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PLASTIC BOBBIN FOR TEXTILE MACHINES

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BLEND OF RUBBERY INTERPOLYMER AND RESINOUS INTERPOLYMER

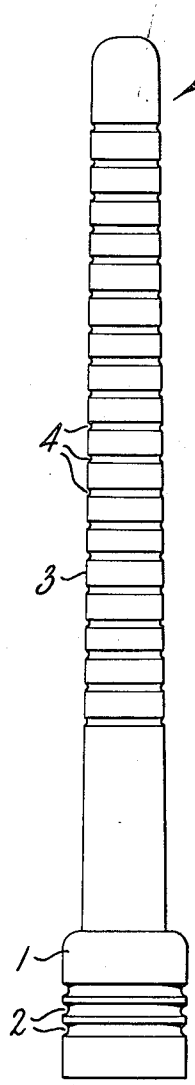


Fig. 1

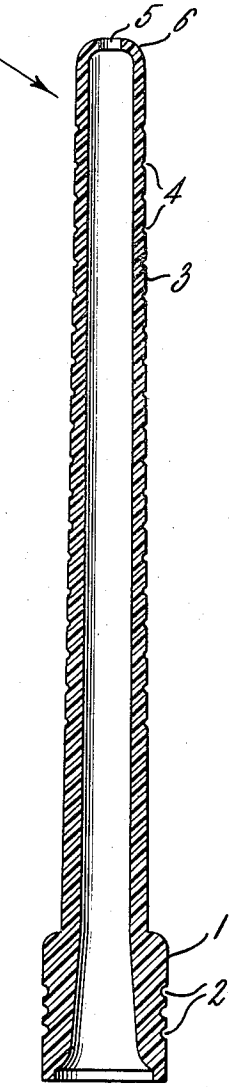


Fig. 2

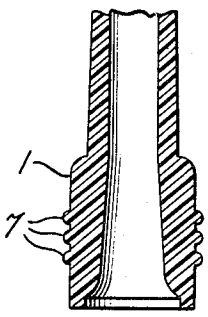


Fig. 3

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PLASTIC BOBBIN FOR TEXTILE MACHINES

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1 Claim. (Cl. 242—122)

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This invention relates to bobbins for textile machines and more particularly to unreinforced one-piece integral bobbins which are molded from the plastic composition disclosed below and which are greatly superior to textile bobbins available heretofore.

As is well known in the textile industry, bobbins supply the base, generally of cylindrical or conical shape, upon which textile yarns are wound in processing in textile machines such as looms and twisters. For automatic looms, the yarn package is generally formed on a quiller and the piece upon which the yarn is wound is often called a quill, the resulting package being inserted in the shuttle of the loom. Yarn coming from a spinning frame is wound on a piece known as a bobbin. For non-automatic looms, this bobbin may be fed directly to the loom or the yarn thereon may be transferred to a quill on a quilling machine to get a more uniform yarn package. A bobbin or quill is commonly employed as the carrier for the weft or filler yarn, this weft carrier being adapted to be mounted on suitable driving means while it is being wound and to be received in the shuttle in the well-known manner. As used herein the term "bobbin" is intended to include pieces or weft carriers of the type mentioned in the foregoing whether they are called quills or bobbins in particular branches of the industry, the usage being largely a matter of nomenclature.

The accompanying drawing portrays an unreinforced one-piece integral molded plastic bobbin made in accordance with my invention. In the drawing, Fig. 1 is a side elevation of the bobbin; Fig. 2 is a vertical sectional view through the bobbin; and Fig. 3 is a vertical sectional view of the lower portion only of a modification.

