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THERMOPLASTIC COMPOSITION

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My present invention relates generally to thermoplastic compositions of matter, and has particular reference to waxy compositions suitable for precision casting procedures.

A general object of the invention is to provide a thermoplastic composition of new and improved character. While its ultimate usefulness is not necessarily restricted to any particular field, it is primarily intended to embody certain desirable qualities which make it particularly valuable for casting procedures employed in making dentures, jewelry articles such as rings or pins, and similar items of detailed and irregular contour. The specific qualities which characterize the present improved product may best be described by reference to certain phases of the art of making castings of the character mentioned.

It is common practice first to create a destructible pattern of wax, then to introduce the pattern in refractory mold material, and after the mold material has set to eliminate the pattern by destroying it, this destruction being usually accomplished by heat or possibly by chemical action or solution. Because of the nature of the work, the wax of which the pattern is composed must obviously be of a kind and consistency which permits it to assume and retain, with extreme accuracy, many fine contours and configurations. The pattern is usually formed by introducing the wax in molten condition into a mold cavity, and the wax must be of a character which undergoes a minimum of shrinkage, preferably no shrinkage at all, as the molded pattern cools. Moreover, the pattern should be hard and form retaining, it should embody a smooth finish and accurate detail, and it should be tough enough to avoid the formation of cracks or other undesired irregularities. In large-scale production of precision castings, the pattern must be sufficiently strong and stable to withstand considerable handling without suffering any deformation.

My present invention is predicated upon the discovery that certain polymerized vegetable oils are miscible with waxes in all proportions, and can be feasibly employed to impart to the resultant intermixtures certain desirable characteristics which are present only to a lesser degree, or not otherwise present at all, in the waxes themselves.

Polymerized vegetable oils, as a class, are known as extenders of and substitutes for natural and synthetic rubbers. They range in consistency from thick adhesive liquids through soft rubbery gel-like solids to harder rubber-like solids. I have found that the relatively soft and soluble members of this group form homogeneous melts with waxes, and can thus be caused to serve as desirable modifiers of waxes to produce thermoplastic compositions having new and improved and highly

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useful characteristics. The oils whose polymerization products have proven most useful for my present purposes are those which are drying oils, viz., those of the class which includes linseed oil, cashew shell oil, oiticica oil, China-wood oil, tung oil, and the like.

To illustrate one of the advantages that may be achieved by my invention, attention is directed to the fact that the waxes preferably employed for precision casting procedures, especially where quantity production is involved, are those of relatively high melting point, since they solidify more quickly and thus shorten the cooling cycle, and since they are more able to withstand distortion in warm weather, and to avoid cold flow, than the lower melting compositions. However, high melting-point waxes, such as carnauba wax, for example, have a great tendency to crack. The present invention provides a convenient means for avoiding this by imparting an enhanced toughness to the composition.

Another characteristic which a precision pattern should have, but which is not present in waxes ordinarily used, is elastic recovery, i. e., the ability exhibited by many plastics to return to an original shape after distortion. By means of the present invention, this desirable quality may be imparted to the wax composition.

Other procedures in this general field make it desirable, under certain circumstances, that the composition have enhanced adhesive or cohesive properties, or a degree of brittleness which results in a clean fracture when a mass of the composition is broken. The present invention makes it possible to achieve these additional advantages.

One of the meritorious features of the new and improved compositions resulting from my invention lies in the fact that conventional procedures of use may be adhered to. Thus, where the composition is to be employed for the creation of a casting pattern, such pattern may be in the usual way invested in refractory mold material and subsequently destroyed by heat. Similarly, wherever fillers or other modifiers are deemed desirable, they may be freely employed in accordance with normal practice.

I achieve these general objectives and advantages, and such other advantages as may hereafter appear or be pointed out, in the manner hereinafter described.

