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ROLLER SKATE WHEEL

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Fig. 1

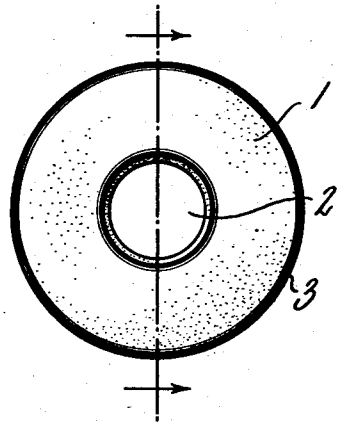
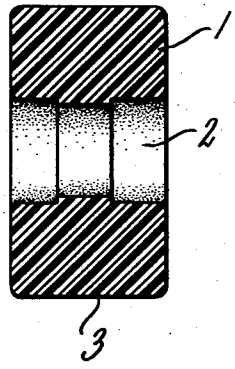


Fig. 2



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ROLLER SKATE WHEEL

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This invention relates to an improved roller skate wheel composition, and, more particularly, it relates to a roller skate wheel comprised of a blend of nitrile rubber with a phenolic resin.

The best roller skate wheels heretofore available have been the wood or fiber roller skate wheels, and in rink skating such wheels have been used virtually exclusively, as providing the most satisfactory skating characteristics that could be obtained. However, such roller skate wheels have been beset by certain inherent difficulties, especially with respect to wearing properties. The conventional rink roller skating wheels not only have worn relatively rapidly, but such wear has been comparatively uneven, with the result that the wheel tended to assume an oval shape and soon acquired totally unsatisfactory skating characteristics. Another disadvantage of the conventional wheels is that they produced a great deal of noise on the rink floor, to the eventual discomfort of the participants in this form of sport. Also, the tendency of conventional wheels to slip sideways, particularly on turns, has usually made it necessary to apply to the floor of the rink an anti-skid substance, such as rosin, to prevent accidental slipping and injury of the skaters. This expedient has not always been entirely satisfactory, and it has the serious disadvantage that the rosin dust eventually pervades the air of the skating rink, to the annoyance of the participants, and soiling their hair, skin and clothing.

Accordingly, the principal object of the present invention is the amelioration of the foregoing difficulties by providing a roller skate wheel which is wear-resistant and does not become out-of-round from uneven wear, and which is substantially quiet running, and is relatively free from sideslip, even when no rosin is applied to the skating floor.

Another object is the provision of a roller skate wheel having unusually low rolling resistance, so that it can be skated on with great ease and enjoyment. It is an additional object of the invention to provide a roller skate wheel that is of simple construction, and convenient and economical to manufacture.

Still a further object is to provide a roller skate wheel composition which will not cause or permit a static electrical charge to accumulate on the person of the skater, causing him to receive a shock when he touches a grounded object, as well as shocking another person that he might touch.

The manner in which the invention accomplishes the foregoing objects, as well as additional objects and advantages, will be made manifest in the following detailed description, which is intended to be read with reference to the accompanying drawings, wherein:

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Fig. 1 is a side elevational view of a roller skate wheel of the invention; and

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1.

The invention is based upon the unexpected discovery that the nitrile type of synthetic rubber, when suitably modified by addition of a phenolic resin, produces a material that is admirably suited for roller skate wheels. The invention therefore contemplates the provision of a roller skate wheel composed of a hard plastic comprised of from about 35 up to about 60 parts by weight of nitrile rubber and correspondingly from about 65 down to about 40 parts of phenolic resin.

The nitrile rubber component of the roller skate wheel is the well known synthetic rubber, also known as Buna N or GR–A or by such trade names as Hycar, Paracril and Perbunan, prepared by copolymerization of butadiene and acrylonitrile, usually by emulsion polymerization, in the well known manner. It is preferred to employ those rubbery butadiene-acrylonitrile copolymers containing a relatively high proportion of combined acrylonitrile, say from about 35 to 45%, because these rubbery copolymers are completely compatible with the phenolic resin whereas rubbery copolymers of lower acrylonitrile content often tend to exhibit somewhat diminished compatability, resulting in poorer physical properties. A butadiene-acrylonitrile rubbery copolymer which gives unusually satisfactory results in the present invention is that known commercially as Hycar OR–15, which contains about 42% of combined acrylonitrile. Another material which gives very excellent results is that known as Perbunan 35, which contains about 35% combined acrylonitrile.

