Office de la Propriété
Intellectuelle
du Canada

Un organisme
d'Industrie Canada

Canadian
Intellectual Property
Office

An agency of
Industry Canada

CA 2464618 A1 2003/05/08

(21) 2 464 618

(12) DEMANDE DE BREVET CANADIEN CANADIAN PATENT APPLICATION

(13) A1

(86) **Date de dépôt PCT/PCT Filing Date**: 2002/10/14

(87) **Date publication PCT/PCT Publication Date**: 2003/05/08

(85) **Entrée phase nationale/National Entry**: 2004/04/23

(86) **N° demande PCT/PCT Application No.**: EP 2002/011474

(87) **N° publication PCT/PCT Publication No.**: 2003/037986

(30) **Priorité/Priority**: 2001/10/26 (101 52 318.1) DE

(51) **Cl.Int.^{7}/Int.Cl.^{7}** C08L 69/00, C08K 5/54, C08K 5/521, C08K 3/34

(71) **Demandeur/Applicant**:
BAYER AKTIENGESELLSCHAFT, DE

(72) **Inventeurs/Inventors**:
SEIDEL, ANDREAS, DE;
ECKEL, THOMAS, DE;
WITTMANN, DIETER, DE

(74) **Agent**: FETHERSTONHAUGH & CO.

(54) **Titre** : MATIERES A MOULER POLYCARBONATE IGNIFUGEES, A RESILIENCE MODIFIEE
(54) **Title**: FLAME-RETARDED POLYCARBONATE MOLDING MATERIALS HAVING MODIFIED IMPACT RESISTANCE

(57) **Abrégé/Abstract**:

The invention relates to a composition that contains: A) 50 to 90 parts by weight of a polycarbonate and/or polyestercarbonate, b) 5 to 20 parts by weight of rubber-modified vinyl(co)polymers, C) 2 to 15 parts by weight of at least one not easily volatized halogen-free flame retardant, D) 0.1 to 6 parts by weight of a silicate mineral, E) 0 to 1 parts by weight of fluorinated polyolefin, and F) 0 to 10 parts by weight of polymer additives. The composition has a rubber content, based on the total composition, of at least 2 and of not more than 6 % by weight and the sum of parts by weight of A) to F) totals 100. The invention also relates to the shaped parts that are produced from the inventive composition.

Impact-Resistant Modified and Flameproofed Polycarbonate Moulding Compositions

Abstract

Composition containing

A) 50 to 90 parts by weight of polycarbonate and/or polyester carbonate,
B) 5 to 20 parts by weight of rubber-modified vinyl (co)polymer,
C) 2 to 15 parts by weight of at least one low-volatility, halogen-free flameproofing agent,
D) 0.1 to 6 parts by weight of a silicate mineral,
E) 0 to 1 part by weight of fluorinated polyolefin, and
F) 0 to 10 parts by weight of polymer additives,

in which the composition has a rubber content referred to the total composition of at least 2 wt.% and at most 6 wt.%, and in which the total sum of the parts by weight of the components A) to F) is 100, as well as moulded parts obtainable therefrom.

Impact-Resistant Modified and Flameproofed Polycarbonate Moulding Compositions

The invention relates to impact-resistant modified and flameproofed polycarbonate compositions that have a rubber content, referred to the total composition, of 2 to 6 wt.% and that are suitable in particular for the production of thin-wall housing parts.

Halogen-free flameproofed PC/ABS moulding compositions are generally known.

Thus for example, flameproofed PC/ABS compositions that contain low-volatility oligomeric phosphoric acid esters as flame-retardant additive are described in US-A 5,204,394. The moulding compositions are characterised by a good thermal stability and flow line strength, and with a wall thickness of 1.6 mm have a V-0 evaluation in the UL 94 V flame resistance test. However, such an evaluation is not sufficient for many thin-wall applications. In order to achieve a satisfactory flame resistance also with thinner wall thicknesses, relatively large amounts of the plasticising flame-retardant additive have to be added. Such moulding compositions have an inadequate thermal stability and tend to form burning droplets in the aforementioned flame test, with the result that they achieve only a V-2 evaluation in the UL 94 V test.

In US-A 5,849,827 it is disclosed that the afterburning times of PC/ABS moulding compositions containing flameproofing agents can be reduced by adding nanoscale inorganic materials. The tendency to form burning droplets, especially in the case of thin wall thicknesses is, however, unaffected thereby.

PC/ABS compositions that contain silicate minerals are also known.

These reinforcing minerals may be used in order to obtain a very wide range of effects. They are used for example in order to have a positive effect on the stiffness and dimensional stability of the compositions. EP-A 0 391 413 describes PC/ABS moulding compositions reinforced with platelet-shaped inorganic fillers, which are characterised by a low coefficient of thermal expansion as well as by a good toughness and thermal stability. US-A 5,965,655 describes PC/ABS compositions to which special wollastonites are added in order to reduce the coefficient of thermal expansion, and which are characterised by an improved surface appearance combined with a good impact resistance. EP-A 0 452 788 describes PC/ABS moulding compositions to which talcum is added in order to reduce the degree of surface gloss. WO 98/51737 describes PC/ABS compositions containing mineral fillers such as talcum and wollastonite that have improved thermal stability, melt flowability, dimensional stability and low-temperature toughness. EP-A 1 038 920 describes *inter alia* PC/ABS moulding compositions reinforced with talcum and wollastonites that have an improved stability to hydrolysis. However, all these moulding compositions are not flameproofed moulding compositions, and are thus materials that do not pass the UL 94 V test.

Flameproofed PC/ABS moulding compositions containing silicate minerals are also known.

PC/ABS moulding compositions containing platelet-shaped minerals such as talcum and which are flameproofed with readily volatile monophosphates or halogen-containing additives are described in EP-A 0 641 827. Although the aforedescribed moulding compositions have a high modulus of elasticity, they have an insufficient toughness and flow line strength for many thin-wall housing applications.

EP-A 0 754 531 describes PC/ABS moulding compositions flameproofed with special low-volatility oligophosphates that contain platelet-shaped fillers such as layer-type aluminosilicates and are characterised by improved dimensional stability. In order to achieve these desired effects comparatively large amounts of fillers are necessary, whereby a toughness of the moulding compositions sufficient for thin-wall applications is no longer ensured.

In WO 00/46298 mixtures of polycarbonate and rubber-modified styrene resins are described that have been flameproofed with phosphoric acid esters and that contain talcum in low concentrations. The described moulding compositions are characterised by improved resistance to hydrolysis, but do not satisfy the stringent flameproofing requirements that thin-wall housing applications have to meet. PC/ABS moulding compositions are also described in WO 00/46298. These however are based on readily volatile monophosphates as flame-retardant additives and do not exhibit a satisfactory processing behaviour in injection moulding.

EP-A 1 026 205 describes flameproofed PC/ABS compositions containing silicate materials such as talcum or wollastonite that are also characterised by improved hydrolysis behaviour but insufficient flame resistance for thin-wall applications.

WO 00/39210 also describes reinforced PC/ABS compositions having an improved resistance to hydrolysis, that have been flameproofed with special phosphoric acid esters having a low acid number. Talcum or mixtures of talcum and glass fibres among other substances may be used as reinforcing material. The described moulding compositions have an insufficient toughness.

JP-A 11 199 768 describes PC/ABS compositions with phosphoric acid esters as flameproofing additives and that contain inorganic fillers such as talcum. The moulding compositions are characterised by an excellent flame resistance (UL 94 V-0 evaluation for wall thicknesses ≤ 1.0 mm) as well as by a good thermal stability and notch-impact resistance. These moulding compositions have an unsatisfactory processing behaviour however.

The flameproofed PC/ABS moulding compositions described in WO 01/48074 containing particularly pure talcum are characterised by improved stress-crack behaviour, high rigidity and good flame resistance. However, they do not satisfy the stringent requirements as regards the processing behaviour (prevention of tool encrustations), thermal stability as well as toughness and flow line strength of many thin-wall housing applications.

The object of the present invention was accordingly to develop flameproofed moulding compounds and compositions that are suitable in particular for the production of thin-wall housing parts such as handhelds (PDAs) and notebooks. Such moulding compositions have to satisfy stringent requirements of various types, including in particular:

a.) flame resistance according to UL 94 V-0 at ≤ 1.0 mm, preferably ≤ 0.9 mm, in particular ≤ 0.8 mm,

b.) no “juicing”, i.e. no outgassing/bleeding during injection moulding processing that lead to downtimes for cleaning the mould in the production of the moulded part and/or cause difficulties on account of oily deposits on the surfaces of the moulded parts during their surface treatment by for example lacquering or metalisation,

c.) thermal stability according to HDT/A of at least 80°C, preferably at least 83 °C, in particular at least 85°C,

d.) sufficient toughness at room temperature,

e.) flow line strength of at least 5 kJ/m^2, preferably at least 6 kJ/m^2, in particular at least 7 kJ/m^2, measured according to ISO 179/1eU,

f.) adequate flowability for the production of the thin-wall moulded parts as well as to avoid internal stresses that can lead to fractures (“cracking”) under long-term mechanical stress, and in particular also under the influence of chemicals.

The object is achieved by special impact-resistant modified flameproofed polycarbonate moulding compositions that have a rubber content, referred to the total composition, of 2 to 6 wt.%, preferably 4 to 6 wt.%.

The present invention accordingly provides compositions containing

A) 50 to 90 parts by weight, preferably 60 to 85 parts by weight, in particular 65 to 80 parts by weight of aromatic polycarbonate and/or polyester carbonate,

B) 5 to 20 parts by weight, preferably 8 to 18 parts by weight, in particular 10 to 15 parts by weight of rubber-modified vinyl (co)polymer,

C) 2 to 15 parts by weight, preferably 5 to 14 parts by weight, in particular 10 to 13.5 parts by weight of at least one low-volatility, halogen-free flameproofing agent, preferably an oligomeric phosphoric acid ester, in particular one based on bisphenol A or based on a bisphenol A derivative,

D) 0.1 to 6 parts by weight, preferably 1 to 5 parts by weight, particularly preferably 2 to 4.5 parts by weight of a silicate mineral, preferably a talcum or wollastonite, in particular a wollastonite,

E) 0 to 1 part by weight, preferably 0.1 to 0.5 part by weight of fluorinated polyolefin,

F) 0 to 10 parts by weight, preferably 0.1 to 5 parts by weight of commercially available polymer additives,

in which the composition has a rubber content, referred to the total composition, of at least 2 wt.% and at most 6 wt.%, preferably from 4 to 6 wt.%, and

in which the sum total of the parts by weight of the components A) to F) is 100.