In compounding the present improved composition, the wax to be employed may be of any desired or suitable character, depending upon the use to which the resultant waxy composition is to be put, and the specific qualities which it is intended to embody. Generally speaking, any of the known waxes are suitable, such as amorphous wax, crystalline wax, microcrystalline wax, candelilla wax, carnauba wax, beeswax, palm wax, bayberry wax, ouricoury wax, ceresin

wax, or the like. These waxes may be employed singly or in combinations, and the wax ingredient generally constitutes the major portion of the resultant composition, being usually present in an amount equal to approximately 50 to 90 per cent, by weight, of the composition.

The polymerized vegetable oil ingredient, may be, for example, the polymerization product of cashew shell oil, linseed oil, oiticica oil, tung oil, China-wood oil, or similar drying oils. As in the case of the wax ingredient, these polymerized vegetable oils may be used singly or in combination, and this ingredient of the composition generally forms a minor portion thereof, usually no more than about 10 to 50 per cent, by weight. Where adhesiveness is a quality desired in the composition, a minimum of 5% of the polymerized vegetable oil should be used.

The ingredients to be mixed are brought together by first melting the wax or waxes, then slowly adding the polymerized vegetable oil ingredient under continued heat and stirring. The temperature should be maintained as high as possible, which will be at least as high as the melting point of the wax or waxes, and may be any higher temperature short of that at which the wax or waxes start to decompose.

The following examples are illustrative of the various kinds and proportions of ingredients that may be employed:

Example I

	Per cent
Candelilla wax	80
Polymerized linseed oil	20
	100

This composition of matter is tough and moderately brittle, and has fairly good adhesive properties.

Example II

	Per cent
Candelilla wax	50
Polymerized China-wood oil	50
	100

This composition is fairly flexible and quite strong, and manifests good qualities of elastic recovery.

Example III

	Per cent
Carnauba wax	80
Polymerized linseed oil	20
	100

This composition is characterized by hardness and toughness, has low shrinkage, and exhibits no tendency to crack as it cools from a molten to a solid state. It is somewhat more brittle than the composition of Example I, and has fairly good adhesive properties.

Example IV

	Per cent
Microcrystalline wax	50
Polymerized linseed oil	50
	100

This composition has excellent qualities of elastic recovery, and it is quite strong. It has a slight degree of tackiness, and is characterized by its softness and flexibility.

Example V

	Per cent
Amorphous mineral wax	75
Polymerized linseed oil	25
	100

This blend of materials is soft and flexible.

Example VI

	Per cent
Beeswax	90
Polymerized China-wood oil	10
	100

This composition is also quite soft, and manifests a slight degree of tackiness.

Example VII

	Per cent
Yellow beeswax	50
Polymerized linseed oil	50
	100

This composition is also soft, and it has good adhesive qualities as well as elasticity.

Example VIII

	Per cent
Ceresin wax	50
Polymerized linseed oil	50
	100

This composition is soft and flexible, but it has very slight adhesiveness.

Example IX

	Per cent
Ceresin wax	90
Polymerized China-wood oil	10
	100

This composition is slightly soft and not tacky.

In each of the foregoing illustrations, the reference to specific qualities of the composition is intended to be descriptive in character and does not constitute a full list of all the desirable properties which the composition embodies. The same is true with respect to the following examples, which illustrate the manner in which the waxes may be used in various combinations:

Example X

	Per cent
Candelilla wax	50
Amorphous wax	40
Polymerized linseed oil	10
	100

This product is quite soft but is unusually tough and can be subjected to considerable handling without distortion.

Example XI

	Per cent
Candelilla wax	57.1
Carnauba wax	28.6
Polymerized linseed oil	14.3
	100

Due to the presence of the carnauba wax ingredient, this composition is very hard and strong. It also embodies a desirable degree of brittleness, but it will not crack during the cooling process.