I have discovered that greatly improved bobbins may be made from a mixture of a rubbery interpolymer of butadiene and either styrene or acrylonitrile and a hard normally inelastic resinous thermoplastic interpolymer of a major proportion of styrene and a minor proportion of butadiene or acrylonitrile or both butadiene and acrylonitrile. Such a composition, and particularly the blend of a rubbery interpolymer of butadiene and acrylonitrile and a hard normally inelastic thermoplastic interpolymer of a major proportion of styrene and a minor proportion of acrylonitrile, is a uniquely suitable material from which to manufacture molded bobbins. This composition has such outstanding physical properties that the bobbins molded therefrom require absolutely no reinforcement and are made in a

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single piece in a single molding operation, no assembly and no use of metallic inserts, tips, etc. being required so that the bobbins of the present invention are simple and economical to manufacture and at the same time have very outstanding qualities as compared with bobbins of the prior art which have been largely made of wood.

The rubbery interpolymer used in making the bobbins of my invention may be any elastomeric interpolymer of butadiene and styrene or acrylonitrile, such rubbery interpolymers being available commercially as synthetic rubbers of the types known as Buna S and Buna N. As is well-known, Buna S is a rubbery copolymer made by the emulsion polymerization of 1,3-butadiene and styrene, the proportions of combined monomers therein usually ranging from 70 to 80% butadiene and correspondingly from 30 to 20% styrene, and more commonly approximating 75% butadiene and 25% styrene. Buna N is a rubbery copolymer of 1,3-butadiene and acrylonitrile made by emulsion polymerization, the proportion of acrylonitrile combined therein generally ranging from 18 to 40% and the proportion of butadiene correspondingly ranging from 82 to 60%. Such rubbery interpolymers may be designated as interpolymers of a major proportion of butadiene and of a minor proportion of a compound having the general formula $CH_2=CH—X$ where X is either phenyl or CN.

The preferred bobbins or my invention are made from a blend of elastic synthetic rubber of the Buna N type and a hard normally inelastic resinous thermoplastic interpolymer of a major proportion of styrene and a minor proportion of acrylonitrile, with or without a minor proportion of butadiene. This rubbery interpolymer and this resinous interpolymer are completely compatible with one another so that a uniform blend thereof is readily obtained.

Less preferably, bobbins of the present invention may be made from blends of a rubbery interpolymer of butadiene and styrene and a hard normally inelastic resinous thermoplastic interpolymer of a major proportion of styrene and a minor proportion of butadiene as the sole monomeric constituents, there commonly being employed in the manufacture of the latter from 70 to 97% by weight of styrene and correspondingly from 30 to 3% by weight of butadiene. Such resinous interpolymers are completely compatible with rubbery butadiene-styrene interpolymers such as Buna S but do not give bobbins having the desirable qualities of those made as

described in the preceding paragraph to quite the same degree.

The elastic synthetic rubber component of the mixture has an ultimate elongation of at least 150% while the relatively inelastic hard resinous component has an elongation of less than 5% and is brittle. Blending of these two widely different types of interpolymers with one another gives a material which is ideally adapted to the manufacture of bobbins which are desirably hard but not brittle and which are capable of withstanding shock and impact and the rough treatment in the textile mill over long periods of time.

The normally hard inelastic resinous thermoplastic interpolymer used in my invention is made by the same general procedure that is used in making a rubbery Buna S or Buna N, namely by emulsion polymerization, but using a major proportion of styrene and a minor proportion of butadiene or acrylonitrile or both, the proportion of styrene preferably ranging from 60 to 97% and the proportion of butadiene or acrylonitrile or both correspondingly ranging from 40 to 3%. In this manner normally hard inelastic resinous thermoplastic interpolymers which are non-rubbery at room temperatures are obtainable with softening points ranging from 150° F. to 300° F.

