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VINYL RESIN PHONOGRAPH RECORDS

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7 Claims. (Cl. 260—9)

This invention relates to improvements in fillers for use in vinyl resin phonograph records whereby records characterized by a very low surface noise level and by exceptionally long life and durability are produced.

Filling materials of various kinds have been proposed for use in vinyl resin molding compositions for phonograph records and in such compositions they serve the dual purpose of reducing the cost of the record and of increasing its resistance to wear during playing. However, it has heretofore proved impossible to incorporate large amounts of these fillers in the molding compositions without causing an undesirable degree of surface noise when the record is played on sound reproducing machines having high amplification and tone fidelity. Moreover, irrespective of the type of filling material used, objectionable features exist when large amounts of fillers are incorporated. Thus, abrasive materials are satisfactory in strengthening the record against wear but cause an undue amount of surface noise and non-abrasive materials are unserviceable from the viewpoint of either the initial surface noise of the record or, if the noise level is originally satisfactory, because of the fact that the noise level increases after playing on account of excessive wear of the record.

It has been found that the above disadvantages may be overcome by the use of certain mixed fillers in regulated proportions in the vinyl resin records. One of these fillers is composed of finely-divided cellulosic or ligno-cellulosic materials and the other consists of finely-divided inorganic substances of an abrasive nature. The cellulosic or ligno-cellulosic materials are characterized by a low density so that they do not increase the weight of the record. At the same time, these products mechanically reinforce the record but do not increase the consistency and stiffness of the composition to a point where molding becomes difficult. Examples of cellulosic or ligno-cellulosic materials are wood flour, cotton flock, finely-divided cellulose, peach shell flour, and apricot shell flour. It has been found by experiment that not all inorganic fillers are suitable to combine with the cellulosic or ligno-cellulosic materials in the amounts required for making a satisfactory mixed filler. Thus, relatively soft and non-abrasive materials such as finely-divided clay or talc were found to be undesirable in large quantities from the view of either durability or surface noise. It has been determined that at least the major portion of the inorganic filler should be composed of substances having an abrasive nature similar to pulverized silica or to diatomaceous earth. Abrasive fillers are understood to be those materials having a hardness of at least 5 on Mohs' scale of hardness and other examples of such materials are anorthite, a lime feldspar, andesine, a calcium sodium feldspar, and anorthoclase, a sodium potassium feldspar.

As a direct result of the use of the mixed fillers of this invention, the weight ratio of filler to vinyl resin may be in excess of 0.60 with a consequent decrease in the cost of the record and with an actual gain in its playing qualities. However, to obtain records of good performance, particularly with respect to their surface noise level, when large amounts of the mixed filler are employed, it is essential that both the cellulosic or ligno-cellulosic fillers and the inorganic abrasive fillers be minutely subdivided to particles that will pass a standard 200 mesh screen and preferably a standard 300 mesh screen. Since the standard commercial grade of fillers is ordinarily not of such a fine particle size, special grades must be secured.

As indicated previously, the ratio in which the cellulosic or ligno-cellulosic fillers and the inorganic abrasive fillers are combined in the mixed filler is of great significance since neither type of filler used singly is satisfactory. It has been found by test that, from the standpoint of both resistance to abrasion and the surface noise level of the record, suitable volume ratios of the cellulosic or ligno-cellulosic filler to the inorganic abrasive filler are between 75:25 and 40:60. These tests were carried out using record compositions having the same vinyl resin content and the same total filler content by volume in which

the ratio of the two types of fillers was varied widely.

In testing the records, initial noise level was determined by playing the record and where improvement was noted, it was of such magnitude as to be plainly discernible to the ear. Any increase in noise level after playing was determined by playing back a portion of the record 15 times and then comparing its noise level at that point with the noise level of an unplayed section of the record. This was repeated in increments of 15 playings. Any record wear was determined at the same time in this series of tests by noting any distortion of the recorded sounds and by visual inspection of the record with the aid of a magnifying lens.

The results of the tests were as follows:

Composition No.	Composition of filler		Initial noise level	Times played	Noise level after testing	Wear after testing
	Wood flour	Diatomaceous earth				
	Percent by volume	*Percent by volume*				
1	100	0	High	15	Very high	Very high.
2	70	30	Low	150	Low	Slight.
3	55	45	do	150	do	Do.
4	30	70	Medium	150	Increased	Do.
5	0	100	do	150	do	Do.

The above test results bring out the interesting fact that the use of the mixed fillers in the proportions set forth produces a vinyl resin record having qualities superior in every respect to records which contain either of the fillers singly.

The vinyl resins employed in the above tests and which are preferred in the practice of this invention are those described in the Groff Patent No. 1,932,889. These resins are conjoint polymers of vinyl halides with vinyl esters of aliphatic acids having combined vinyl halide contents in excess of 70% by weight. A particularly desirable resin of this class is a conjoint polymer of vinyl chloride with vinyl acetate containing 87% vinyl chloride by weight and having an average macromolecular weight of about 10,000 as determined by Staudinger's method. Less desirably, other vinyl resins may be employed as the base of the sound records, such as the more highly polymerized polyvinyl acetate resins and the resins formed from them by their partial hydrolysis and subsequent reaction with aldehydes.

In the production of the molding compositions for forming the records a wide variety of the customary plasticizers, waxes, lubricants, heat stabilizers and pigments may be included. However, because of the large amount of the mixed fillers which are incorporated in the compositions of this invention, certain plasticizers have been found to be particularly effective in increasing the plasticity of the composition during molding. These are alkyl-substituted phenanthrenes, such as retene (1-methyl, 7-isopropyl phenanthrene), and the fatty acid pitches remaining as a residue from the distillation of fats, oils and waxes. These pitches are dark in color and the preferable ones for use in this invention have softening points of about 145° F. Both of these plasticizers are desirably used in amounts ranging from about 5% to about 25% by weight of the vinyl resin portion of the record.