Ingredients other than waxes and polymerized

vegetable oils may be employed as modifiers or fillers. The following example is illustrative:

Example XII

	Per cent
Candelilla wax	64
Polymerized linseed oil	16
Rosin	20
	100

This composition is unusually strong and is somewhat harder and more brittle than the product of Example I. It has excellent adhesive properties. The rosin ingredient has a higher melting point than candelilla wax and thus contributes toward making the product stronger and more rigid.

Other modifying ingredients that may be employed, depending upon specific properties which are to be incorporated in the mixture, are natural and synthetic resins of various types. For example, dammar could be used to impart adhesiveness to the mixture. Various thermo-setting resins such as melamine or phenolic resins, may be employed to reduce shrinkage, enhance brittleness or adhesiveness, or modify the properties in similar ways. Ground thermoplastic resins, such as polystyrene or polymethyl methacrylate may be emloyed as fillers for reducing shrinkage.

In general it will be understood that the ingredients employed, and the proportions in which they are used, will be so chosen that the resultant composition will exhibit to best advantage the particular characteristics which any specific use may call for. Thus, in compounding a material for use as a destructible pattern in a precision casting procedure, in which the pattern is to be invested in refractory material and then melted out, qualities of low shrinkage, strength and toughness, and elastic recovery, are of paramount importance. In the techniques employed in building up or altering dentures or the like, qualities of softness, flexibility, and adhesiveness are desirable. In the taking of dental impressions and other analogous procedures, cohesiveness and brittleness are desirable attributes.

It will therefore be understood that the invention is not restricted to the specific waxes, polymerized vegetable oils, or other ingredients hereinbefore mentioned, the foregoing examples having been set forth merly to illustrate the wide range of possibilities. In each case, however, the composition is characterized by the basic concept of the invention, viz., the intermixture of wax or waxes with one or more polymerized vegetable oils which are miscible therewith, the resultant composition having desirable properties which are not otherwise present, or present only to a lesser degree, in the waxes themselves.

For these reasons, it will be understood that the details herein described may readily be modified by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is therefore intended that these details be interpreted as being illustrative, and not in a limiting sense.

Having thus described my invention, which I claim as new and desire to secure by Letters Patent is:

1. A casting pattern formed of a thermoplastic moldable form-retaining composition consisting essentially of wax and polymerized oil and being devoid of any non-meltable ingredient leaving any substantial ash residue upon combustion thereof, the wax constituting at least 50% of the composition, whereby said pattern after investment in refractory mold material may be completely eliminated therefrom by the application of heat.

2. A casting pattern as set forth in claim 1, the wax ingredient including an appreciable proportion of candelilla wax.

3. A casting pattern comprising an intermixture of about 80% of candelilla wax and about 20% of polymerized linseed oil, said pattern being thermoplastic, moldable, form-retaining, and adapted to be invested in refractory mold material and completely eliminated therefrom by the application of heat.

4. A casting pattern as set forth in claim 1, the wax ingredient including an appreciable proportion of carnauba wax.

5. A casting pattern comprising an intermixture of about 80% of carnauba wax and about 20% of polymerized linseed oil, said pattern being thermoplastic, moldable, form-retaining, and adapted to be invested in refractory mold material and completely eliminated therefrom by the application of heat.

6. A casting pattern as set forth in claim 1, the oil ingredient consisting of polymerized linseed oil.

7. A sticky thermoplastic form-retaining composition consisting essentially of beeswax and polymerized drying oil, the wax constituting at least 50% of the composition, the polymerized oil having an inherent gelatinous rubbery character which imparts toughness to the composition, said composition being devoid of any non-meltable ingredient leaving any substantial ash residue upon combustion thereof, and being adapted to form part of and to be adhesively applied to a casting pattern to be invested in refractory mold material and completely eliminated therefrom by the application of heat, said composition adhering to said pattern by virtue of its inherent stickiness and forming part of said pattern during said investment and elimination.

8. A sticky composition as set forth in claim 7, the oil ingredient consisting of polymerized linseed oil.

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