The compositions have at typical processing temperatures preferably a mass loss of at most 0.8 wt.%, particularly preferably at most 0.5 wt.%, referred to the total composition, this mass loss being measured by means of thermogravimetric analysis

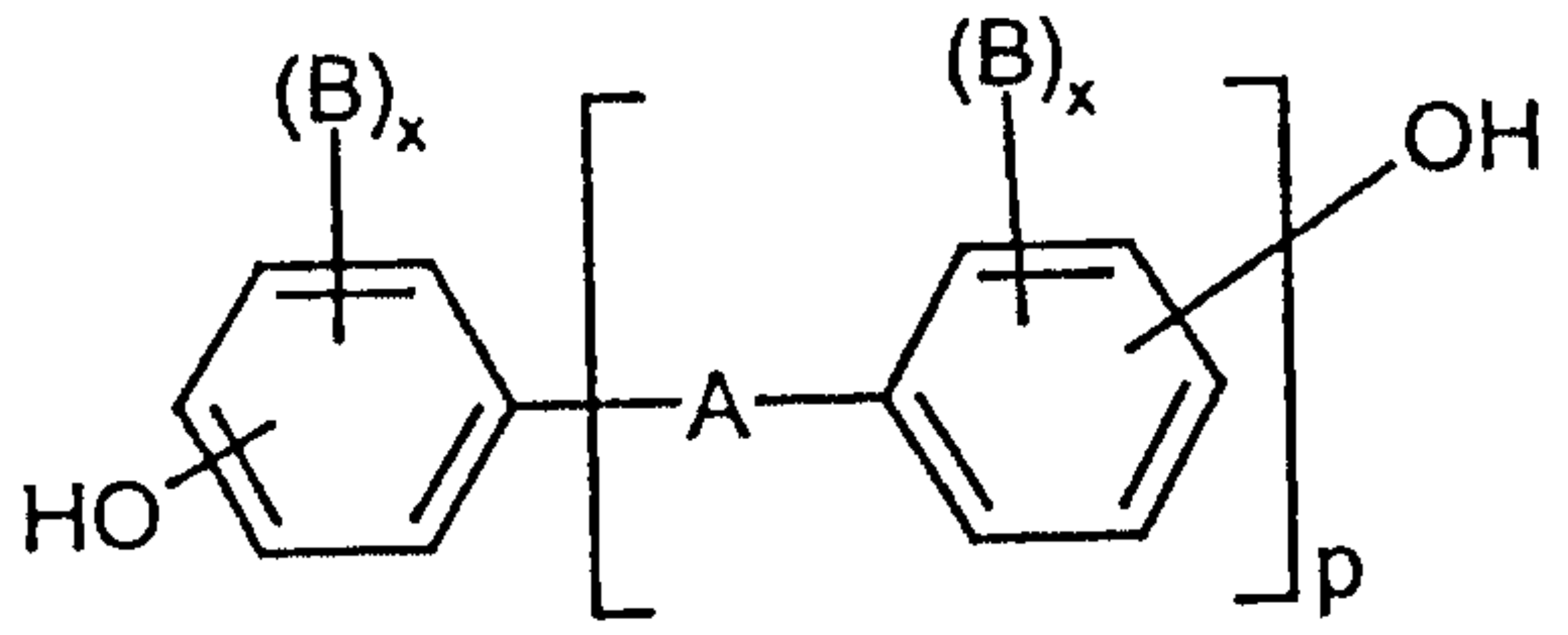
(TGA) dynamically in a nitrogen gas stream of 50 ml/min with a heating rate of 10 K/min at a temperature of 280°C.

Component A

Suitable aromatic polycarbonates and/or aromatic polyester carbonates of component A according to the invention are known in the literature or may be produced by processes known in the literature (for the production of aromatic polycarbonates see for example Schnell, "Chemistry and Physics of Polycarbonates", Interscience Publishers, 1964 as well as DE-AS 1 495 626, DE-A 2 232 877, DE-A 2 703 376, DE-A 2 714 544, DE-A 3 000 610, DE-A 3 832 396; for the production of aromatic polyester carbonates see for example DE-A 3 077 934).

The production of aromatic polycarbonates is carried out for example by reacting diphenols with carbonic acid halides, preferably phosgene, and/or with aromatic dicarboxylic acid dihalides, preferably benzenedicarboxylic acid dihalides, according to the phase interface process, optionally with the use of chain terminators, for example monophenols, and optionally with the use of trifunctional or higher-functional branching agents, for example triphenols or tetraphenols.

Diphenols suitable for the production of the aromatic polycarbonates and/or aromatic polyester carbonates are preferably those of the formula (I)

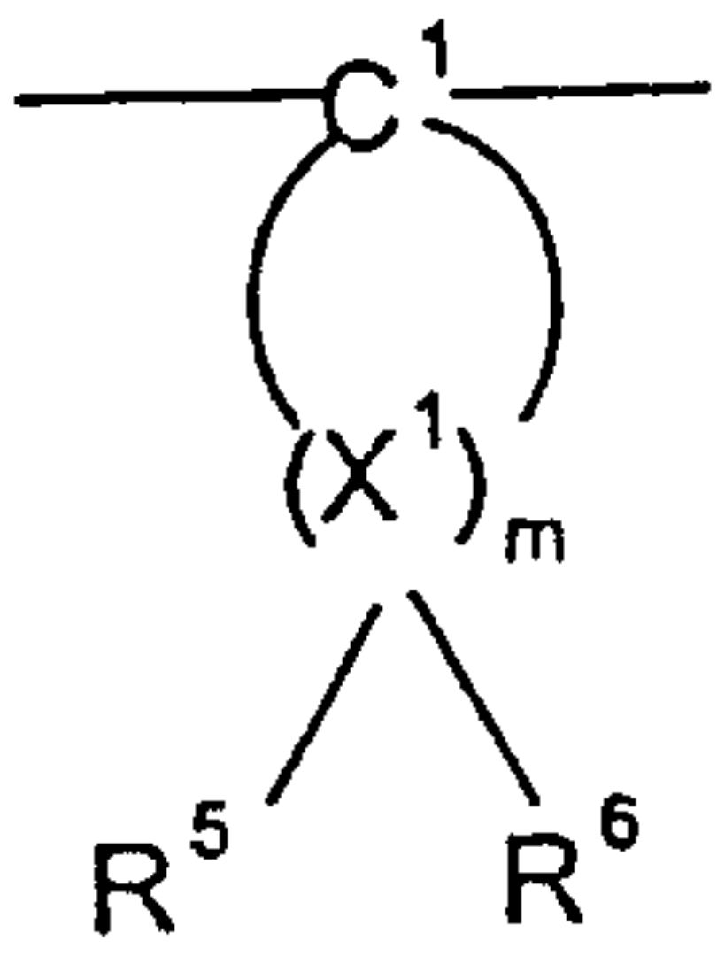


(I),

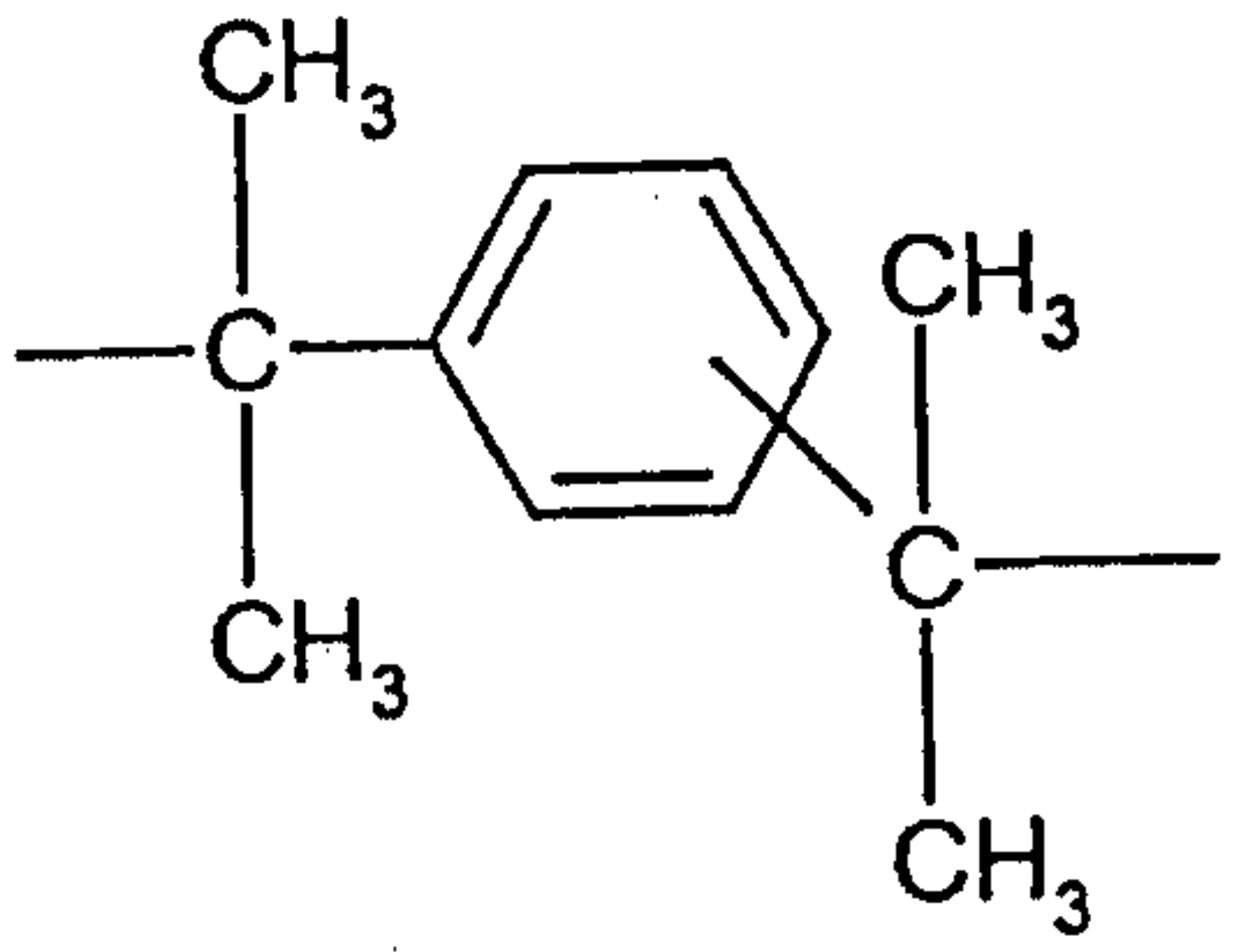
in which

A denotes a single bond, C_1 to C_5-alkylene, C_2 to C_5-alkylidene, C_5 to C_6-cycloalkylidene, -O-, -SO-, -CO-, -S-, $-SO_2-$, C_6 to C_{12}-arylene, onto which further aromatic rings, optionally containing heteroatoms, may be condensed,

