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CABLE FOR USE IN REINFORCING ELASTOMERIC PRODUCT

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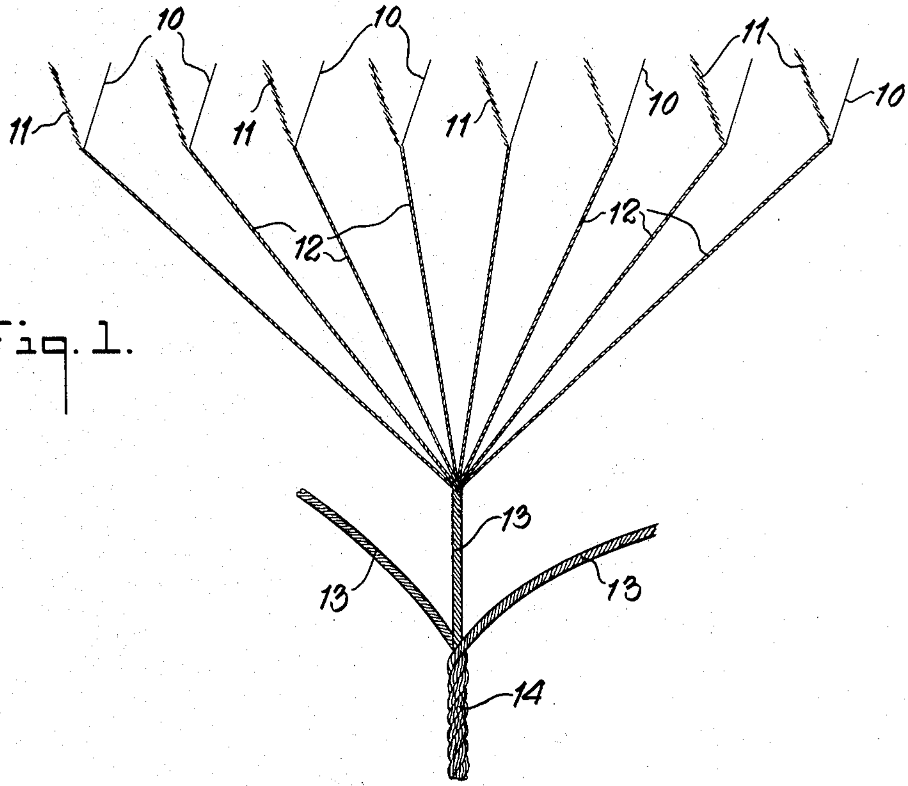


Fig. 1.

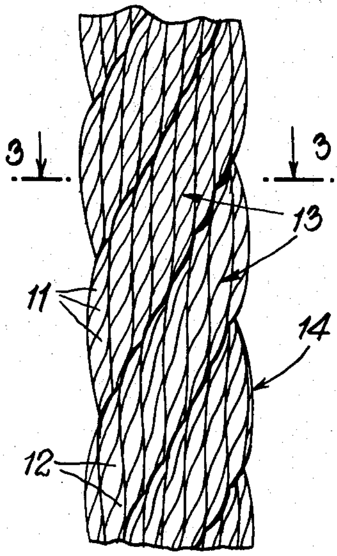


Fig. 2.

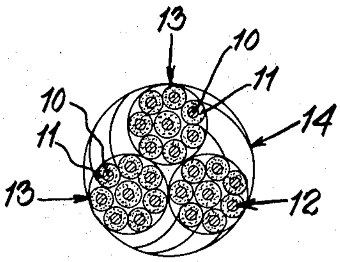


Fig. 3.

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## CABLE FOR USE IN REINFORCING ELASTOMERIC PRODUCT

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**4 Claims. (Cl. 57—140)**

This invention relates to composite products comprising an elastomeric material and a textile reinforcement particularly tyres, belting and hose.

In order to reduce the weight and cost of such composite products it is desirable that the reinforcement should have as high a tenacity as possible and with this object in view cotton, which was the reinforcement originally used, has been replaced to some extent by the continuous filament synthetic materials, particularly nylon, and proposals have also been made to use the polyester material sold under the registered trademark "Terylene." These materials have the disadvantage, however, that they do not adhere so well as cotton to rubber which is one of the elastomeric materials usually employed.