In more detail, the thermoplastic hard normally inelastic interpolymer may be prepared by the emulsion polymerization of styrene and acrylonitrile as disclosed in U. S. Patent No. 2,140,048 in the presence of an emulsifying agent and a polymerization catalyst. The customary regulators used in making synthetic rubber may be included. A convenient recipe is

	Parts
Water	180 –400
Peroxidic catalyst	0.1– 1.5
Styrene	65 – 80
Acrylonitrile	20 – 35
Butadiene	0 – 15
Emulsifying agent (e. g., soap)	0.5–150
Regulator (e. g., dodecyl mercaptan)	0 – 1

After the autoclave, which is equipped with a stirrer, is charged with the above mixture, it is heated with stirring until there is a 90% or better conversion of the monomeric components to the desired resinous interpolymer. Time and temperature are co-related. The temperature may range from 80° F. to 200° F.; at 950 F. about 10–14 hours are required. The resulting emulsion is withdrawn from the autoclave and coagulated with stirring in a conventional way as by admixture of acid or salt solution. The coagulate is separated in any suitable manner, washed with water and dried to produce a friable powder. The solid resinous interpolymer at room temperatures, e. g. 20° C., is completely lacking in elastic (rubber-like) properties; it can be milled into a sheet which is hard, tough and brittle at ordinary room temperatures.

The rubbery interpolymer and the hard inelastic resinous interpolymer may be mixed to a uniform homogeneous mixture in any suitable manner as on a rubber mill or in a Banbury mixer at any suitable elevated temperature, for example at 320–350° F., whereupon the resulting mix may be cooled, for example to 150–180° F., whereupon other ingredients such as vulcanizing agents, anti-oxidants, vulcanization accelerators and other rubber compounding agents may be admixed if desired. However, as will appear below, the bobbins of my invention may be made from an unvulcanized composition of the rubbery interpolymer and the inelastic resinous interpolymer. For textile applications where the bobbin is subjected to heat or high unit stresses it is desirable to vulcanize the elastomeric portion of the mixture during the molding by the use of the usual rubber compounding ingredients and a temperature sufficient to effect vulcanization.

Where a vulcanized product is desired, enough vulcanizing agent, almost invariably sulfur, is incorporated in proportion to the synthetic rubbery interpolymer in the formulation to cure it to a soft vulcanized state if it were cured alone. The amount of sulfur may range from ½ to 5 parts per 100 parts of elastomer-resin mix. It is not known whether or not all of the sulfur combines with the elastomer but in any event incorporation of vulcanizing ingredients and vulcanization give a bobbin which shows greatly increased wear-resistance and resistance to high temperatures.

The usual fillers, softeners and pigments may be added as required for ease of processing and control of physical properties. The use of a plasticizer is particularly desirable where the bobbin is not vulcanized. Any of the known plasticizers commonly used in plasticizing synthetic resins may be employed. The fillers, softeners and pigments may be incorporated in the high temperature mixing operation if desired.

I generally employ the rubbery interpolymer and the resinous interpolymer in such relative proportions that there is present from 20 to 60% of the rubbery interpolymer and correspondingly from 80 to 40% of the resinous interpolymer. I prefer to employ from 20 to 50% of the rubbery interpolymer and correspondingly from 80 to 50% of the resinous interpolymer. These percentages are based on the sum of the rubbery and resinous interpolymers.

Examples of styrene-acrylonitrile interpolymers which are employed in conjunction with rubbery butadiene-acrylonitrile interpolymers in the preferred practice of my invention are resinous binary interpolymers made from monomers consisting of 70% styrene and 30% acrylonitrile and from 75% styrene and 25% acrylonitrile and ternary interpolymers of monomeric constituents consisting of 65% styrene, 30% acrylonitrile and 5% butadiene and 69.2% styrene, 23.1% acrylonitrile and 7.7% butadiene. The binary styrene-acrylonitrile resinous interpolymers are usually made from monomers consisting of from 65 to 80% of styrene and correspondingly from 35 to 20% of acrylonitrile. The ternary styrene-acrylonitrile-butadiene resinous interpolymers are usually made from monomers consisting of 65 to 80% of styrene, from 20 to 35% of acrylonitrile and up to 15% of butadiene.