or a radical of the formula (II) or (III)



(II)



(III)

B in each case denotes C_1 to C_{12}-alkyl, preferably methyl, halogen, preferably chlorine and/or bromine

x in each case independently of one another denotes 0, 1 or 2,

p is 1 or 0, and

R^5 and R^6 may be chosen individually for each X^1, and independently of one another denote hydrogen or C_1 to C_6-alkyl, preferably hydrogen, methyl or ethyl,

X^1 denotes carbon, and

m is a whole number from 4 to 7, preferably 4 or 5, with the proviso that on at least one atom X^1, R^5 and R^6 are simultaneously alkyl.

Preferred diphenols are hydroquinone, resorcinol, dihydroxydiphenols, bis-(hydroxyphenyl)-C_1-C_5-alkanes, bis-(hydroxyphenyl)-C_5-C_6-cycloalkanes, bis-(hydroxyphenyl)-ethers, bis-(hydroxyphenyl)-sulfoxides, bis-(hydroxyphenyl)-ketones, bis-(hydroxyphenyl)-sulfones and α,α-bis-(hydroxyphenyl)-diisopropylbenzenes as well as their nuclear-brominated and/or nuclear-chlorinated derivatives.

Particularly preferred diphenols are 4,4'-dihydroxydiphenyl, bisphenol A, 2,4-bis(4-hydroxyphenyl)-2-methylbutane, 1,1-bis-(4-hydroxyphenyl)-cyclohexane, 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane, 4,4'-dihydroxydiphenyl sulfide, 4,4'-dihydroxydiphenyl sulfone as well as their dibrominated and tetrabrominated or chlorinated derivatives such as for example 2,2-bis(3-chloro-4-hydroxyphenyl)-propane, 2,2-bis(3,5-dichloro-4-hydroxyphenyl)-propane or 2,2-bis(3,5-dibromo-4-hydroxyphenyl)-propane. In particular preferred is 2,2-bis(4-hydroxyphenyl)-propane (bisphenol A).

The diphenols may be used individually or as arbitrary mixtures with one another. The diphenols are known in the literature or may be obtained by processes known in the literature.

Suitable chain terminators for the production of the thermoplastic, aromatic polycarbonates include for example phenol, p-chlorophenol, p-tert.-butylphenol or 2,4,6-tribromophenol, as well as long-chain alkylphenols such as 4-(1,3-tetramethylbutyl)-phenol according to DE-A 2 842 005, or monoalkylphenol or dialkylphenols with a total of 8 to 20 carbon atoms in the alkyl substituents, such as 3,5-di-tert.-butylphenol, p-iso-octylphenol, p-tert.-octylphenol, p-dodecylphenol, and 2-(3,5-dimethylheptyl)-phenol and 4-(3,5-dimethylheptyl)-phenol. The amount of chain terminators to be used is in general between 0.5 mole % and 10 mole %, referred to the molar sum of the diphenols used in each case.

The thermoplastic, aromatic polycarbonates have mean, weight average molecular weights (M_w, measured for example by ultracentrifugation or light-scattering measurements) of 10,000 to 200,000, preferably 15,000 to 80,000.

The thermoplastic, aromatic polycarbonates may be branched in a known manner, and more specifically preferably by the incorporation of 0.05 to 2.0 mole %, referred to the sum of the diphenols used, of trifunctional or higher than trifunctional compounds, for example those with three and more phenolic groups.

Both homopolycarbonates as well as copolycarbonates are suitable. For the production of copolycarbonates of component A according to the invention there may also be used 1 to 25 wt.%, preferably 2.5 to 25 wt.%, referred to the total amount of diphenols to be used, of polydiorganosiloxanes with hydroxyaryloxy terminal groups. These are known (for example from US 3 419 634) and/or may be prepared according to processes known in the literature. The production of polydiorganosiloxane-containing copolycarbonates is described in DE-A 3 334 782.

Preferred polycarbonates include, besides the bisphenol A homopolycarbonates, also the copolycarbonates of bisphenol A with up to 15 mole %, referred to the molar sums of diphenols, other than preferred and/or particularly preferred aforementioned diphenols.

Aromatic dicarboxylic acid dihalides used for the production of aromatic polyester carbonates are preferably the diacid dichlorides of isophthalic acid, terephthalic acid, diphenylether-4,4′-dicarboxylic acid and naphthalene-2,6-dicarboxylic acid.

Particularly preferred are mixtures of the diacid dichlorides of isophthalic acid and terephthalic acid in a ratio between 1:20 and 20:1.

In the production of polyester carbonates a carbonic acid halide, preferably phosgene, is additionally co-used as bifunctional acid derivative.

As chain terminators for the production of the aromatic polyester carbonates there may suitably be used, apart from the already mentioned monophenols, also their chlorocarbonic acid esters as well as the acid chlorides of aromatic monocarboxylic acids that may optionally be substituted by C_1 to C_{22}-alkyl groups or by halogen atoms, as well as aliphatic C_2 to C_{22}-monocarboxylic acid chlorides.

The amount of chain terminators is in each case 0.1 to 10 mole %, referred in the case of phenolic chain terminators to moles of diphenol, and in the case of monocarboxylic acid chloride chain terminators, to moles of dicarboxylic acid dichlorides.

The aromatic polyester carbonates may also contain incorporated aromatic hydroxycarboxylic acids.

The aromatic polyester carbonates may be linear as well as, in a known manner, branched (see in this connection DE-A 2 940 024 and DE-A 3 007 934).

As branching agents there may for example be used trifunctional or higher-functional carboxylic acid chlorides such as trimesic acid trichloride, cyanuric acid trichloride, 3,3′,4,4′-benzophenonetetracarboxylic acid tetrachloride, 1,4,5,8-naphthalenetetracarboxylic acid tetrachloride or pyromellitic acid tetrachloride, in amounts of 0.01 to 1.0 mole % (referred to dicarboxylic acid dichlorides used) or trifunctional or higher-functional phenols such as phloroglucinol, 4,6-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-heptene-2,4,4-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-heptane, 1,3,5-tri-(4-hydroxyphenyl)-benzene, 1,1,1-tri-(4-hydroxyphenyl)-ethane, tri-(4-hydroxyphenyl)-phenylmethane, 2,2-bis[4,4-bis-(4-hydroxyphenyl)cyclohexyl]-propane, 2,4-bis-(4-hydroxyphenylisopropyl)-phenol, tetra-(4-hydroxyphenyl)-methane, 2,6-bis-(2-hydroxy-5-methylbenzyl)-4-methylphenol, 2-(4-hydroxyphenyl)-2-(2,4-dihydroxyphenyl)-propane, tetra-(4-[4-hydroxyphenylisopropyl]phenoxy)-methane, 1,4-bis-[4,4′-

dihydroxytriphenyl)methyl]-benzene, in amounts of 0.01 to 1.0 mole %, referred to diphenols used. Phenolic branching agents may be added together with the diphenols, while acid chloride branching agents may be introduced together with the acid dichlorides.

The proportion of carbonate structure units may vary arbitrarily in the thermoplastic, aromatic polyester carbonates. The proportion of carbonate groups is preferably up to 100 mole %, in particular up to 80 mole %, particularly preferably up to 50 mole %, referred to the sum total of ester groups and carbonate groups. Both the ester proportion as well as the carbonate proportion of the aromatic polyester carbonates may be present in the form of blocks or randomly distributed in the polycondensate.

The relative solution viscosity ($\eta_{rel.}$) of the aromatic polycarbonates and polyester carbonates is in the range 1.18 to 1.4, preferably 1.20 to 1.32 (measured in solutions of 0.5 g of polycarbonate or polyester carbonate in 100 ml of methylene chloride solution at 25°C).

The thermoplastic, aromatic polycarbonates and polyester carbonates may be used alone or in arbitrary mixtures. They may be contained in the composition according to the invention in an amount of preferably 50 to 90 parts by weight, in particular 60 to 85 parts by weight, and more particularly preferably 65 to 80 parts by weight.

Component B

The component B comprises graft polymers B1 of at least one vinyl monomer on at least one rubber with a glass transition temperature < 10°C as graft base.

