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# PATTERN WAX COMPOSITIONS

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This invention relates to pattern wax compositions, and more particularly relates to low-shrinkage wax base pattern compositions for making eliminable casting patterns. These new compositions have the desired property, among others, of low shrinkage during the period of cooling and formation of the desired pattern.

Ordinary, unmodified pattern waxes shrink substantially upon cooling and freezing from the melt. Castings produced with prior art waxes cannot accurately reproduce the object for which the master mold has been made. After the wax compositions which have been injected into a master mold are allowed to cool, the resulting pattern is inevitably of reduced over-all dimensions. In addition, as a result of irregular cooling, there may be distortions in local areas of the casting and a variation in the correct dimensional proportions. Clearly, this is an unsatisfactory situation, especially in those arts where it is necessary to produce precision casts.

Various fillers or extenders have been added to the base pattern waxes in an effort to inhibit or prevent shrinkage. Compositions formed by such additions have not possessed the required non-shrinking property, and frequently possess other undesirable characteristics as well. Thus, inorganic fillers such as powdered mica or silica are left in the mold in small amounts subsequent to melting out of the wax pattern material. Irregular shaped particles, such as wood fiber, sugar or silica, inhibit the flow of pattern wax. Various plastic additives and sugar have a higher specific gravity than pattern wax and settle out either during the pre-casting operation or during castings, at which time particles of the additive settle into depressions within the mold. Polystyrene beads have also been used for some time; but this material has disadvantages: the pattern wax melts first and runs out of the mold, leaving a polystyrene residue. If heating rates are not properly controlled, the polystyrene will char, making it difficult to remove from the mold. Moreover, even if the polystyrene is melted properly, its viscous or tacky consistency often causes it to pull away some of the refractory composition from the wall of the mold, thus introducing defects therein.

This invention provides novel pattern wax compositions, the advantages of which will permit their use in casting operations, particularly precision casting operations, where shrinkage should be minimized. The compositions of this invention have suitable flow characteristics and are homogeneous mixtures; their constituents do not settle out during casting or in any of the steps of the molding process. This invention also provides pattern wax compositions which can be easily removed from molds without damaging them by the removal of mold materials from the inner walls thereof. The constitution of the wax compositions of this invention is such that the components may be recycled and used again and again effecting obvious economies.

These and other advantages are attained by providing low-shrinkage wax-base pattern compositions for making eliminable casting patterns which contain a standard base wax and a nitrogen-containing wax having a relatively low thermal expansion coefficient. This characteristic minimizes shrinkage and improves the dimensional consistency of the wax patterns. The wax compositions herein comprise upwards of 50% by weight of a base wax and from about 5% to 50% by weight of a filler compound having a structure which conforms to the formula:

$$R_1-\overset{\overset{\large O}{\|}}{C}-NH-R_3-NH-\overset{\overset{\large O}{\|}}{C}-R_2$$

and which filler compound is also substantially insoluble in and has a melting point higher than the base wax. $R_1$ and $R_2$ are substituents selected from the group consisting of unsubstituted aliphatic radicals having from 8 to 24 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, $R_3$ is selected from the group consisting of unsubstituted aliphatic radicals having from 2 to 10 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals.

More particularly, the pattern wax compositions of this invention broadly comprise upwards of 50% by weight of a material selected from the group consisting of petroleum wax, vegetable wax, synthetic resin and mixtures thereof and from about 5% to 50% by weight of a filler compound having the formula:

$$R_1-\overset{\overset{\large O}{\|}}{C}-NH-R_3-NH-\overset{\overset{\large O}{\|}}{C}-R_2$$

$R_3$ is preferably a straight-chain aliphatic radical having from 2 to 10 carbon atoms: it is preferably saturated but may also be unsaturated; it may be an unsubstituted radical or it may have a substituent selected from the group consisting of an amino radical, a carboxylic radical, a hydroxyl radical and a cyclic aliphatic radical. $R_1$ and $R_2$ are aliphatic radicals having from 8 to 24 carbon atoms. $R_1$ and $R_2$ may be identical or they may be different. Either or both may be saturated or unsaturated; either or both may be branched or straight-chain aliphatics; finally, either or both may be unsubstituted or substituted with a substituent selected from the group consisting of an amino radical, a carboxylic radical, a hydroxyl radical and a cyclic aliphatic radical.

Each of the radicals, $R_1$ and $R_2$, have from 8 to 24 carbon atoms. Below 8 carbon atoms, the solubility of the filler compound in the base wax increases. This is an undesirable consequence since later separation of base wax from filler compound is then impractical. In addition, as the number of carbon atoms in the radical decreases, the compound becomes increasingly crystalline and eventually loses its wax-like characteristics. Establishing a minimum of 8 carbon atoms in the radical side chains avoids undesirable crystalline properties in the resulting filler compounds. As the number of carbon atoms increases in the side chains, the wax product becomes softer and the melting point decreases. Hence, a maximum upper limit of 24 carbon atoms in either or both radicals $R_1$, $R_2$ has been established. Above 24 carbon atoms, the wax is too soft to be efficacious in casting procedures; the melting point too closely approaches that of the base wax thus making subsequent fractional separation impractical.

