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J. B. CARTER ET AL

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FILLED THERMOPLASTIC TRAVELERS

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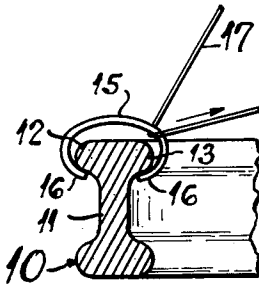


Fig. 1

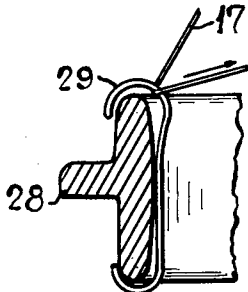


Fig. 5

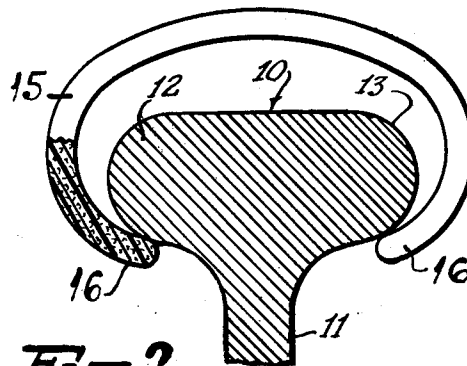


Fig. 2

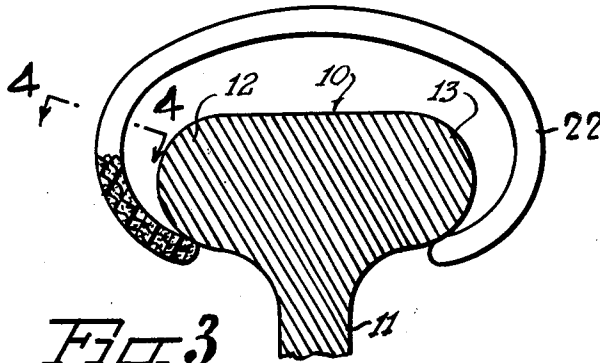


Fig. 3

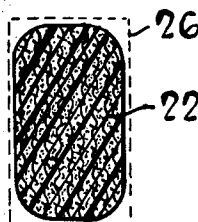


Fig. 4

INVENTORS:
JAMES BYNUM CARTER
AND EDWARD HAINES GREGG

BY

Robert Brown, Jr.

ATTORNEY

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FILLED THERMOPLASTIC TRAVELERS

James B. Carter and Edward H. Gregg, Gastonia, N.C.,
assignors to A. B. Carter, Incorporated, Gastonia,
N.C., a corporation of North Carolina
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This invention relates to spinning and twisting apparatus for use in textile manufacture, and more especially to improved plastic travelers.

Nylon and other plastic travelers heretofore devised often suffer from being too limber as compared with metal travelers. In practice, there is considerable loss often experienced due to the traveler flying off the ring, rather than to fracture or to wear-through of the traveler by the strand of yarn associated therewith. This difficulty is due to excessive flexibility of the traveler under load and the warmth developed in the traveler under operating conditions. Moreover, the greatest amount of wear is often not due to wear-through by the thread, but rather to the cutting of the foot of the traveler by the metal ring. Usually the damage to the foot of the traveler in the latter case is caused by the high coefficient of friction of nylon and other plastic travelers when wearing against steel rings.

It is therefore an object of this invention to provide improved plastic travelers devoid of the aforementioned objectionable defects, and which possess desirable characteristics such as increased dimensional stability and heat resistance, higher tensile and impact strengths, and very much reduced cold flow properties.

It is another object of this invention to provide travelers which are formed from continuous compositions consisting of relatively soft organic matrices having low friction coefficients, and of relatively hard inorganic aggregates consisting of heat-resistant fibers, particles or fabrics. The aggregate materials are uniformly distributed or dispersed throughout the matrix materials in such proportions and in such manner as to impart the necessary stiffness and rigidity for preventing accidental removal of the traveler from the ring during operation, and also to preserve other useful properties of the plastic materials such as the low friction coefficient characteristics.

The improved travelers may be molded or extruded from continuous compositions of molten materials, or cut from continuous laminated compositions. In the latter case, the parts may be die-punched or stamped from laminated or filled sheet stock of appropriate thicknesses, and then the punched scarred edges may be bevelled, smoothed and polished by suitable means such as tumbling in abrasive materials.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which,

FIGURE 1 is a fragmentary view showing a portion of a metal textile spinning and twisting ring having our improved fiber-filled traveler movably mounted thereon;

FIGURE 2 is an enlarged view with portions thereof shown in section, illustrating the fiber-filled plastic traveler shown in FIGURE 1 in association with the ring;

FIGURE 3 is a view similar to FIGURE 2, but illustrating a laminated fiber-filled plastic traveler which has been stamped from sheet stock material, said traveler being movably mounted upon a metallic ring;

FIGURE 4 is an enlarged sectional view taken along line 4—4 in FIGURE 3, showing in dotted lines the approximate cross-sectional outline of the traveler as it appears after being stamped, and showing in bold lines the outline after the traveler has been finished;

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FIGURE 5 is a fragmentary sectional view, showing another design of ring and traveler which may be constructed in accordance with this invention.