Preferred graft polymers B1 are one or more graft polymers of

5 to 95 wt.%, preferably 20 to 90 wt.%, of a mixture of

1. 50 to 99 wt.%, in particular 50 to 90 wt.%, more preferably 55 to 85 wt.% and most particularly preferably 60 to 80 wt.% of vinyl aromatic compounds and/or nuclear-substituted vinyl aromatic compounds (such as for example styrene, α-methylstyrene, p-methylstyrene, p-chlorostyrene) and/or methacrylic acid -(C_1-C_8)-alkyl esters (such as methyl methacrylate, ethyl methacrylate) and

2. 1 to 50 wt.%, in particular 10 to 50 wt.%, more preferably 15 to 45 wt.% and most particularly preferably 20 to 40 wt.% of vinyl cyanides (unsaturated nitriles such as acrylonitrile and methacrylonitrile) and/or (meth)acrylic acid -(C_1-C_8)-alkyl esters (such as methyl methacrylate, n-butyl acrylate, tert.-butyl acrylate) and/or derivatives (such as anhydrides and imides) of unsaturated carboxylic acids (for example maleic anhydride and N-phenylmaleimide) on

95 to 5 wt.%, preferably 80 to 10 wt.% of one or more rubbers with glass transition temperatures < 10°C, preferably < 0°C, particularly preferably < -20°C as graft base.

The graft base generally has a mean particle size (d_{50} value) of 0.05 to 10 μm, preferably 0.1 to 5 μm, particularly preferably 0.2 to 1 μm.

The mean particle size d_{50} is the diameter above and below which in each case 50 wt.% of the particles lie, and may be determined by ultracentrifuge measurements (W. Scholtan, H. Lange, Kolloid, Z. und Z. Polymere 250 (1972), 782-796).

Preferred monomers of group 1 are selected from at least one of the monomers styrene, α-methylstyrene and methyl methacrylate, and preferred monomers of group 2 are selected from at least one of the monomers acrylonitrile, maleic anhydride and methyl methacrylate.

Particularly preferred monomers are styrene from group 1 and acrylonitrile from group 2.

Suitable graft bases for the graft polymers B1 include for example diene rubbers, EP(D)M rubbers, i.e. those based on ethylene/propylene and optionally diene, acrylate, polyurethane, silicone, chloroprene and ethylene/vinyl acetate rubbers as well as composite rubbers consisting of two or more of the aforementioned systems.

Preferred graft bases are diene rubbers (e.g. based on butadiene, isoprene, etc.) or mixtures of diene rubbers or copolymers of diene rubbers or their mixtures with further copolymerisable monomers (e.g. according to the above-specified groups 1 and 2), such as for example butadiene/styrene copolymers, with the proviso that the glass transition temperature of the graft base is < 10°C, preferably < 0°C, particularly preferably < -10°C.

Pure polybutadiene rubber is particularly preferred.

Particularly preferred graft polymers B1 are for example ABS polymers (emulsion, bulk and suspension ABS) such as are described for example in DE-A 2 035 390 (=US-PS 3 644 574) or in DE-A 2 248 242 (=GB-PS 1 409 275) or in Ullmanns Enzyklopädie der Technischen Chemie, Vol. 19 (1980), p. 280 ff. The gel content of the graft base is at least 30 wt.%, preferably at least 40 wt.%.

The gel content of the graft base is determined at 25°C in toluene (M. Hoffmann, H. Krömer, R. Kuhn, Polymeranalytik I und II, Georg Thieme-Verlag, Stuttgart 1977).

The graft copolymers B1 are produced by free-radical polymerisation, e.g. by emulsion, suspension, solution or bulk polymerisation, preferably by emulsion or bulk polymerisation.

Particularly suitable graft rubbers are also ABS polymers that are produced by redox initiation with an initiator system of organic hydroperoxide and ascorbic acid according to US-P 4 937 285.

Since in the grafting reaction the graft monomers are, as is known, not necessarily completely grafted onto the graft base, according to the invention the term graft polymer is also understood to include those products that are obtained by (co)polymerisation of the graft monomers in the presence of the graft base and that occur during the working-up.

Suitable acrylate rubbers as graft base are preferably polymers of acrylic acid alkyl esters, and optionally also copolymers with up to 40 wt.% referred to the graft base of other polymerisable, ethylenically unsaturated monomers. The preferred polymerisable acrylic acid esters include C_1 to C_8-alkyl esters, for example methyl, ethyl, butyl, n-octyl and 2-ethylhexyl esters, halogenated alkyl esters, preferably halogen-C_1-C_8-alkyl esters such as chloroethyl acrylate, as well as mixtures of these monomers.

For the crosslinking, monomers containing more than one polymerisable double bond may be copolymerised. Preferred examples of crosslinking monomers are esters of unsaturated monocarboxylic acids with 3 to 8 C atoms and unsaturated monohydric alcohols with 3 to 12 C atoms, or saturated polyols with 2 to 4 OH groups and 2 to 20 C atoms, such as ethylene glycol dimethacrylate, allyl methacrylate; multiply unsaturated heterocyclic compounds such as trivinyl cyanurate and triallyl cyanurate; polyfunctional vinyl compounds such as divinylbenzenes and trivinylbenzenes; and also triallyl phosphate and diallyl phthalate.

Preferred crosslinking monomers are allyl methacrylate, ethylene glycol dimethacrylate, diallyl phthalate and heterocyclic compounds that have at least three ethylenically unsaturated groups.

Particularly preferred crosslinking monomers are the cyclic monomers triallyl cyanurate, triallyl isocyanurate, triacryloylhexahydro-s-triazine, and triallylbenzenes.

The amount of the crosslinking monomers is preferably 0.02 to 5 wt.%, in particular 0.05 to 2 wt.%, referred to the graft base.

In the case of cyclic crosslinking monomers containing at least three ethylenically unsaturated groups it is advantageous to restrict the amount to below 1 wt.% of the graft base.

Preferred "other" polymerisable ethylenically unsaturated monomers that apart from the acrylic acid esters may optionally serve for the production of the graft base include for example acrylonitrile, styrene, α-methylstyrene, acrylamides, vinyl -C_1-C_6-alkyl ethers, methyl methacrylate, and butadiene. Preferred acrylate rubbers as graft base are emulsion polymers that have a gel content of at least 60 wt.%.

Further suitable graft bases are silicone rubbers with graft-active sites, such as are described in DE-A 3 704 657, DE-A 3 704 655, DE-A 3 631 540 and DE-A 3 631 539.

Component B may furthermore contain one or more thermoplastic vinyl (co)polymers B2 in which the aforementioned graft polymers B1 are preferably present in dispersed form in the composition according to the invention.

Suitable as vinyl (co)polymers B2 are polymers of at least one monomer from the group comprising vinyl aromatic compounds, vinyl cyanides (unsaturated nitriles), (meth)acrylic acid (C_1-C_8) alkyl esters, unsaturated carboxylic acids as well as derivatives (such as anhydrides and imides) of unsaturated carboxylic acids. Suitable in particular are (co)polymers of

50 to 99 wt.%, preferably 60 to 80 wt.% of vinyl aromatic compounds and/or nuclear-substituted vinyl aromatic compounds such as for example styrene, α-methylstyrene, p-methylstyrene, p-chlorostyrene and/or methacrylic acid -(C_1-C_8)-alkyl esters such as methyl methacrylate, ethyl methacrylate, and

1 to 50 wt.%, preferably 20 to 40 wt.% of vinyl cyanides (unsaturated nitriles) such as acrylonitrile and methacrylonitrile and/or (meth)acrylic acid -(C_1-C_8)-alkyl esters (such as methyl methacrylate, n-butyl acrylate, tert.-butyl acrylate) and/or unsaturated carboxylic acids (such as maleic acid) and/or derivatives (such as anhydrides and imides) of unsaturated carboxylic acids (for example maleic anhydride and N-phenylmaleimide).

The (co)polymers B2 are resin-like and thermoplastic.

The copolymer of styrene and acrylonitrile is particularly preferred.

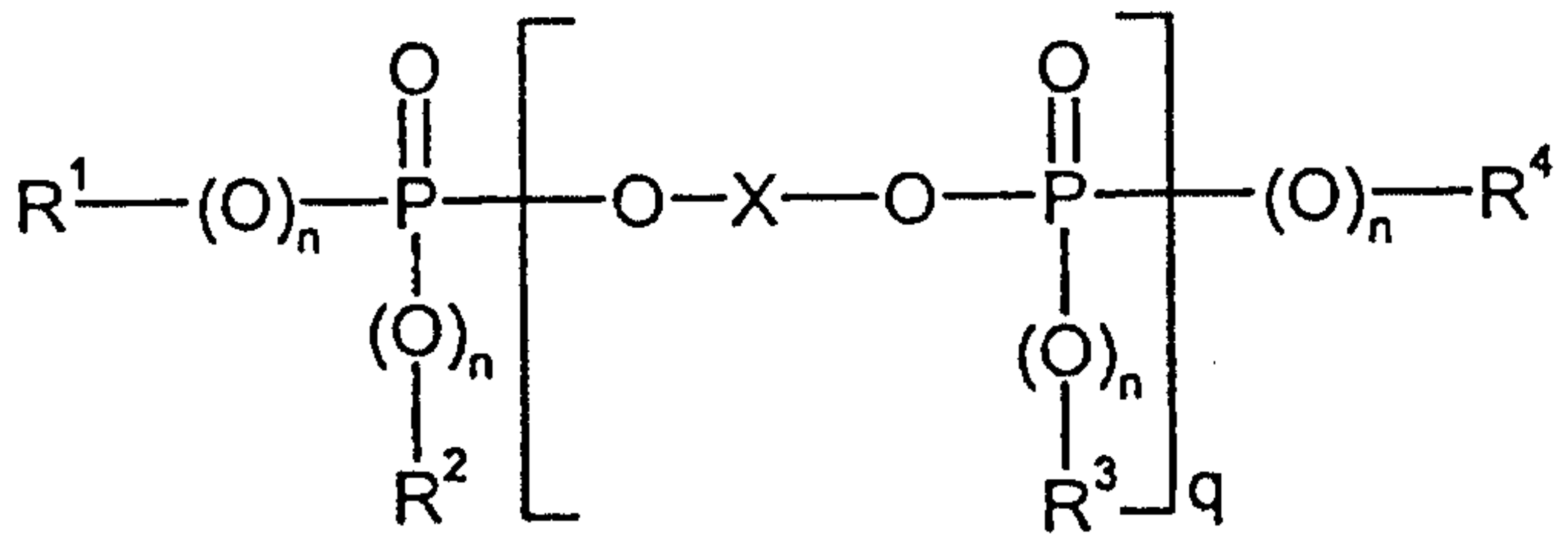
The (co)polymers according to B2 are known and can be produced by free-radical polymerisation, in particular by emulsion, suspension, solution or bulk polymerisation. The (co)polymers preferably have mean molecular weights M_w (weight average, determined by light scattering or sedimentation measurements) between 15,000 and 200,000.