Theoretically it should be possible to increase the strength of a yarn composed of a blend of cotton and nylon staple fibres or of cotton and "Terylene" staple fibres, by increasing the proportion of nylon or "Terylene" which is incorporated in the blend, but it is found in practice, as shown by FIGURE 2 on page T687 of the Journal of the Textile Institute for November 1955, that the incorporation of nylon staple fibres with cotton in an amount up to 50% of nylon in fact reduces the tenacity of the yarn produced. Similar results are obtained with "Terylene" staple fibres.

We have found however, if nylon or "Terylene" continuous filament yarn is spun together with cotton by the process known as "core-spinning," using up to 50% of continuous filaments, the tenacity of the yarns so produced increases regularly with increase in the continuous filament content. In addition, we have found that when the yarns are doubled together with suitable twist the tenacity of the doubled yarn is approximately equal to the sum of the tenacities of the continuous filament component and of a cotton yarn spun with optimum twist from the cotton fibres present in the core-spun yarn. Thus whereas in the experiments to which the above FIGURE 2 referred the tenacity of the yarn decreased from about 1.7 gm./denier for an all cotton yarn to about 1.4 gm./denier for a yarn with 50% nylon content, experiments with core-spun cotton/"Terylene" doubled yarn gave a steady increase from 2.0 gm./denier for an all cotton yarn to 4.0 gm./denier for 50% "Terylene" content. The same regular increase can be obtained in cabled cord constructions in which previously doubled yarns are twisted together, preferably in the opposite direction to the doubling twist, to form a cabled cord.

The present invention makes use of the special properties of these core-spun yarns to obtain improved composite products comprising an elastomeric material and a textile reinforcement.

According to the present invention, composite products such as tyres, belts and hose comprise an elastomeric material reinforced by doubled or cabled yarns comprising a continuous filamentary material having a sheath of a staple fibrous material spun thereon, the proportion of continuous filamentary material being up to 50% by weight of the yarn.

Suitable continuous filamentary materials are rayon, nylon or "Terylene" (a polyethylene terephthalate) having a tenacity of 3 or 4 gms./denier or more and suitable fibrous materials are cotton and rayon staple. The elastomeric material usually employed is a natural rubber or synthetic rubber, e.g. a butadiene-styrene co-polymer, a butadiene-acrylonitrile co-polymer or polychloroprene, or a plasticised polyvinyl chloride composition. Balata or gutta-percha may also be used in the construction of belting.



The core-spun yarns are of the type in which the continuous filamentary component is surrounded by a sheath of spun staple fibrous material and are subsequently doubled or cabled together to give optimum strength. The core of the yarn may comprise a plurality of continuous filaments, if desired.

An additional advantage is that by core-spinning the filament core, for example, "Terylene" is more efficiently covered by the staple fibre than by doubling and hence gives better adhesion to the elastomeric material.

The proportion of continuous filamentary material in the core-spun yarns may be in any proportion up to 50% by weight, depending on the cost/strength ratio desired and on the purpose for which they are required. It has been found that adequate adhesion can be obtained to yarns, cords or fabrics made of core-spun yarns containing up to 50% of filamentary material.

Composite products produced using such yarns possess exceptional resistance to flexing and also show little growth or elongation under either constantly applied or repeated loading once the initial stretch has occurred.

The accompanying drawing illustrates the assembly of a cable according to the invention in which;

FIG. 1 is a diagrammatic sketch showing the manner of assembling the elements of the cable;

FIG. 2 is a side view of a portion of the cable, and

FIG. 3 is a cross-section of the cable on the line **3—3** of FIG. 2.

As illustrated in FIG. 1 particularly, the cable is made of a core **10** of filamentary material such as "Terylene" or Dacron, nylon or rayon, about which is core-spun a sheath **11** of spun stable fibrous material such as cotton or rayon staple to form a yarn **12**.

In the particular embodiment shown, eight such yarns are formed and twisted to form a cord **13**. Three such cords are twisted together to form a cable **14**. This cable may be used as a reinforcement for an elastomeric material.

The core spun yarns can be incorporated in the composite products without the use of adhesives but, if desired the simpler well-known adhesives can be applied to the yarn before fabrication of the product. Examples of such adhesives are diluted natural rubber latex which may if desired contain a resorcinol-formaldehyde resin dispersed therein or a synthetic rubber latex comprising a copolymer of butadiene, vinyl pyridine and/or styrene.