Less preferably, I may use rubbery copolymers of butadiene and acrylonitrile containing less than 35% combined acrylonitrile, say from 15% up to 35%. Examples of such copolymers are those known commercially as Perbunan 26 and Perbunan 18 which contain approximately 26% and 18% acrylonitrile, respectively. As the combined acrylonitrile content is lowered, the compatibility with the phenolic resin tends to progressively decrease and the physical properties of the product tend to be progressively poor.

The phenolic resin component of the roller skate wheel is a phenol-formaldehyde resin of the type that is capable of being converted by heat to the permanently infusible state in the presence of formaldehyde, or a methylene-yielding curing agent of the type commonly used for curing phenolic resins, such as hexamethylene tetramine or paraformaldehyde. Preferably the phenolic resin is one which has been modified with cashew nut oil. Such modified phenolic resins are well

known commercially available materials, as typified by the resin sold under the trade designation Durez No. 12686, which is made from cashew nut shell oil and a lower molecular weight phenol. Frequently the commercial form of the resin already contains a sufficient quantity of a methylene-yielding curing agent to render it heat-hardenable, as in the case of the material sold under the trade designation Durez No. 12687, which is believed to be a mixture of 92 parts of cashew nut shell oil modified phenolic resin and 8 parts of hexamethylene tetramine. Other commercially available cashew nut oil modified phenolic resins, containing a curing agent, are the materials known in the trade as Varcum 9820 and Varcum 9831.

To make the roller skate wheel of the invention the nitrile rubber and phenolic resin are mixed intimately together, suitably with the aid of the mixing equipment usually used in the rubber and plastics industries, such as roll mills or internal mixers such as the Banbury mixer. Application of heat during the mixing aids the blending process, but the mixing temperature should not be sufficiently elevated to cause premature curing of the phenolic resin, which would prevent its being properly molded later on. If the phenolic resin is not one of the commercial grades already containing a hardening agent, then the hardening agent should be added as the nitrile rubber and resin are blended together. Those skilled in the art will understand that the phenolic resin can be cured or hardened by heating in the presence of curing agents such as hexamethylene tetramine or its known equivalent, typically employed in amount of about $\frac{1}{10}$ of the weight of the resin.

For purposes of the invention it has been found that the roller skate wheel possesses the most desirable combination of physical properties when a quantity of wood flour is incorporated as a filler in the blend of nitrile rubber and phenolic resin. For this purpose, from about 30 parts to about 60 parts of wood flour may be included in the mixture, per 100 parts of the nitrile rubber.

It has further unexpectedly been found that if the roller skate wheel is made of a composition including powdered cryolite, there arises no difficulty from build-up of a static electrical charge on the person of a skater using the wheels. This surprising advantage of cryolite, which is a mineral double fluoride of sodium and aluminum (Na_3AlF_6), and which is an ionizible salt, is believed to be related to the fact that the cryolite apparently has a profound effect on the electrical conductivity of the plastic composition. The effect is believed to be related to the fact that the cryolite is very slightly soluble in water, with a resulting tendency to form electrically conductive films from small amounts of moisture condensed from or adsorbed from the surrounding atmosphere. The sodium salt in the cryolite would be completely ionized in a water solution. While it is not desired to limit the invention to any particular theory of operation, it appears that the cryolite prevents a static electrical charge from building up, either by so modifying the composition as to prevent charges from forming, or by allowing static charges to be conducted away, once formed. In any event, remarkably different results are obtained as a result of inclusion of cryolite in the mixture.

For purposes of the invention, from about 10 to about 30 parts of the cryolite are preferably included in the plastic blend per 100 parts by weight of the nitrile rubber.

The composition from which the wheel is made may also contain small amounts of other ingredients such as mold lubricants (e. g., zinc stearate), pigments and coloring agents, anti-oxidants for the rubber, etc. If desired, vulcanizing agents, such as sulfur, and other vulcanizing ingredients, such as the usual vulcanization accelerators and activators, may also be present, although they are not necessary and in some cases it is believed that slightly better results are obtained without the use of such rubber vulcanizing agents and ingredients.

After mixing the foregoing ingredients intimately as previously described, the resulting mixture may be sheeted out, as on a rubber calendar, and allowed to cool. The material is then preferably comminuted, as by chopping or grinding, to a powdered or granulated material of suitable size for use as a molding powder. The chopping or grinding may be facilitated by refrigerating the sheeted stock to about 35° F., or below.