The component B may be used in the moulding compositions according to the invention in amounts of 5 to 20 parts by weight, preferably 8 to 18 parts by weight, in particular 10 to 15 parts by weight.

Component C

The compositions contain low-volatility halogen-free flameproofing agents. The following may be mentioned by way of example of such flameproofing agents: phosphorus-containing compounds such as oligomeric phosphoric acid esters and phosphonic acid esters, phosphonatamines and phosphazenes, as well as silicones, in which connection mixtures of several of the aforementioned components may also be used as flameproofing agents. There may also be used other low-volatility flameproofing agents not specifically mentioned here, in particular phosphorus compounds, which may be used alone or in arbitrary combinations with one another.

There are preferably used as flame-retardant additives those oligomeric phosphoric acid and phosphonic acid esters of the general formula (IV)



$$R^1-(O)_n-\overset{O}{\overset{\|}{\underset{\underset{R^2}{|}}{\underset{(O)_n}{\underset{|}{P}}}}}-\left[O-X-O-\overset{O}{\overset{\|}{\underset{\underset{R^3}{|}}{\underset{(O)_n}{\underset{|}{P}}}}}\right]_q-(O)_n-R^4$$

(IV)

in which

R^1, R^2, R^3 and R^4 independently of one another in each case denote C_1 to C_8-alkyl, or C_5 to C_6-cycloalkyl, C_6 to C_{20}-aryl or C_7 to C_{12}-aralkyl in each case optionally substituted by alkyl, preferably C_1 to C_4-alkyl,

n independently of one another is 0 or 1

q is 0.9 to 30, and

X denotes a mononuclear or polynuclear aromatic radical with 6 to 30 C atoms, or a linear or branched aliphatic radical with 2 to 30 C atoms, which may be OH-substituted and may contain up to 8 ether bonds.

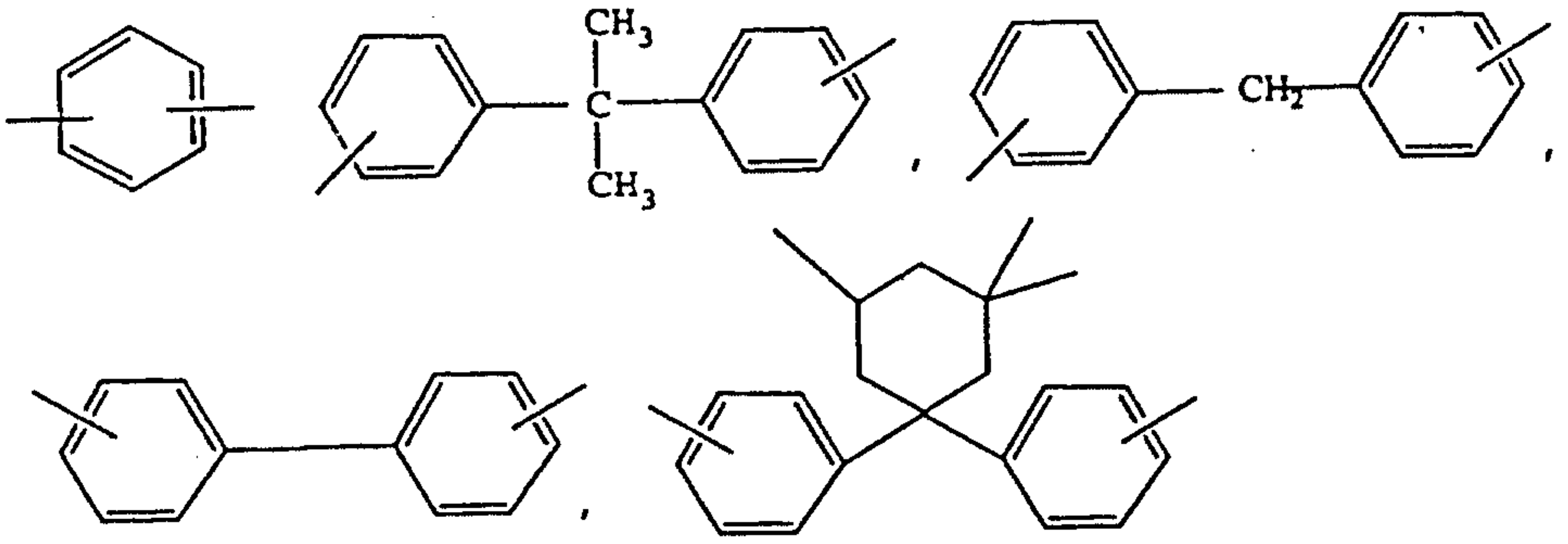
Preferably R^1, R^2, R^3 and R^4 independently of one another denote C_1 to C_4-alkyl, phenyl, naphthyl or phenyl-C_1-C_4-alkyl. The aromatic groups R^1, R^2, R^3 and R^4 may in turn be substituted by alkyl groups, preferably C_1 to C_4-alkyl. Particularly preferred aryl radicals are cresyl, phenyl, xylenyl, propylphenyl or butylphenyl.

X in the formula (IV) preferably denotes a mononuclear or polynuclear aromatic radical with 6 to 30 C atoms. This is preferably derived from diphenols of the formula (I).

n in the formula (IV) may independently of one another be 0 or 1, and n is preferably equal to 1.

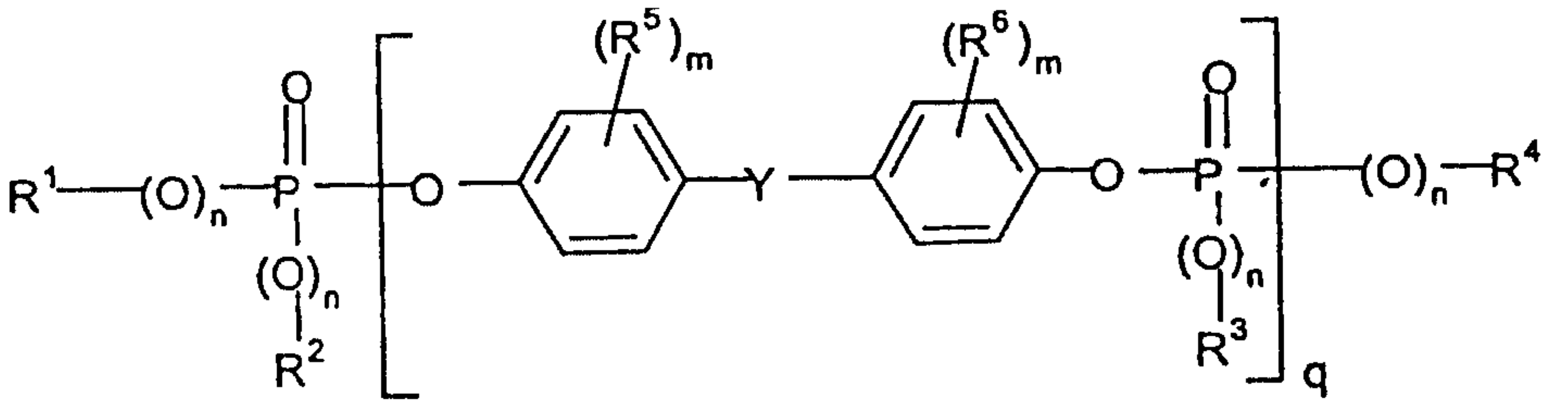
q denotes values from 0.9 to 30, preferably 1 to 15, particularly preferably 1 to 5, in particular 1 to 2.

X particularly preferably denotes



and in particular X is derived from resorcinol, hydroquinone, bisphenol A or diphenylphenol. Particularly preferably X is derived from bisphenol A.

Further preferred phosphorus-containing compounds are compounds of the formula (IVa)



(IVa)

in which

R^1, R^2, R^3, R^4, n and q have the meanings given in formula (IV),

m independently of one another is 0, 1, 2, 3 or 4,

R^5 and R^6 independently of one another denote C_1 to C_4-alkyl, preferably methyl or ethyl, and

Y denotes C_1 to C_7-alkylidene, C_1 to C_7-alkylene, C_5 to C_{12}-cycloalkylene, C_5 to C_{12}-cycloalkylidene, -O-, -S-, $-SO_2-$ or -CO-, preferably isopropylidene or methylene.

Mixtures of several components according to formulae (IV) and (IVa) may also preferably be used, in which connection these may differ both in their chemical structure as well as in the degree of oligomerisation q.

As component C according to the invention there may also be used monophosphates (q=0), optionally mixed with other compounds so long as these are either of sufficiently low volatility *per se* or can be used in sufficiently small concentrations.

The phosphorus compounds according to component C are known (see for example EP-A 0 363 608, EP-A 0 640 655) or can be produced in a similar manner by known methods (see for example Ullmanns Enzyklopädie der Technischen Chemie, Vol. 18, p. 301 ff. 1979; Houben-Weyl, Methoden der Organischen Chemie, Vol. 12/1, p. 43; Beilstein Vol. 6, p. 177).

The mean q values may be derived by determining the composition of the phosphate mixture (molecular weight distribution) by means of suitable methods (gas chromatography (GC), high pressure liquid chromatography (HPLC), gel permeation chromatography (GPC)) and calculating therefrom the mean values for q.

The component C may be used in the compositions according to the invention in amounts of 2 to 15 parts by weight, preferably 5 to 14 parts by weight, in particular 10 to 13.5 parts by weight.

Component D

As silicate material there may in principle be used all natural or synthetically produced salts of silicic acid as well as all salts that are derived from silicic acid as the main constituent. The silicate minerals are generally known and can be obtained commercially.