Representative types of resinous interpolymers made from styrene and butadiene only, which are employed in conjunction with rubbery interpolymers of butadiene and styrene in the less preferred practice of my invention include interpolymers made from monomers consisting of 80% styrene and 20% butadiene, 85% styrene and 15% butadiene, 87% styrene and 13% butadiene, 90% styrene and 10% butadiene, 93% styrene and 7% butadiene, 95% styrene and 5% butadiene, and 97% styrene and 3% butadiene.

In the drawing, the bobbin is shown as an integral single-piece molding having the enlarged portion 1 at one end which is provided with cir-

cumferential grooves 2 designed to accommodate the usual metal wire rings (not shown) which are snapped in place to become part of the bobbin, these rings being adapted to be engaged by the spring action in the shuttle, thus holding the bobbin in position. Alternatively, if desired the metal rings may be molded in place in the portion 1 of the bobbin by preinserting them in the mold cavity. The bobbin is further shown as having the upwardly extending tapered portion 3 which is provided with annular grooves 4 and which is adapted to receive the yarn. The bobbin is hollow, the inner portion being adapted to receive from below the driving means such as a spindle when it is being wound with yarn. The hole 5 at the upper end of the bobbin enables the core used in molding the bobbin to be positively supported at both ends rather than from only the larger end of the core thereby giving an accurately sized bobbin. The drawing shows the relatively thin walls of the bobbin and, surrounding the hole 5, the curved inwardly extending arcuate wall portion 6 which would be relatively weak when made of wood as in the prior art. Molding of the bobbins of my invention is very simple and economical in comparison to the difficulty of forming bobbins of wood which involves a difficult boring operation. It will be understood that molding of the bobbins of the present invention is simplified by the ease of removing the molded bobbin from the upwardly tapered core.

If desired, the grooves 2 and the metal rings mentioned above may be dispensed with in which case the bobbin may be molded with protruding circumferential rings 7, integral with the body of the bobbin as illustrated in Fig. 3 of the drawing. Construction of the bobbin with such integral rings of the same material as the body of the bobbin and formed in the same molding operation further simplifies manufacture.

Example 1

Textile bobbins, as illustrated in the drawing, were molded in an injection molding press from the following formulation:

	Parts
Elastomeric copolymer of 65% butadiene and 35% acrylonitrile	35
Hard inelastic resinous copolymer of 70% styrene and 30% acrylonitrile (softening point 200 F.)	65
Red iron oxide	5
Anti-oxidant (phenyl alpha naphthylamine	1
Clay	25
Plasticizer (dioctyl phthalate)	5

Following is an example of the manufacture of vulcanized bobbins in accordance with my invention.

Example 2

The following formulation was employed:

	Parts
Elastomeric copolymer of 75% butadiene and 25% acrylonitrile	50
Hard inelastic resinous copolymer of 70% styrene and 30% acrylontrile (softening point 200 F.)	50
Red iron oxide	10
Anti-oxidant (as in Example 1)	1
Clay	25
Sulfur	2
Accelerator (mercaptobenzothiazole)	0.5
Zinc oxide	2

This mixture was formulated in the manner described above and vulcanized to give molded bobbins such as illustrated in the drawing, the vulcanization being carried out at a temperature of about 300° F.

Any suitable method of molding such as injection molding, compression molding, transfer molding, etc., may be employed in making the bobbins of my invention. The vulcanized bobbins will generally be molded by compression or transfer molding while the unvulcanized bobbins will often be made by injection molding.

Bobbins made in accordance with the present invention have many advantages over bobbins on the market commercially which are made of wood (generally maple or dogwood) or of resin-impregnated paper. Among these advantages the following may be mentioned.