Referring to FIGURE 1 of the drawings, the numeral 10 designates a conventional metal spinning ring provided with a vertical web portion 11 and with oppositely projecting flanges 12 and 13 integral with the upper portion of the web. A traveler 15 is mounted for movement around ring 10, said traveler having points or horns 16 at opposite ends thereof which are normally held in sliding engagement with the lower surfaces of the flanges 12 and 13 by a strand of yarn 17 passing underneath the traveler.

Broadly stated, the invention comprises ring travelers made from continuous plastic compositions, filled and/or laminated, and which possess unexpected properties falling within specified critical ranges of kinetic frictional coefficient, flexural modulus, tensile strength, hardness and abrasion resistance.

By the term "continuous composition" is meant a composition of substances in which the one is homogeneously dispersible in the other in all proportions between a specified range. This contrasts with a discontinuous composition in which the one substance is not uniformly dispersed in the other and where regions of inhomogeneity in the composition will appear. In a discontinuous composition, the aggregate seriously impairs the properties of the matrix and causes loss of mechanical strength, when compared to the matrix material by itself.

A composition may be discontinuous because the aggregate is not uniformly dispersed, and thus when the aggregate is hard and inflexible as compared to the matrix, it can act as a fulcrum on which to break the continuity of the matrix during a bending stress application. In such cases, the permissible radius of bending is locally rendered very small. A composition may be discontinuous also because the aggregate is not wetted by the matrix and, consequently, the effect produced is that the aggregate does not move in the same way as the matrix in response to an applied stress to the total composition. The mechanical disadvantages that arise from discontinuous compositions therefore tend to render them unsuitable for traveler and ring applications.

The continuous compositions employed in the present invention consist of relatively soft, flexible and heat-resistant plastic matrices in which certain relatively hard inorganic aggregates, selected from fibrous, amorphous, metallic or crystalline substances, are uniformly distributed or dispersed. During the formation of the composition, the aggregate is readily dispersed or uniformly distributed in the molten matrix; and the aggregate remains in such condition when the resultant composition is cooled. Thus, a continuous composition is formed, as opposed to a discontinuous composition which separates into inhomogeneous constituents upon cooling of the mass.

The plastic matrices, in addition to being relatively flexible as compared to the associated aggregate, or to steel or similar metals, and in addition to their relatively low friction coefficients, are made from relatively chemically inert substances, resistant to the chemical action of lubricants, wetting agents, sizes and other compositions commonly employed in treating textiles. The resultant matrix-aggregate composition from which the present travelers are made is characterized by improved properties of toughness, rigidity and dimensional stability which greatly enhance the performance of the finished product.

Specific examples of continuous compositions which

afford improved performance in traveler applications as compared to the unfilled plastic are:

Example	Plastic-Matrix	Filler-Aggregate	Percent Range for Filler
(1)-----	synthetic linear polyamide polymer (identified in the trade as nylon or "Zytel" and sold by E. I. Du Pont Co., Wilmington, Delaware).	asbestos staple.	2-30
(2)-----	do	glass fibers.	2-30
(3)-----	do	spun metal fibers.	2-30
(4)-----	polytetrafluoroethylene (identified in the trade as "Teflon" and sold by E. I. Du Pont Co.).	glass fibers.	10-50
(5)-----	do	asbestos staple.	10-50
(6)-----	polyperfluoroethylenepropylene (identified in the trade as "FEP" and sold by E. I. Du Pont Co.).	glass fibers.	10-25
(7)-----	do	asbestos staple.	10-25
(8)-----	polychlorotrifluoroethylene (identified in the trade as "Kel-F Resin" and sold by Minnesota Mining & Manufacturing Co., St. Paul, Minnesota).	glass fibers.	10-50
(9)-----	do	asbestos staple.	10-50
(10)-----	do	spun metal fibers.	10-50
(11)-----	3,3 bis(chloromethyl) oxetane polymer (identified in the trade as "Penton" and sold by Hercules Powder Co., Wilmington, Delaware).	glass fibers.	2-25
(12)-----	do	asbestos staple.	2-25
(13)-----	do	spun metal fibers.	2-25
(14)-----	linear polypropylene (similar to that identified in the trade as "Profax" and sold by Hercules Powder Company).	zinc oxide.	10-50
(15)-----	do	asbestos staple.	10-35
(16)-----	do	glass fibers.	10-35
(17)-----	linear polyethylene (similar to that identified in the trade as "Hifax" and sold by Hercules Powder Co.).	do	10-35
(18)-----	do	asbestos staple.	10-35
(19)-----	polyoxymethylene polymer (identified in the trade as "Delrin" acetal resin and sold by E. I. Du Pont Co.).	glass fibers.	2-20
(20)-----	polycarbonate resins which are polycarbonates of bis-phenol (p,p' dihydroxydiphenyldimethylmethane). This type of resin is identified in the trade as "Phenoxi" and "Lexan," sold by Union Carbide & Chemical Co. and General Electric Co., respectively).	do	0.5-15
(21)-----	do	asbestos staple.	0.5-15
(22)-----	do	spun metal fibers.	0.5-15