Preferably inorganic materials such as talcum, wollastonite or mixtures of talcum and wollastonite are used. Wollastonite is in particular preferred. The inorganic materials may be surface-treated, for example silanised, in order to ensure a better polymer compatibility.
The component D may be used in the compositions according to the invention in amounts of 0.1 to 6 parts by weight, preferably 1 to 5 parts by weight, particularly preferably 2 to 4.5 parts by weight.

Component E

The flameproofing agents corresponding to component C are often used in combination with so-called anti-drip agents, which reduce the tendency of the material to form burning droplets in the event of fire. By way of example there may be mentioned here compounds from the classes of substances comprising fluorinated polyolefins, silicones as well as aramide fibres. These may also be employed in the compositions according to the invention. Fluorinated polyolefins are preferably used as anti-drip agents.

Fluorinated polyolefins are known and are described for example in EP-A 0 640 655. They are marketed by DuPont for example under the trade name Teflon® 30N.

The fluorinated polyolefins may be used in pure form as well as in the form of a coagulated mixture of emulsions of the fluorinated polyolefins with emulsions of the graft polymers (component B) or with an emulsion of a copolymer, preferably based on styrene/acrylonitrile, in which the fluorinated polyolefin is mixed as an emulsion with an emulsion of the graft polymer or of the copolymer and is then coagulated.

Furthermore the fluorinated polyolefins may be employed as pre-compound with the graft polymer (component B) or with a copolymer, preferably based on styrene/acrylonitrile. The fluorinated polyolefins are mixed as powder with a powder or granular material of the graft polymer or copolymer and compounded in the melt in general at temperatures from 200° to 330°C in conventional equipment such as internal kneaders, extruders or double-shaft screw extruders.

The fluorinated polyolefins may also be used in the form of a master batch that is produced by emulsion polymerisation of at least one monoethylenically unsaturated monomer in the presence of an aqueous dispersion of the fluorinated polyolefin. Preferred monomer components are styrene, acrylonitrile and their mixtures. The polymer is used after precipitation with an acid and subsequent drying as a flowable powder.

The coagulates, pre-compounds or master batches usually have solids contents of fluorinated polyolefin of 5 to 95 wt.%, preferably 7 to 80 wt.%.

The fluorinated polyolefins may be employed in concentrations of 0 to 1 part by weight, preferably 0.1 to 0.5 part by weight, these quantitative figures referring to the pure fluorinated polyolefin in the case of the use of a coagulate, precompound or master batch.

Component F (further additives)

The compositions according to the invention may furthermore contain up to 10 parts by weight, preferably 0.1 to 5 parts by weight, of at least one conventional polymer additive such as a lubricant or mould release agent, for example pentaerythritol tetrastearate, a nucleating agent, an antistatic, a stabiliser or a filler and reinforcing agent as well as a dye or pigment.

All figures relating to parts by weight in this application are standardised so that the sum total of the parts by weight of all components in the composition is 100.

The compositions according to the invention are produced by mixing the respective constituents in a known manner and melt-compounding and melt-extruding the compositions at temperatures of 200°C to 300°C in conventional equipment such as internal kneaders, extruders and double-shaft screw extruders.

The mixing of the individual constituents may be carried out in a known manner successively as well as simultaneously, and more specifically at about 20°C (room temperature) as well as at higher temperatures.

The moulding compositions according to the invention may be used to produce all types of moulded parts. These may be produced by injection moulding, extrusion and blow moulding processes. A further form of processing is the production of moulded parts by thermoforming from previously fabricated sheets or films.

Examples of such moulded parts are sheets, profiled sections, all types of housing parts, e.g. for domestic appliances such as juice presses, coffee-making machines, mixers; for office equipment such as monitors, printers, copiers; also panels, tubing, electrical installation ducting, profiled sections for internal and external applications in the building and construction sector; parts from the electrical equipment sector such as switches and plugs, as well as internal and external vehicle parts.

In particular the moulding compositions according to the invention may be used for example to produce the following moulded parts:

Internal structural parts for tracked vehicles, ships, aircraft, buses and automobiles, wheelcaps, housings for electrical equipment containing small transformers, housings for equipment for information processing and transmission, housings and casings for medical purposes, massage equipment and housings therefor, children's toy vehicles, two-dimensional wall elements, housings for safety devices and equipment, rear spoilers, motor vehicle body parts, thermally insulated transportation containers, devices for holding or looking after small animals, moulded parts for sanitaryware and bathroom fittings, cover gratings for ventilator openings, moulded parts for garden sheds and equipment housings, and housings for gardening tools.

The compositions are particularly preferably used in the production of thin-wall housing parts by injection moulding; the following may be mentioned by way of example: notebooks, handhelds (PDAs) and mobile phone casings.

The following examples serve to illustrate the invention in more detail.

Examples

The components listed in Table 1 and described briefly hereinafter were melt-compounded in a ZSK-25 machine at 240°C. The test specimens were produced in an Arburg 270 E type injection moulding machine at 240°C.

Component A1

Linear polycarbonate based on bisphenol A with a relative solution viscosity of 1.24 measured in CH_2Cl_2 as solvent at 25°C and in a concentration of 0.5 g/100 ml.

Component A2

Linear polycarbonate based on bisphenol A with a relative solution viscosity of 1.25 measured in CH_2Cl_2 as solvent at 25°C and in a concentration of 0.5 g/100 ml.

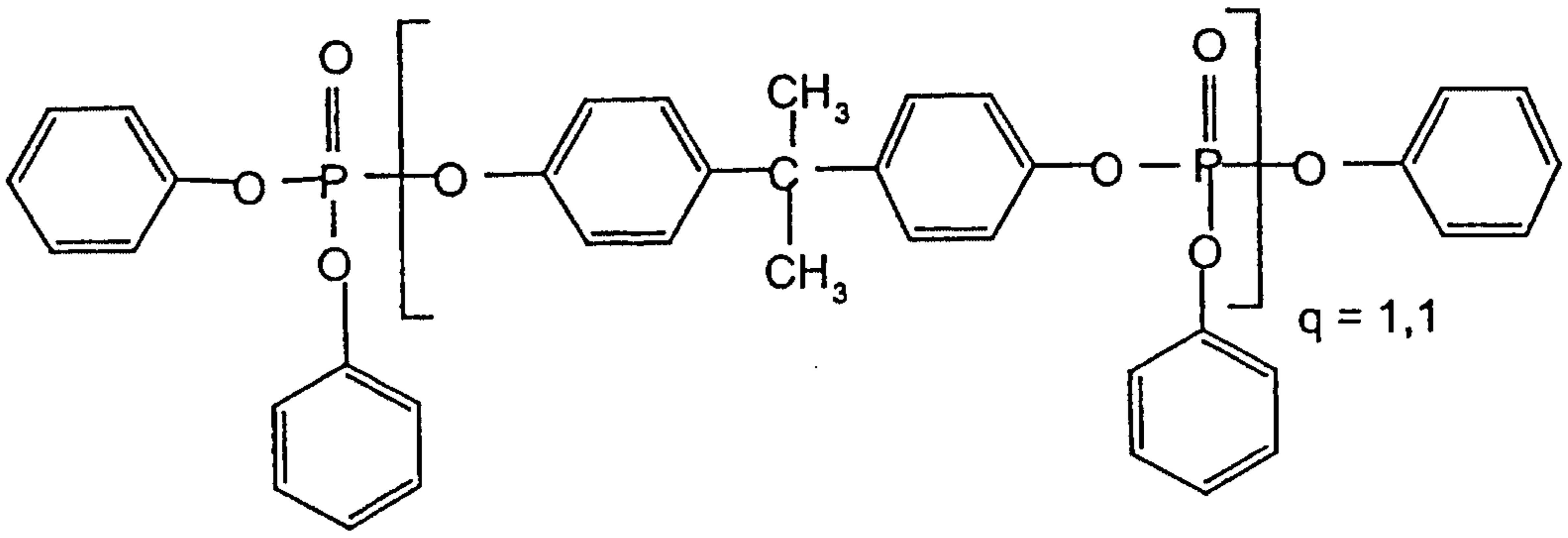
Component B

B1: Graft polymer of 40 parts by weight of a copolymer of styrene and acrylonitrile in a ratio of 73:27 on 60 parts by weight of particulate crosslinked polybutadiene rubber (mean particle diameter $d_{50} = 0.3$ µm) produced by emulsion polymerisation.

B2: Styrene/acrylonitrile copolymer with a styrene/acrylonitrile weight ratio of 72:28 and an intrinsic viscosity of 0.55 dl/g (measured in dimethylformamide at 20°C).

Component C1

Bisphenol A-based oligophosphate



Component C2

Mixture of 3 parts by weight of m-phenylene-bis-diphenyl phosphate (Fyrolflex® RDP from Akzo Nobel Chemicals GmbH, 52349 Düren, Germany) and 1 part by weight of triphenyl phosphate (Disflamoll® TP, Bayer AG).

Component D1

Naintsch A3: talcum from Naintsch Mineralwerke GmbH, Graz, Austria

Component D2

Westmin 8: talcum from Omya GmbH, Cologne, Germany

Component D3

Pural 200: nanoscale boehmite A1O(OH) from Condea Chemie GmbH, Hamburg, Germany

Component D4

Nyglos® 4: wollastonite from NYCO Minerals Inc., Willsboro, NY, USA

Component D5

Wolkron® 1005: wollastonite from Heinrich Osthoff-Petrasch GmbH & Co., KG, Norderstedt, Germany

Component D6

Nyglos® 5: wollastonite from NYCO Minerals Inc., Willsboro, NY, USA

Component E

Tetrafluoroethylene polymer as a coagulated mixture of a graft polymer emulsion according to the component B1 mentioned above in water and a tetrafluoroethylene polymer emulsion in water. The weight ratio of graft polymer B1 to tetrafluoroethylene polymer in the mixture is 90 wt.% to 10 wt.%. The tetrafluoroethylene polymer emulsion has a solids content of 60 wt.%, and the mean particle diameter is between 0.05 and 0.5 μm. The graft polymer emulsion has a solids content of 34 wt.%.