To make the roller skate wheel, there is provided a mold having the shape of the desired wheel, and such mold is charged with the foregoing molding powder. The mold is then placed in a suitable heated molding press, where it is subjected to an elevated temperature, say of the order of 300 to 350° F., and to substantial pressure, say of the order of 100 to 4,000 p. s. i. to form the skate wheel. The mixture is thus caused to flow together to give a solid, uniform, integral molded wheel in which the phenolic resin has been converted to the insoluble, infusible state. The curing time required to accomplish this will vary widely, say from 10 minutes to 4 hours, depending upon many factors such as the thickness of the wheel, etc. The exact nature of the phenomenon that occurs during the curing of the roller skate wheel is not known with certainty. It is known that the curing operation advances the resin to the insoluble, infusible form. It is believed that the resin and the nitrile rubber components of the mixture exert a mutual co-curing action upon one another during the curing step, but the nature of any such co-curing effect is not understood, and it is not desired to limit the invention by any theory or hypothetical explanation. In any event, the cured roller skate wheel has an unusual combination of properties, which is more than the expected sum of the known properties of the various components taken alone, and which results in a far superior roller skate wheel compared to those heretofore obtainable.

The following example will illustrate the invention in more detail:

Example 1

	Percent by Weight	Parts by Weight
Nitrile rubber	37.93	100.0
Phenolic resin	31.99	84.4
Wood flour	16.94	44.7
Titanium dioxide	1.89	5.0
Cryolite	7.30	19.3
Paraffin wax	.49	1.3
Yellow iron oxide	3.46	9.1
	100.00	263.8

The nitrile rubber employed was the commercially available synthetic rubber sold under the

designation Hycar OR–15, containing about 42% of combined acrylonitrile. The phenolic resin was a commercially available cashew nut shell oil modified phenolic sold under the trade designation Durez No. 12687, and already contained sufficient curing agent to convert it to the insoluble, infusible state upon heating. The wood flour was nominally of the 100 mesh size, (95% passing through a 100 mesh screen), comprised of ground pine having a light cream color, a pH of 4.5 to 5.5, and exhibiting a maximum weight loss of 8% upon heating for 2 hours at 100° C. The titanium dioxide was added as a pigment, as also was the yellow iron oxide. The paraffin wax was added as a mold lubricant. The cryolite was white ground Greenland cryolite, nominally of the 300 mesh size (98% passes a 200 mesh screen, 52% is retained on a 325 mesh screen, and 46% passes the 325 mesh screen).

The nitrile rubber was banded on a roll mill, and the powders were added in any desired order (or preferably mixed together). The temperature was permitted to reach about 250° F. during the mixing so as to melt the resin and insure a thoroughly intimate and homogeneous blend. However, substantially more elevated temperatures than this should be avoided, because of the danger of "scorching" the stock. The blend may also be made in an internal type of mixer by adding all of the ingredients together and mixing until they are blended.

The blend was sheeted out and comminuted. The resulting molding powder was molded for 10 minutes at 330° F. under a pressure of about 3,000 p. s. i. in the form of a roller skate wheel having, as shown in the accompanying drawing, an annular body 1 with an axial opening 2 adapted to receive a bearing assembly of a roller skate. Prior to use, the rolling surface 3 of the wheel is preferably ground off slightly to remove the relatively smooth surface formed during the molding operation. The wheel had a hardness of 70, as measured on the D scale of the Shore durometer. The wheel was also unusually strong, having a tensile strength of about 4,000 p. s. i., and was highly resistant to shocks and impact.

It was determined by testing of the roller skate wheel under actual conditions of use, that the wheel had unusually good skating characteristics. The wheel displayed a minimum of resistance to rolling, so that skating upon the wheel was comparatively effortless, in marked contrast to skating upon a wheel made of rubber, which requires relatively great effort.

The wheel was free from any undesirable tendency to side-slip on the turns, but, at the same time the wheel did not have such a great frictional grip upon the floor as to interfere with the usual maneuvers in fancy skating. From this it will be seen that the wheel provided in a most surprising manner an unusual balance between tendency to side-slip, and tendency to grip the floor.

Even when water was poured on the floor, it was possible to skate without any noticeable side-slip. This ability is quite unexpected and unpredictable from the appearance of the molded skate wheel, since the wheel gives the appearance, if any thing, of being quite smooth and slick on its surface.