The respective matrix and aggregate materials in the examples above have a community of characteristics which makes them especially adaptable for forming continuous compositions suitable for traveler applications. The matrices are each moldable plastic materials having kinetic coefficients of friction ranging between 0.1 and 0.5; each has an abrasion resistance, as measured by the Tabor Abrasion Test, ranging between 6 mg./1000 cycles and 40 mg./100 cycles; each has a relatively low Vicat softening point temperature or crystalline melting point, ranging approximately between ca. 250° Fahrenheit and 600° Fahrenheit; each is relatively soft and flexible as compared with the aggregate or with steel; and each has a relative chemical inertness which makes them resistant to lubricants such as water, petroleum, and other substances employed in treating textiles. Likewise, the aggregates in the above examples have common characteristics which render them especially suitable for forming continuous compositions to be used in traveler applications. Each of the aggregate materials is highly dispersible in the matrix; each has a relatively high Vicat softening point temperature or crystalline melting point as com-

pared to the matrix; each has a relatively low coefficient of friction as compared with the matrix; and each is relatively hard as compared with the matrix.

The above-mentioned kinetic coefficient of friction is defined as the rate of the observed frictional force divided by the normal force. The coefficient is therefore a dimensionless number. The aggregates used do not materially increase the friction coefficient of the total composition beyond the upper limit of 0.5 of the total composition; and in the event an aggregate material should, it would be unsuitable. Glass, in fact, is a standard of minimum friction, and the other aggregate materials are quite comparable to it. Some such as talc and zinc oxide, have such low coefficients of friction that they can't be measured on the same scale and are used as lubricants.

Another factor which enters here is the abrasion resistance as measured by the Tabor Abrasion Test. This test is a measure of the weight of material worn away per thousand cycles against an abrasive wheel. Results for typical matrix materials are given below:

	Mg./1000 cycles
"Zytel" (nylon) -----	6-8
Polycarbonate resins -----	7-11
"Delrin" -----	20
Linear polypropylene -----	29-32

"Teflon," "FEP" and "Kel-F," among others possess abrasion resistances above 40, but when sufficient quantities of aggregates are introduced the abrasion resistances are improved so that the test values are brought down within the desired range. Filled compositions, which have valuable properties in all other respects and are useful in traveler applications, possess test values in the range of 6 to 40 mg./1000 cycles.

When the matrix and aggregate are not formed into a continuous composition, e.g. when the aggregate is not wetted by the matrix, the fillers or aggregate materials are easily ripped out of the composition when subjected to abrasion, and the abrasion resistance is much lower than that of the matrix given above. When the composition is continuous, the desirable property of the aggregate is manifested as an increase in abrasion resistance.

As used in this application the term "relatively hard" is defined as a material having a much higher softening point and being more resistant to flow or creep upon increasing the temperature. The term "relatively soft" and "flexible" is defined as that part of the molding composition which is molten during the process of forming the traveler. The relatively hard components, that is, the fibers, staples or particles, are not molten under these conditions and undergo no shrinkage, expansion or dimensional change.

The following are some illustrative values of matrix materials and corresponding Vicat melting or softening temperatures:

Material:	Approximate melting or softening temperature, degrees Fahrenheit
Nylon -----	490
"Delrin" -----	340
Linear polyethylene -----	255
Linear polypropylene -----	290
"FEP" -----	Greater than 600
"Kel-F resin" -----	390
"Penton" -----	320
Polycarbonate resins -----	519

The above values represent the approximate upper limit of temperatures where the matrix material can still be perceived to possess its original form, or beyond which it suffers extensive deformation with no applied stress. Even beyond these temperatures, such aggregate materials as glass, asbestos, zinc oxide, talc and metal fibers show no visible effects of heat. These aggregate materials are dimensionally perfectly stable, and, when incorporated in the matrix, tend to support the form of the total com-

position much beyond the temperature limits at which the matrix cannot retain its own form alone.