Typical formulations which have been employed with success in the production of sound records are as follows:

	A		B	
	Parts by weight	*Parts by volume*	*Parts by weight*	*Parts by volume*
Conjoint polymer of vinyl chloride with vinyl acetate	59.0	63.0	57.0	62.9
Wood flour—300 mesh	22.5	24.1	17.6	19.3
Diatomaceous earth—300 mesh	16.8	10.5	23.7	15.4
Calcium stearate	0.85	1.2	0.83	1.2
Carnauba wax	0.85	1.2	0.83	1.2

These formulations may be modified by the inclusion of plasticizers and pigments as follows:

	Parts by weight	
	C	D
Conjoint polymer of vinyl chloride with vinyl acetate	392	392
Wood flour—300 mesh	172.5	138.4
Diatomaceous earth—300 mesh	128.2	186.4
Retene	56.0	56.0
Carnauba wax	6.6	6.6
Lead stearate	6.6	6.6
White lead	2.0	2.0
Carbon black	12.0	12.0

Records may be formed from these compositions by first mixing the ingredients on a heated rubber mill or in a heated dough-type mixer until homogeneous and then pressing the composition into preforms. This latter operation may be performed at temperatures of from 130° to 150° C. and at pressures up to 2000 pounds per square inch. The impression of the sound groove is then accomplished by pressing the heated preforms against an appropriate die. Records having the above formulations are representative of those which exhibited the excellent characteristics in the tests previously described.

Modifications within the designated limits of the formulations described in the examples and the addition or substitution of other ingredients are permissible without departing from the scope of the invention as defined by the appended claims.

This application contains subject matter in common with my copending application Serial No. 356,525, filed Sept. 12, 1940.

I claim:

1. A molding composition for phonograph records comprising a base of a vinyl resin, composed of a conjoint polymer of vinyl chloride with a vinyl ester of an aliphatic acid, and substantial amounts of mixed filled composed of from 75 to

40 parts by volume of one of the group consisting of finely-divided cellulosic and ligno-cellulosic materials and from 25 to 60 parts by volume of a finely-divided inorganic abrasive material having a hardness of at least 5 on Mohs' scale of hardness, both ingredients of said mixed filler being substantially of such a degree of fineness as to pass a standard 200 mesh screen.

2. A phonograph record comprising a base of a vinyl resin, composed of a conjoint polymer of vinyl chloride with a vinyl ester of an aliphatic acid, and at least 0.6 as much by weight of a mixed filler composed of from 75 to 40 parts by volume of one of the group consisting of finely-divided cellulosic and ligno-cellulosic materials and from 25 to 60 parts by volume of a finely-divided inorganic abrasive material having a hardness of at least 5 on Mohs' scale of hardness, both ingredients of said mixed filler being substantially of such a degree of fineness as to pass a standard 200 mesh screen.

3. A molding composition for phonograph records comprising a base of a vinyl resin, composed of a conjoint polymer of vinyl chloride with vinyl acetate, and substantial amounts of a mixed filler composed of from 75 to 40 parts by volume of one of the group consisting of finely-divided cellulosic and ligno-cellulosic materials and from 25 to 60 parts by volume of a finely-divided inorganic abrasive material having a hardness of at least 5 on Mohs' scale of hardness, both ingredients of said mixed filler being substantially of such a degree of fineness as to pass a standard 200 mesh screen.

4. A phonograph record comprising a base of a vinyl resin, composed of a conjoint polymer of vinyl chloride with vinyl acetate, and at least 0.6 as much by weight of a mixed filler composed of from 75 to 40 parts by volume of one of the group consisting of finely-divided cellulosic and ligno-cellulosic materials and from 25 to 60 parts by volume of a finely-divided inorganic abrasive material having a hardness of at least 5 on Mohs' scale of hardness, both ingredients of said mixed filler being substantially of such a degree of fineness as to pass a standard 200 mesh screen.

5. A phonograph record comprising a base of a vinyl resin, composed of a conjoint polymer of vinyl chloride with vinyl acetate, and substantial amounts of a mixed filler composed of from 75 to 40 parts by volume of finely-divided wood flour and from 25 to 60 parts of diatomaceous earth, both the wood flour and the diatomaceous earth being substantially of such a degree of fineness as to pass a standard 200 mesh screen.

6. A molding composition for phonograph records comprising a base of a vinyl resin, composed of a conjoint polymer of vinyl chloride with vinyl acetate, a small amount of retene as a plasticizer and a substantial amount of a mixed filler composed of from 75 to 40 parts by volume of one of the group consisting of finely-divided cellulosic and ligno-cellulosic materials and from 25 to 60 parts by volume of a finely-divided inorganic abrasive material having a hardness of at least 5 on Mohs' scale of hardness, both ingredients of said mixed filler being substantially of such a degree of fineness as to pass a standard 200 mesh screen.

7. A molding composition for phonograph records comprising a base of a vinyl resin, composed of a conjoint polymer of vinyl chloride with vinyl acetate, a small amount of a fatty acid pitch as a plasticizer and substantial amounts of a mixed filler composed of from 75 to 40 parts by volume of one of the group consisting of finely-divided cellulosic and ligno-cellulosic materials and from 25 to 60 parts by volume of a finely-divided inorganic abrasive material having a hardness of at least 5 on Mohs' scale of hardness, both ingredients of said mixed filler being substantially of such a degree of fineness as to pass a standard 200 mesh screen.

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