A wide variety of base materials have been used in precision casting techniques. The compositions of this invention have production versatility in that any of the standard base waxes and like materials may be mixed with the nitrogen-containing compounds specified above to yield a wax composition exhibiting non-shrinking and other desired properties. Thus, petroleum waxes such as paraffins, microcrystalline waxes, Kendex petroleum resin and the like; vegetable waxes such as candelilla wax, and such vegetable-derived materials as hydrogenated castor oil, oxidized linseed oil and other similar materials which have wax-like properties (as used in this specification, the term "vegetable wax" shall be deemed to cover such materials); synthetic materials including polyester resins, Carbowaxes and the like; and mixtures of these foregoing materials may be employed. Blends of these several substances are described in the examples below, which also serve to illustrate the variety of nitrogen-containing filler compounds which may be added to the particular base wax to yield the compositions of this invention.

*Example I*

A base wax composition was produced by mixing 20 parts by weight of paraffin having a melting point of about 145° F.; 20 parts by weight of microcrystalline wax having a melting point of about 170° F.; 50 parts by weight of polyester resin having a softening point of about 257° F.; and 10 parts by weight of candelilla wax. To 60 parts by weight of this mixture, there was added 40 parts by weight of ethylene distearamide (more precisely N,N$^1$-ethylene bisstearamide). The resulting blend was smooth and the components showed no tendency to segregate. Several patterns were produced with this composition and molds were then formed. Shrinkage was minimal during the entire casting operation. Ethylene distearamide has a melting point of about 280° F. It was found to be essentially insoluble in this specific base wax composition; and is substantially insoluble, moreover, in most normal petroleum waxes and wax resin blends. Its density is also approximately the same as that of petroleum waxes. When a mold was subsequently formed around the patterns produced and the mold preheated, the base-wax melted out freely. At a slightly more elevated temperature, the ethylene distearamide melted out freely.

*Example II*

A base wax mixture was made by combining 78% by weight of candelilla wax with 22% by weight of oxidized linseed oil. Ethylene dipalmitamide was then added in the proportion 50 parts by weight of the dipalmitamide to 50 parts by weight of the base wax. The patterns formed from this composition exhibited minimal shrinkage.

*Example III*

A base wax composition was produced by mixing 58 parts by weight of candelilla wax, 10 parts by weight of hydrogenated castor oil and 32 parts by weight of Kendex petroleum resin, a high molecular weight synthetic hydrocarbon resin of cyclic and iso-paraffins. 20 parts by weight of n-propylene dicapramide was added to 80 parts by weight of the base wax composition to yield a highly satisfactory, substantilly non-shrinking pattern wax.

*Example IV*

The base wax composition of Example I was combined with 30% by weight of n-butylene dicaprylamide. This composition also exhibited superior pattern wax characteristics, including non-shrinkage, homogeniety, fractional melting of the two major constituents and non-adhesion to the sides of the mold subsequently formed around the pattern.

*Example V*

45 parts by weight of ethylene diricinoleamide were added to 55 parts of the base wax composition of Example II. The resulting wax mixture exhibited highly desirable non-shrinking properties.

*Example VI*

50 parts by weight of n-propylene dioleamide were added to 50 parts of the base wax composition of Example II, yielding an efficacious, substantially non-shrinking pattern wax product.

The following compounds, in amounts ranging from about 10% to 50% by weight of standard base wax compositions, were also found to produce superior pattern wax compositions: ethylene dilauramide, ethylene dilinoleamide, ethylene dilinolenamide, ethylene dicetoleamide, and n-propylene and n-butylene distearamides, dipalmitamides and diricinoleamides. Each of these filler compounds and those described in the examples above were substantially insoluble in the base wax and had a melting point higher than the melting point of the base wax.

I claim:

1. A low-shrinkage wax-base pattern composition for making eliminable casting patterns consisting essentially of a wax admixed with from about 5% to 50% by weight of a filler compound which is substantially insoluble in and has a melting point higher than the wax and has a structure conforming to the formula:

$$R_1-\overset{O}{\overset{\|}{C}}-NH-R_3-NH-\overset{O}{\overset{\|}{C}}-R_2$$

where $R_1$ and $R_2$ are substituents selected from the group consisting of unsubstituted aliphatic radicals having from 8 to 24 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, and $R_3$ is selected from the group consisting of unsubstituted aliphatic radicals having from 2 to 10 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, said composition having suitable flow characteristics and being a homogeneous mixture.