Apart from the construction of the cord employed the manufacture of composite products in accordance with the present invention is carried out by the usual methods. Examples of such composite products are pneumatic tyre covers having reinforcing cords or breakers containing core-spun yarns, power transmission and conveyor belting reinforced with cords or fabric containing core-spun yarns, V-belts having outer fabric layers or jacket plies containing core-spun yarns and natural or synthetic rubber hose containing core-spun yarns as reinforcement embedded in the hose wall or as a braiding on the exterior of the hose.

The invention is illustrated by the following various types of composite products constructed in accordance therewith.

*Example I*

A yarn which has given good results in hose fabric is one containing about 32% "Terylene" yarn and 68% of cotton, made from 250 denier "Terylene" yarn core-spun with $10^S$ cotton to give a resultant count of $7^S$, the yarn being then doubled to a $7^S/3$ fold construction. With 10.0 turns per inch (Z) in the single twist and 5.5 turns per inch (S) in the folding twist the folded yarn had a breaking strength of 16.24 lbs. and a tenacity of 3.20 grams per denier. With 22 warp threads per inch and 19.2 weft threads per inch the fabric strength figures for prepared test strips 2 inches wide, unravelled from strips cut 3 inches wide were 650.8 lb. in the warp direction and 609.9 lb. in the weft direction. A fabric made of all cotton yarn from the same grade of cotton spun to $7^S$ counts, made into a 3 fold thread with the same twist particulars and woven with approximately the same number of warp and weft threads gives only 335 lb. per 2 inches for the warp strength and only 315 lb. per 2 inches for the weft strength.

This fabric was used in the construction of hose by the usual methods i.e. by application of a natural rubber composition and building on a mandrel so that the fabric was embedded in the wall of the hose followed by vulcanisation of the rubber. The resulting hose exhibited greatly improved adhesion of the rubber to the fabric and was consequently very robust.

*Example II*

Another yarn which has been found satisfactory for the construction of conveyor belting contains about 28% "Terylene" yarn and 72% of cotton and is made from 250 denier "Terylene" yarn core-spun with $8^S$ cotton to give a resultant count of $6^S$, the yarn being then doubled and cabled to a $6^S/8/3$ construction. With a single twist of 11.0 turns per inch (Z), a first folding twist of 4.0 turns per inch (S) and a second folding or cabling twist of 2.0 turns per inch (Z) the strength of the cord was 134.6 lb. This is a tenacity of 3.24 grams per denier. A similar cord made wholly of the same quality of cotton with the same construction and twist particulars gives an average breaking load of 84.5 lb., or a tenacity of 2.03 grams/denier. This cord was woven with a very low weft content to give a belting fabric which was impregnated with a compounded unvulcanised rubber. Unvulcanised rubber covers were applied and the assembled belting vulcanised by heating in a belting press. The belt so obtained was characterised by extremely good adhesion of the rubber to the fabric.

*Example III*

A base yarn which has been found particularly suitable for the construction of wedge-shaped driving belts (or V-belts) consists of 30% "Terylene" yarn and 70% of cotton and was made from 250 denier "Terylene" yarn core-spun with $8^S$ cotton to give a resultant count of $7^S$, the yarn was doubled and cabled to give a $7^S/5/3$ construction. The cabled cord had a strength of 94 lbs.

A narrow section wedge-shaped driving belt was made having four plies each containing thirteen endless cords of the above type with a skeleton weft, arranged in a lateral plane of the belt and embedded in a layer of cushion rubber. The layer of cushion rubber was sandwiched between a layer of base rubber and an upper layer of filler rubber, the whole being shaped to the desired V profile. The assembly was covered with a number of jacket plies of rubber-covered fabric and the final belt vulcanised in a mould. Belts of this construction were tested on a high speed testing machine and ran for more than 1,000 hours without failure.