The wheel was also unusually long wearing, and a professional skater skated on the wheels for thirty days without replacing them, under conditions such that wooden wheels would have required replacing at least once a week. In addition, such wear as did occur, took place very evenly, and the wheel did not become out-of-round in use, unlike the wooden wheels, which wear oval.

The freedom of the wheel from skidding and side-slip made it perfectly feasible to skate with safety on a wooden floor having no rosin. This makes for definitely cleaner and more comfortable skating, and the comfort obtainable by the use of the present wheel is further enhanced by the fact that the wheel is unusually quiet running, compared to previously known rink skating wheels.

The wheel of the invention is also advantageous in that it provides the desirable combination of properties in a simple, one-piece construction, and it is unnecessary to resort to complicated composite constructions.

The present wheel is far superior to a wheel molded from phenolic resin itself, since, in addition to being quieter and providing a more certain grip on the floor without increased rolling resistance, the present wheel will far outlast the phenolic wheel.

The inclusion of the cryolite in the roller skate wheel composition is a particularly advantageous feature of the invention, as indicated previously, because the skate wheels made from this composition do not develop static charges in service, whereas this is a most serious problem with other plastic roller skate wheels. Cryolite is especially well suited for this purpose because it is found that the skate wheels so formulated have no tendency to sweat under conditions of high humidity due to adsorption or condensation of moisture, and the cryolite composition never yields moisture films on the surface of the wheel which are visible or which feel wet to the touch. The cryolite has the further advantage of largely mashing the usual cherry red color of the phenolic resin used in the blend, and therefore provides a much lighter colored stock, which not only has a more pleasing appearance, but does not undesirably color the floor of the skating rink as it wears off. The cryolite also aids in the reinforcement of the stock, and gives body to the stock without unduly increasing its stiffness. With the addition of cryolite it is possible to use a higher resin content while still preserving a given hardness.

The preferred filler for use in the roller skate wheel stock is wood flour, preferably of the finest grade—100 mesh or finer—since wood flour provides the most desirable combination of properties and in the finer sizes it provides the most desirable surface which is smooth and has low rolling resistance, but yet affords complete control against undesired slipping or skidding.

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

1. A roller skate wheel comprising an annular body having an axial opening for receiving a roller skate wheel bearing, said body being made of from 35 to 60 parts of a rubbery butadiene-acrylonitrile copolymer containing from 15 to 45% of acrylonitrile blended with correspondingly from 65 to 40 parts of a cashew nut shell oil modified phenol-formaldehyde resin, and containing a small amount of cryolite to prevent static electrical charges, said composition being cured to the insoluble, infusible state.

2. A roller skate wheel comprising an annular body having an axial opening for receiving a

roller skate wheel bearing, said body being made of from 35 to 60 parts of a rubbery butadiene-acrylonitrile copolymer containing from 15 to 45% of acrylonitrile blended with correspondingly from 65 to 40 parts of a cashew nut shell oil modified phenol-formaldehyde resin, in admixture with wood flour as a filler and a small amount of cryolite to prevent static electrical charges, said composition being cured to the insoluble, infusible state.

3. A roller skate wheel composition characterized by long wear and improved skating qualities, comprising an uncured intimate homogeneous blend of 35 to 60 parts of a rubbery butadiene-acrylonitrile copolymer containing from 35 to 45% of combined acrylonitrile, and correspondingly from 65 to 40 parts of cashew nut shell oil modified phenol-formaldehyde resin containing a methylene-yielding curing agent, in admixture with from 30 to 60 parts, per 100 parts of the said nitrile rubber, of finely powdered wood flour as a filler, and from 10 to 30 parts, per 100 parts of the said nitrile rubber, of finely powdered cryolite to prevent said composition from building up a static electrical charge on the person of a skater using the wheel.

4. A roller skate wheel composition characterized by long wear and improved skating qualities, comprising an uncured intimate homogeneous blend of 35 to 60 parts of a rubbery butadiene-acrylonitrile copolymer containing from 35 to 45% of combined acrylonitrile, and correspondingly from 65 to 40 parts of cashew nut shell oil modified phenol-formaldehyde resin containing a methylene-yielding curing agent, in admixture with from 10 to 30 parts, per 100 parts of the said nitrile rubber, of finely powdered cryolite to prevent said composition from building up a static electrical charge on the person of a skater using the wheel.

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