mixture according to British Patent No. 357,624).

Material	A	B	C	D	E	F	G	H
		Percent	*Percent*				*Percent*	*Percent*
Polystyrene-rubber					2.75	.0015		
Polystyrene-rubber+mica	2.9	19.1	7.5	6.0	2.99	.0014	−6.7	8.7
		21.8	9.1		3.00			9.1
		24.4	10.0		3.25	.0016	+6.7	18.2
		33.9	15.0		3.13	.0021	+40.0	13.8
		35.8	16.7		3.08			12.0
		42.0	20.0		3.23	.0023	+53.3	17.4
Polystyrene-rubber+Iceland spar	2.71	8.9	3.5	8.2	2.97	.0015	0	8.0
		18.0	7.5		3.11	.0012	−20.0	13.1
		20.6	9.1					
		23.1	10.0		3.24	.0011	−26.7	17.8
		32.3	15.0		3.57	.0012	−20.0	29.8
		40.3	20.0		4.03	.0010	−33.3	46.6
Polystyrene-rubber+commercial rutile	4.17	17.0	4.7	(Calc.) (14.3)	3.29	.0016	+6.67	19.6
		27.3	8.6		3.46			25.8
		30.2	9.4		3.88	.0018	−20.0	41.1
		40.7	14.0		4.40	.0020	+33.3	60.0
Polystyrene-rubber+lead chloride	5.85	39.4	10.0	(Calc.) (13.8)	3.86	.0009	−40.0	40.4
		50.5	15.5		4.4	.0010	−29.0	60.5

A shows density of loading material.
B shows percentage of loading material—by weight.
C shows percentage of loading material—by volume.
D shows dielectric constant of loading material.
E shows dielectric constant of mixture—measured.
F shows power factor of mixture.
G shows percentage increase of power factor.
H shows percentage increase of dielectric constant.

The following table gives the results obtained by admixing various proportions of mica, Iceland spar, calc. spar, commercial rutile and lead chloride with pure polystyrene.

Material	A	B	C	D	E	F	G
Polystyrene					2.5	.0003	
Polystyrene+mica	2.9	*Percent* 13 27 35.6	*Percent* 5.0 11.8 16.7	6.0	2.77 2.78 3.20	 .0009	*Percent* 10.9 11.2 28.1
Polystyrene+Iceland spar	2.71	13	5.5	8.2	2.86	.0008	10.9
Polystyrene+calc. spar	2.71	13	5.5	8.2	2.82	.0004	12.8
Polystyrene+commercial rutile	4.17	13	3.7	(Calc.) (14)	3.00		16.2
Polystyrene+lead chloride	5.85	38.2 58.0	10.0 20.0	(Calc.) (14.6) (13.2)	4.04 4.94	.0007 .0017	41.0 72.5

A shows density of loading material.
B shows percentage of loading material—by weight.
C shows percentage of loading material—by volume.
D shows dielectric constant of loading material.
E shows dielectric constant of mixture—measured.
F shows power factor of mixture.
G shows percentage increase of dielectric constant.

In addition to the materials mentioned above, the following table gives a list of other materials which may be added in the form of finely comminuted particles to polymerised material in order to produce insulating material according to the invention.

	Permittivity	*Power factor*
Silver chloride	11.2	
Pure rutile	120–130	
Zircon ($Zr SiO_4$)	12	
Cassiterite (SnO_2)	23.7	
Pyromorphite	26+150 / 2	
Calomel	14	
Corundum	12	
Cerrussite ($PbCO_3$)	24	
Lead chloride	42	
Rochelle salt	80	
PbO	25.9	
CuO	18.1	
Aluminum oxide sintered at 1730°–1750° C. (about)	10-14	.003
Marble (calcium carbonate)	8.3	-----
Quartz or fused silica	5.0	.0002
Commercial steatite materials (forms of magnesium silicate) known under the trade name Alsimag as the products of the American Land Corporation		
No. 196	6.0	.0006
No. 197	6.0	.0012
No. 211	5.8	.0003
(Mainly rutile) No. 192	85	.0008
Ultra steatite (a form of magnesium silicate), product of the General Ceramics Co.	6.3	.0007
Commercial titanium dioxide fired twice at 1350° C	22-40	-----

Insulating materials in accordance with the invention may be applied in the manufacture of condensers as flexible films for winding into the well-known roll type condensers, or the insulating material may be shaped into moulded plates or the like. The electrodes may take the form of metal foil pressed into intimate contact with the insulating material, or metal may be sprayed or deposited onto the surface or surfaces thereof.

Preferably not more than 25% by volume of finely comminuted inorganic particles will be added to the polymerised material, and furthermore it is desirable that the added particles should have a permittivity value of 6 or above.

In preparing insulating material according to the invention, polymerised material may be dissolved in a suitable solvent, e. g. benzene, to form a thick dope to which the finely comminuted particles are added; thereafter the resulting mixtures may be sprayed or cast in a manner well known in the art in the preparation of films. Alternatively, the finely comminuted inorganic particles may be milled into the polymerised material in a manner similar to that employed in the rubber industry for incorporating fillers in rubber.

What is claimed is:

An insulating material for use as a dielectric of a condenser comprising a binding agent primarily consisting of polymerised styrene and an admixture of powdered particles of lead chloride, embedded in said binding agent in an amount not exceeding 25% by volume and not sufficient to raise the power factor of the resulting material above .0025, but sufficient to raise the permittivity of the resulting material by at least 10%.

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