*Example IV*

For the fabrication of a fan belt, a basic yarn was constructed by core-spinning cotton rovings around a "Terylene" yarn core to produce, after doubling eight fold and cabling three fold a cord of $7^s/8/3$ construction. The cord had a strength of 140 lbs. and contained approximately 30% "Terylene" yarn and 70% cotton. The fan belt was constructed by application of a rubber composition to a single ply of nine endless cords of this type as in Example III and when tested on a high speed testing machine gave a life of 340 hours. A belt of similar construction but using an all-cotton cord which had a strength of 110 lbs. when tested for comparison under similar conditions on the same machine failed after 175 hours. Fan belts made with the $7^s/8/3$ "Terylene" 30%-cotton 70% described above, were practically unaltered in length when measured under load after being stored for at least 3 months, showing that these cords are virtually unaffected by moisture and so are particularly suitable for use in countries where the atmosphere may have high humidity.

*Example V*

A yarn which has given good results in pneumatic tyres is one containing about 30% "Terylene" yarn and 70% cotton and made from "Terylene" yarn core-spun with cotton to give a resultant count of $16.7^s$, the yarn being then doubled and cabled to give a tyre cord of $16.7^s/3/3$ construction.

The requisite number of these cords in the form of a weftless layer were frictioned and topped with a compounded vulcanisable natural rubber by passing through a calender in the usual manner. From this material plies were cut and pockets constructed. A 750–20 pneumatic tyre having 8 plies was built up in known manner on a rotatable drum and then moulded and vulcanised.

Run on a tyre-testing machine this tyre gave a mileage before failure equivalent to that obtained from a tyre of similar size and construction but made with 10 plies of $16.7^s/3/4$ cotton cord. These results show that equivalent strength from fewer plies of thinner cord is obtained from the core-spun "Terylene"/cotton cord.

Although the invention has been illustrated in the foregoing examples by means of yarns comprising a core of "Terylene" filaments and a sheath of cotton staple fibre, excellent results can also be obtained by replacing the "Terylene" filaments by filaments of polyamide materials such as nylon having a similar denier. In many cases, also the cotton fibres in the examples can be replaced by rayon staple fibre and satisfactory products obtained.

Having now described my invention, what I claim is:

1. A cable for use in reinforcing elastomeric products such as tires, belts and hose, wherein said cable comprises at least two cords doubled together of which each cord comprises at least two yarns doubled together, each yarn comprising an inner core of at least one continuous textile filament having a tenacity of at least 3 grams per denier with a covering outer sheath of staple fibrous material core-spun together with and covering said core, the proportion of continuous filaments being up to 50 percent by weight of the yarn.

2. A cable for use in reinforcing elastomeric products such as tires, belts and hose, wherein said cable comprises three cords doubled together of which each cord comprises at least two yarns doubled together, each yarn comprising an inner core of at least one continuous textile filament having a tenacity of at least 3 grams per denier with a covering outer sheath of staple fibrous material core-spun together with and covering said core, the proportion of continuous filaments being up to 50 percent by weight of the yarn.

3. A cable for use in reinforcing elastomeric products such as itres, belts and hose, wherein said cable comprises from 3 to 8 cords doubled together each of which comprises at least 2 yarns doubled together, each yarn comprising an inner core of at least one continuous filament of polyethylene terephthalate having a tenacity of at least 3 grams per denier with a covering outer sheath of cotton fibres core-spun together with and covering said core, the proportion of polyethylene terephthalate filaments being up to 50 percent by weight of the yarn.

4. A cable for use in reinforcing elastomeric products such as tires, belts and hose, wherein said cable comprises from 3 to 8 cords doubled together each of which com-

prises at least three yarns doubled together each yarn comprising an inner core of one or more continuous filaments of polyethylene terephthalate having a tenacity of at least 3 grams per denier with a covering outer sheath of cotton fibres core-spun together with and covering said core, the proportion of polyethylene terephthalate filaments being up to 50 percent by weight of the yarn.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,468,304 | Musselman | Apr. 26, 1949 |
| 2,477,652 | Robbins | Aug. 2, 1949 |
| 2,483,861 | Weiss | Oct. 4, 1949 |
| 2,526,523 | Weiss | Oct. 17, 1950 |
| 2,591,628 | Snyder | Apr. 1, 1952 |
| 2,739,918 | Illingworth | Mar. 27, 1956 |
| 2,755,214 | Lyons et al. | July 17, 1956 |
| 2,901,884 | Weinberger et al. | Sept. 1, 1959 |