The emulsion of the tetrafluoroethylene polymer (Teflon® 30 N from DuPont) is mixed with the emulsion of the graft polymer B1 and stabilised with 1.8 wt.%, referred to polymer solids, of phenolic antioxidants. The mixture is coagulated at 85° to 95°C with an aqueous solution of $MgSO_4$ (Epsom salt) and acetic acid at pH 4 to 5, filtered and washed until practically free from electrolyte, then freed from the majority of the water by centrifugation and finally dried at 100°C to form a powder.

Component F1

Pentaerythritol tetrastearate (PETS) as mould release agent

Component F2

Phosphite stabiliser

Investigation of the properties of the moulding compositions according to the invention

In order to determine the flow line strength the impact resistance at the flow line of test bodies of dimensions 170 mm x 10 mm x 4 mm gated on both sides (processing temperature: 240°C) is measured according to ISO 179/1eU.

The fire behaviour of the flameproofed test specimens was measured according to UL-Subj. 94 V on rods of dimensions 127 mm x 12.7 mm x 1.2 mm/1.0 mm/0.8 mm.

The determination of the HDT/A is carried out according to ISO 75.

The determination of the melt viscosity is carried out according to DIN 54 811 up to 260°C and at a shear rate of 1,000 s^{-1}.

The toughness level is evaluated in the impact bending test according to ISO 180-1U, and more specifically whether a fracture occurs at 23°C.

Table 1 Moulding compositions and their properties

Components (figures in parts by weight)	V1	V2	3	4	V5	6	7	8
A1 (PC)	66.0	69.0	72.0	75.0	63.2	69.0	69.0	69.0
A2 (PC)	-	-	-	-	-	-	-	-
B1 (graft)	3.0	3.0	3.0	3.0	4.9	4.9	4.9	4.9
B2 (SAN)	5.0	5.0	5.0	5.0	4.9	4.9	4.9	4.9
C1 (BDP)	11.0	11.0	11.0	11.0	12.8	12.8	12.8	12.8
C2 (RDP/TPP mixture)	-	-	-	-	-	-	-	-
D1 (talcum) Naintsch A3	10.0	7.0	4.0	1.0	9.8	4.0	-	-
D2 (talcum) Westmin 8	-	-	-	-	-	-	-	-
D3 (nano boehmite) Pural 200	-	-	-	-	-	-	-	-
D4 (wollastonite) Nyglos 4	-	-	-	-	-	-	-	-
D5 (wollastonite) Wolkron 1005	-	-	-	-	-	-	4.0	-
D6 (wollastonite) Nyglos 5	-	-	-	-	-	-	-	4.0
E (Teflon/B1 master batch 10:90)	-	-	-	-	-	-	-	-
G1 (mould release agent)	4.5	4.5	4.5	4.5	3.9	3.9	3.9	3.9
G2 (stabiliser)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ABS total [1]	12.1	12.1	12.1	12.1	13.3	13.3	13.3	13.3
Rubber content in wt.% [2]	4.2	4.2	4.2	4.2	5.0	5.0	5.0	5.0
UL 94 V (1.2 mm)	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-1
UL 94 V (1.0 mm)	V-0	V-0	V-0	V-0	V-0	V-0	V-0	V-0
UL 94 V (0.8 mm)	V-1	V-0	V-0	V-0	V-0	V-0	V-0	V-0
HDT/A [°C]	89	88	88	88	85	86	85	84
a_n (flow line) [kJ/m^2]	4	5	6	8	3	6	8	10
Impact bend. test according to ISO 180/1U	Fracture	Fracture	No fracture	No fracture	Fracture	No fracture	No fracture	No fracture
Melt viscosity (260°C/1000s^{-1}) [Pas]	181	182	184	181	150	171	164	156
TGA (mass loss at 280°C) [%]	n.m.	n.m.	n.m.	n.m.	0.2	n.m.	n.m.	n.m.

[1] B1 + B2 + B1 from E (amount B1 from E corresponds to 90 wt.% of E)

[2] Referred to the total composition

[3] not measured = n.m.

Table 1 (continued)

Components (figures in parts by weight)	9	10	11	12	V13	V14	V15	V16
A1 (PC)	69.0	70.0	74.0	71.0	73.0	65.3	65.3	71.2
A2 (PC)	-	-	-	-	-	-	-	-
B1 (graft)	4.9	4.9	3.0	5.0	5.0	7.0	7.0	5.0
B2 (SAN)	4.9	4.9	5.0	5.0	5.0	6.0	6.0	5.0
C1 (BDP)	12.8	12.8	12.5	12.5	12.5	14.6	14.6	13.0
C2 (RDP/TPP mixture)	-	-	-	-	-	-	-	-
D1 (talcum) Naintsch A3	2.0	3.0	1.0	2.0	-	2.0	-	-
D2 (talcum) Westmin 8	-	-	-	-	-	-	-	-
D3 (nano boehmite) Pural 200	-	-	-	-	-	-	-	0.7
D4 (wollastonite) Nyglos 4	2.0	-	-	-	-	-	-	-
D5 (wollastonite) Wolkron 1005	-	-	-	-	-	-	-	-
D6 (wollastonite) Nyglos 5	-	-	-	-	-	-	2.0	-
E (Teflon/B1 master batch 10:90)	3.9	3.9	4.0	4.0	4.0	4.6	4.6	4.6
G1 (mould release agent)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
G2 (stabiliser)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ABS total [1]	13.3	13.3	11.6	13.6	13.6	17.1	17.1	14.1
Rubber content in wt.% [2]	5.0	5.0	4.0	5.2	5.2	6.7	6.7	5.5
UL 94 V (1.2 mm)	V-0	V-0	V-0	V-0	V-1	V-0	V-0	V-1
UL 94 V (1.0 mm)	V-0	V-0	n.m.	n.m.	n.m.	V-0	V-2	n.m.
UL 94 V (0.8 mm)	V-0	V-0	V-0	V-0	V-2	V-2	n.m.	n.m.
HDT/A [°C]	85	85	86	86	85	79	78	n.m.
a_n (flow line) [kJ/m^2]	7	7	8	8	9	7	9	n.m.
Impact bending test	No fracture	No fracture	No fracture	No fracture	No fracture	No fracture	No fracture	No fracture
Melt viscosity (260°C/1000s^{-1}) [Pas]	164	170	182	177	163	151	154	170
TGA (mass loss at 280°C) [%]	n.m.	0.3	n.m.	n.m.	n.m.	0.5	n.m.	n.m.

[1] B1 + B2 + B1 from E (amount B1 from E corresponds to 90 wt.% of E)

[2] Referred to the total composition

[3] not measured = n.m.

Table 1 (continued)

Components (figures in parts by weight)	V17	V18	V19
A1 (PC)	70.5	-	63.2
A2 (PC)	-	70.1	-
B1 (graft)	4.9	5.5	4.9
B2 (SAN)	4.9	6.1	4.9
C1 (BDP)	14.0	-	12.8
C2 (RDP/TPP mixture)	-	10.9	-
D1 (talcum) Naintsch A3	-	-	-
D2 (talcum) Westmin 8	-	2.5	-
D3 (nano boehmite) Pural 200	0.7	-	-
D4 (wollastonite) Nyglos 4	-	-	-
D5 (wollastonite) Wolkron 1005	-	-	-
D6 (wollastonite) Nyglos 5	-	-	9.8
E (Teflon/B1 master batch 10:90)	4.5	4.4	3.9
G1 (mould release agent)	0.4	0.4	0.4
G2 (stabiliser)	0.1	0.1	0.1
ABS total [1)]	13.9	15.6	13.3
Rubber content in wt.% [2)]	5.4	5.7	5.0
UL 94 V (1.2 mm)	V-1	V-0	V-0
UL 94 V (1.0 mm)	n.m.	V-2	V-0
UL 94 V (0.8 mm)	n.m.	n.m.	n.m.
HDT/A [°C]	n.m.	79	82
a_n (flow line) [kJ/m^2]	n.m.	n.m.	9
Impact bending test according to ISO 180/1U	No fracture	No fracture	Fracture
Melt viscosity (260°C/1000s^{-1}) [Pas]	146	180	157
TGA (mass loss at 280°C) [%]	n.m.	1.5	n.m.

n.m. = not measured

V = comparison

[1)] B1 + B2 + B1 from E (amount B1 from E corresponds to 90 wt.% of E)

[2)] Referred to the total composition

From Table 1 it is clear that the polycarbonate compositions according to the invention satisfy the various aforementioned requirements.

In this connection it is essential to maintain the specified quantitative amounts since otherwise at least one of the required properties is not be obtained:

a) With too high a rubber content the stringent flame resistance requirements are not met, while with too low a rubber content the toughness requirements are not met. If the higher rubber content moulding compositions with too low a flame resistance are compensated by increasing the amount of flame-retardant additive, then the thermal stability falls below the required level (V14, V15).

b) With too high a content of flameproofing agent the required thermal stability is not met (V14, V15), while with too low a content the flame resistance is not ensured with thin wall thicknesses.

c) With too high a silicate content the mechanical performance is inadequate (toughness, flow line strength, see V1, V2, V5, V18), while with too low a silicate content and if other inorganic materials such as nanoscale boehmite are used, the flame resistance is not guaranteed (V13, V16, V17). Talcum (e.g. Examples 3 and 4), wollastonite (e.g. Examples 7 and 8) as well as mixtures of talcum and wollastonite (Example 9) are suitable as silicate.

When using wollastonites, irrespective of the type employed advantages are obtained as regards the flow line strength compared to comparable moulding compositions containing talcum (see V5 and V18), so that when using wollastonites slightly higher concentrations overall are possible.

Compositions containing monomeric phosphates (V18) have a higher mass loss at the processing temperature compared to the examples according to the invention.