2. A low-shrinkage wax-base pattern composition for making eliminable coating patterns consisting essentially of a base wax admixed with from about 5% to 50% by weight of a filler compound which is substantially insoluble in and has a melting point higher than the base wax and has a structure conforming to the formula:

$$[C_nH_{2n+1}]-\overset{O}{\overset{\|}{C}}-NH-R_1-NH-\overset{O}{\overset{\|}{C}}-[C_nH_{2n+1}]$$

where $R_1$ is selected from the group consisting of straight-chain unsubstituted aliphatic radicals having from 2 to 10 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, and $n$ has a value of from 8 to 24, said composition having suitable flow characteristics and being a homogeneous mixture.

3. A low-shrinkage wax-base pattern composition for making eliminable casting patterns consisting essentially of a base wax admixed with from about 5% to 50% by weight of a filler compound which is substantially insoluble in and has a melting point higher than the base wax and has a structure conforming to the formula:

$$R_1-\overset{O}{\overset{\|}{C}}-NH-R_3-NH-\overset{O}{\overset{\|}{C}}-R_2$$

where $R_1$ and $R_2$ are substituents selected from the group consisting of unsubstituted aliphatic radicals having from 8 to 24 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, where $R_1$ is an unsaturated aliphatic radical, where $R_2$ is a radical selected from the group consisting of saturated and unsaturated aliphatic radicals, and where $R_3$ is selected from the group consisting of unsubstituted saturated and unsubstituted unsaturated aliphatic radicals having from 2 to 10 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, said composition having suitable flow characteristics and being a homogeneous mixture.

4. A low-shrinkage wax-base pattern composition for making eliminable casting patterns consisting essentially of a base wax admixed with from about 5% to 50% by weight of a filler compound which is substantially insoluble in and has a melting point higher than the base wax and has a structure conforming to the formula:

$$R_1-\overset{O}{\overset{\|}{C}}-NH-R_3-NH-\overset{O}{\overset{\|}{C}}-R_2$$

where $R_1$ and $R_2$ are substituents selected from the group consisting of unsubstituted aliphatic radicals having from 8 to 24 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, where $R_1$

is a branched-chain aliphatic radical, where $R_2$ is a radical selected from the group consisting of straight-chain and branched-chain aliphatic radicals, and where $R_3$ is selected from the group consisting of unsubstituted saturated and unsubstituted unsaturated aliphatic radicals having from 2 to 10 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, said composition having suitable flow characteristics and being a homogeneous mixture.

**5.** A low-shrinkage wax-base pattern composition for making eliminable casting patterns consisting essentially of a base wax admixed with from about 5% to 50% by weight of ethylene distearamide, said base wax being selected from the waxes having a lower melting point than and substantially a nonsolvent of ethylene distearamide, said composition having suitable flow characteristics and being a homogeneous mixture.

**6.** A low-shrinkage wax-base pattern composition for making eliminable casting patterns consisting essentially of a base wax admixed with from about 5% to 50% by weight of ethylene dipalmitamide, said base being selected from the waxes having a lower melting point than and substantially a nonsolvent of ethylene dipalmitamide, said composition having suitable flow characteristics and being a homogeneous mixture.

**7.** A low-shrinkage wax-base pattern composition for making eliminable casting patterns consisting essentially of about 5% to 50% by weight of ethylene distearamide admixed with upwards of 50% by weight of a base wax comprising 10% by weight of candelilla wax, 20% by weight of paraffin having a melting point of about 140° F., and 20% by weight of microcrystalline wax having a melting point of about 170° F., and 50% by weight of a polyester resin having a softening point of about 257° F., said composition having suitable flow characteristics and being a homogeneous mixture.

**8.** A low-shrinkage eliminable casting pattern consisting essentially of a base wax admixed with from about 5% to 50% by weight of a filler compound which is substantially insoluble in and has a melting point higher than



said base wax material and has a structure conforming to the formula:

$$R_1-\overset{\overset{\displaystyle O}{\|}}{C}-NH-R_3-NH-\overset{\overset{\displaystyle O}{\|}}{C}-R_2$$

where $R_1$ and $R_2$ are substituents selected from the group consisting of unsubstituted aliphatic radicals having from 8 to 24 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, and where $R_3$ is selected from the group consisting of unsubstituted aliphatic radicals having from 2 to 10 carbon atoms and corresponding hydroxy, amino, carboxy and cyclic aliphatic substituted radicals, said composition having suitable flow characteristics and being a homogeneous mixture.

**9.** A low shrinkage eliminable precision casting pattern consisting essentially of a base wax admixed with from about 5% to 50% by weight of ethylene distearamide, said base wex being selected from the waxes having a lower melting point than and substantially a nonsolvent of ethylene distearamide, said composition having suitable flow characteristics and being a homogeneous mixture.

**10.** A low shrinkage eliminable precision casting pattern consisting essentially of from about 5% to 50% by weight of ethylene distearamide admixed with upwards of 50% by weight of a base wax comprising 10% by weight of candelilla wax, 20% by weight of paraffin having a melting point of about 140° F., and 20% by weight of microcrystalline wax having a melting point of about 170° F., and 50% by weight of a polyester resin having a softening point of about 257° F., said composition having suitable flow characteristics and being a homogeneous mixture.

**References Cited by the Examiner**

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