The bobbins of my invention are much less sensitive to moisture and have much better dimensional stability than wood or paper bobbins which swell and warp when exposed to moisture. The bobbins of my invention are rigid, light in weight, durable and are tougher and less easily broken or dented than bobbins made of wood or paper which are easily broken and which splinter and roughen on the surface and in turn roughen the yarn. My bobbins have higher unit strength and are completely free from grain. Hence they may be made with thinner walls which enables them to handle larger yarn packages within the space limitation imposed by a shuttle for example. It will be understood that the internal dimensions of bobbins and the external dimensions of the yarn package are fixed. The greater strength and toughness of my bobbins enables the outside dimensions of the bobbin (i. e. the wall thickness) to be reduced so that the bobbin can accommodate more yarn without exceeding the fixed external dimensions of the yarn package. The bobbins of the present invention require no surface coating to produce the proper surface friction or drag. This is a tremendous advantage over wood or paper bobbins which require frequent varnishing to control surface friction. The bobbins of the present invention have the proper friction, the yarn coming off the bobbin in exactly the manner preferred by textile workers. The bobbins of my invention may be molded in identifying colors for different yarns and the coloration is permanent whereas wood and paper bobbins must be painted for the identification of types of yarns. The bobbins of the present invention are much more economical than bobbins available heretofore because of their longer life and lower breakage rate. They have high hardness coupled with high impact strength and toughness so that breakage is practically eliminated.

Another advantage of bobbins of my invention is that they may be made in a single integral piece by a single molding operation and thus their manufacture is simple and economical. No reinforcement is necessary and no assembly problem is presented. It will be understood that in some types of bobbins metal inserts are necessary for electrical contact purposes. Such metal inserts may possibly be considered to exert a slight reinforcing action and the same is true of the metal rings applied to the lower enlarged portion of the bobbin. Although such slight reinforcement may be used, it is not necessary to give a bobbin of satisfactory characteristics in accordance with my invention. The term "unreinforced," as used herein, is intended to denote that the bobbins of my invention are devoid of sub-

stantial reinforcing means, i. e., reinforcing means which is essential to give the bobbins satisfactory strength, but this term is not intended to exclude any such slight reinforcement as would be incidentally provided by electrical contact means or metal rings such as just referred to.

Bobbins made from other plastic materials are not satisfactory and show the following points of weakness in comparison with the bobbins of my invention. Bobbins made from polystyrene are too brittle. Those made from cellulose acetate have much too low impact strength at the required hardness and also have poor dimensional stability. Attempts to make bobbins from phenolic resins such as phenol-formaldehyde resins are unsuccesful because the bobbins are too weak and brittle without reinforcement and the reinforced types are too hard to mold in the required shapes. Bobbins from hard rubber are too brittle. Polyvinyl chloride exhibits too much plastic flow in the finished bobbin and has too low surface friction. The requirements of a plastic material used for making bobbins are exceedingly rigid and cannot be met by the ordinary plastic materials. However, the plastic material used in accordance with my invention ideally meets these requirements and not only provides a solution to the problem of making bobbins from plastics but gives a bobbin which is greatly superior to the best bobbins of the prior art.

All parts and percentages herein are by weight. The term "copolymer" is used herein in a restrictive sense that is as excluding monomers other than those named while the term "interpolymer" is used in a non-excluding sense that is as not excluding the presence of other monomers which do not detract from the essential characteristics of copolymers of the named monomers. For example in the manufacture of the Buna N component of my preferred bobbins a small amount of 2-chloro-1,3-butadiene may be employed together with 1,3-butadiene without interference with the essential rubbery elastic nature of the resulting interpolymer. In the normal practice of my invention, however, I employ the copolymers of the monomers mentioned, that is, interpolymers of monomers consisting of those named.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

An unreinforced one-piece integral plastic bobbin for textile machines, said bobbin being molded from a composition of which the principal components are a rubbery interpolymer of butadiene and acrylonitrile and a hard normally inelastic resinous thermoplastic interpolymer of a major proportion of styrene and a minor proportion of acrylonitrile, the relative proportions of said rubbery interpolymer and said resinous interpolymer being such that there is present from 20 to 60% of said rubbery interpolymer and correspondingly from 80 to 40% of said resinous interpolymer, said percentages being by weight based on the sum of the weights of said rubbery interpolymer and said resinous interpolymer.

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