Patent Claims

1. Composition containing

   A) 50 to 90 parts by weight of polycarbonate and/or polyester carbonate,
   B) 5 to 20 parts by weight of rubber-modified vinyl (co)polymer,
   C) 2 to 15 parts by weight of at least one low-volatility, halogen-free flameproofing agent,
   D) 0.1 to 6 parts by weight of a silicate mineral,
   E) 0 to 1 part by weight of fluorinated polyolefin, and
   F) 0 to 10 parts by weight of polymer additives,

   in which the composition has a rubber content referred to the total composition of at least 2 wt.% and at most 6 wt.%, and in which the total sum of the parts by weight of the components A) to F) is 100.

2. Composition according to claim 1, in which the rubber content is 4 to 6 wt.%.

3. Composition according to claims 1 and 2, containing 5 to 14 parts by weight of component C.

4. Composition according to any one of claims 1 to 3, containing 1 to 5 parts by weight of component D.

5. Composition according to any one of claims 1 to 4, containing 2 to 4.5 parts by weight of component D.

6. Composition according to one or more of the preceding claims, containing 65 to 80 parts by weight of component A.

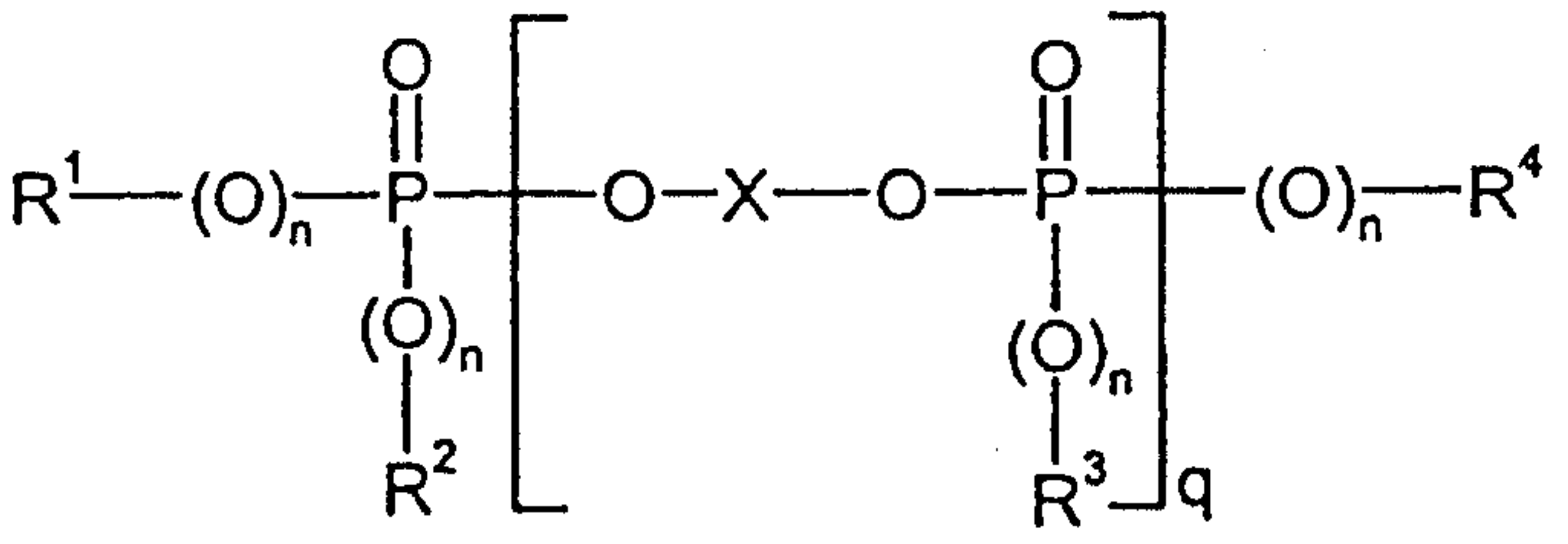
7. Composition according to one or more of the preceding claims, containing 10 to 13.5 parts by weight of component C.

8. Composition according to one or more of the preceding claims, containing 0.1 to 0.5 part by weight of fluorinated polyolefin.

9. Composition according to one or more of the preceding claims, in which component C) is selected from at least one of the group comprising the phosphorus-containing compounds and silicones.

10. Composition according to claim 9, in which component C) is selected from at least one of the group comprising oligomeric phosphoric acid esters, oligomeric phosphonic acid esters, phosphonatamines and phosphazenes.

11. Composition according to claim 10, in which component C) is selected from oligomeric phosphoric acid esters and/or phosphonic acid esters of the formula (IV)



$$R^1-(O)_n-\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle R^2}{|}}{\underset{(O)_n}{\underset{|}{P}}}}-\left[O-X-O-\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle R^3}{|}}{\underset{(O)_n}{\underset{|}{P}}}}\right]_q-(O)_n-R^4 \qquad \text{(IV)}$$

in which

R^1, R^2, R^3 and R^4 independently of one another denote C_1 to C_8-alkyl, or C_5 to C_6-cycloalkyl, C_6 to C_{20}-aryl or C_7 to C_{12}-aralkyl in each case optionally substituted by alkyl,

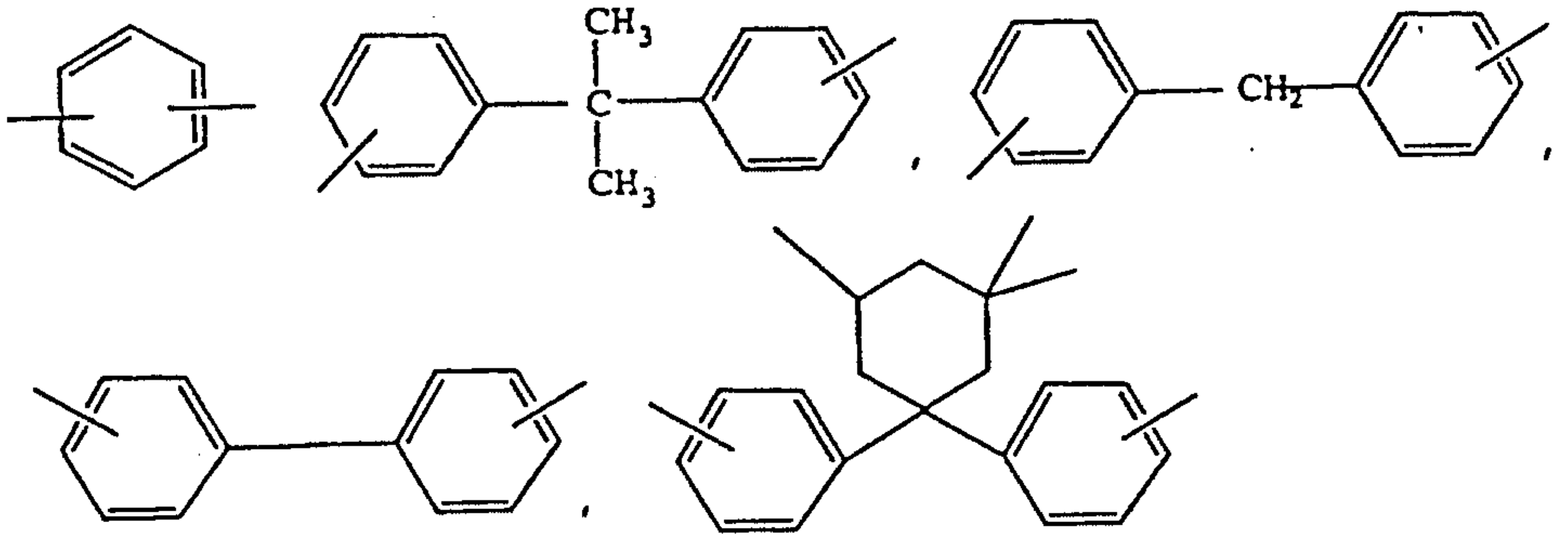
n independently of one another is 0 or 1

q is 0.9 to 30, and

X denotes a mononuclear or polynuclear aromatic radical with 6 to 30 C atoms, or a linear or branched aliphatic radical with 2 to 30 C atoms, which may be OH-substituted and may contain up to 8 ether bonds.

12. Composition according to claim 11, in which q is 1 to 5.

13. Composition according to claim 11, in which X denotes



14. Composition according to one or more of the preceding claims, in which the component B) contains graft polymers of at least one vinyl monomer on at least one rubber with a glass transition temperature of < 10°C as graft base.

15. Composition according to claim 14, containing graft polymers of

5 to 95 wt.% of a mixture of

50 to 99 wt.% of at least one monomer selected from vinyl aromatic compounds, nuclear-substituted vinyl aromatic compounds and methacrylic acid -(C_1-C_8)-alkyl esters and

1 to 50 wt.% of at least one monomer selected from vinyl cyanides, methacrylic acid -(C_1-C_8)-alkyl esters, acrylic acid -(C_1-C_8)-alkyl esters and derivatives of unsaturated carboxylic acids

on

95 to 5 wt.% of one or more rubbers with glass transition temperatures of <10°C.

16. Composition according to claim 15, in which a mixture of 50 to 99 wt.% of styrene and 1 to 50 wt.% of acrylonitrile is grafted onto the rubber.

17. Composition according to claim 15, in which the rubber is selected from at least one of the group comprising diene rubbers, acrylate rubbers, silicone rubbers and EPDM rubbers.

18. Composition according to claim 17, in which the rubber is a partially crosslinked polybutadiene, butadiene/styrene copolymer or a mixture thereof.

19. Composition according to one or more of the preceding claims, containing 10 to 15 parts by weight of component B.

20. Composition according to claims 1 to 19, containing polymer additives selected from at least one of the group comprising lubricants, mould release agents, nucleating agents, antistatics, stabilisers, dyes, pigments and fillers and reinforcing agents different from component D.

21. Use of the composition according to one or more of the preceding claims for the production of moulded parts.

22. Use of the compositions according to one or more of the preceding claims for the production of housings for portable computers and mobile phones.

23. Moulded parts obtainable from compositions according to one or more of the preceding claims.

24. Housings for portable computers and mobile phones, obtainable from compositions according to claims 1 to 20.

Fetherstonhaugh
Ottawa, Canada
Patent Agents