On account of the like characteristic properties of the respective matrix and aggregate materials, the uniformly distributed or dispersed aggregate in the molten mass, will remain in such condition when the molten mass is cooled and solidified, thereby forming a resultant solidified continuous composition which has greater dimensional stability, rigidity and toughness than possessed by the matrix starting material.

The resultant plastic composition illustrated in any of the above examples shows a marked improvement in the tensile strength. For example, a nylon matrix filled with 30% glass (Example 1 above) fibers produces a composition which has a tensile strength of about 20,000 lbs./sq. in. by American Society for Testing Materials, test D638-58T, whereas, the nylon matrix without a filler has a tensile strength of about one-half this amount, or 10,000 lbs./sq. in. by the same test.

The increase in tensile strength is accompanied by an increase in the flexural modulus as defined in American Society for Testing Materials, test D790-587, from about 175,000 lbs./sq. in. to 985,000 lbs./sq. in.; and the flexural strength as defined by this test has increased from about 14,000 lbs./sq. in. to 22,000 lbs./sq. in. In addition, the Rockwell hardness has increased from about M-59 to M-100 as defined in American Society for Testing Materials, test D785-51.

Corresponding improved properties are realized in continuous compositions from the other examples.

It is to be noted in Examples 1 through 22 above, that a number of matrices accommodate different percentage ranges of filler materials; but notwithstanding this variation in percentage range, the final product falls within the specified limits as to frictional coefficient, flexural modulus, tensile strength, hardness and abrasion resistance. Of equal importance in the fact that when the percentage of filler material falls outside the specified range in any one of the Examples 1 through 22, one or more of the five physical properties of the final product will also fall outside the prescribed critical limits, thus making the final product less desirable and in most instances unsuitable for traveler applications. Thus it is seen that the stiffness and rigidity of the resultant product may be vastly increased by filling plastic matrices having essential common physical and corrosion and solvent resistant properties with aggregates having other essential physical properties in common, such as relatively high hardness, relatively high resistance to temperature deformation, and often improved lubricating properties, all without seriously impairing the wearing properties of the plastic component, and often improving them.

The above-described continuous compositions may be incorporated in ring travelers in various manners to accommodate the conditions of use. In FIGURE 1, the traveler 15 may be molded from any one of the above Examples 1 through 22 of filled continuous compositions and employed on the metallic ring 10. This embodiment constitutes an improvement over the conventional all-metal ring-traveler combinations as well as over the conventional combinations of unfilled plastic traveler and a metal ring.

FIGURE 3 shows a traveler 22 formed from a continuous laminated composition mounted upon ring 10. Here the laminate may consist of cementable plies of relatively soft matrix materials such as "Teflon" sheets cemented to alternate plies of relatively hard glass fabric with a common type of epoxy adhesive. The traveler is cold punched from this laminate and tumble polished before use on the ring.

This laminate conforms to the above specifications as to flexural modulus, tensile strength, hardness, abrasion resistance and frictional coefficient. The travelers punched from the laminate are sufficiently flexible to permit them to be deformed without damage while mount-

ing them upon the ring. This is a property not possessed by other laminated resinous materials. Instead, travelers made from such other materials experience fracture due to brittleness when the traveler jaws are spread to permit insertion upon the ring.

The "Teflon" sheets, prior to assembling, are made cementable by suitable means such as by etching with sodium in liquid ammonia bath. If desired, fabrics made from other relatively hard organic materials such as metal or asbestos, may be substituted for glass fabric plies with good results.

Where a glass fabric is employed as a ply material, 10 to 15 coated plies will produce a thickness of about 80 millimeters; and where asbestos fabric is employed, this same thickness is obtained with from 7 to 10 plies. The traveler 22 is stamped out of the laminate stock sheet consisting of the above-described alternate plies of appropriate thickness, then cold punched into the proper shape. At this time the cross-sectional outline of the traveler 22 will be approximately rectangular as shown by dotted lines 26 in FIGURE 4. Finally, the sharp corners and outer surfaces are finished by suitable means such as tumbling in abrasive materials.

In cutting travelers from laminated or filled stock, one may also employ laminates made from alternate plies of continuous filled compositions such as Examples 1 through 22, and plies of fabric made from glass, metal or asbestos.

The mechanical means employed to produce the traveler will vary with the design of the end product and also with the specific compositions. Such means comprise stamping the traveler from sheet stock, die-molding, extrusion molding, or hot injection molding all of which are well developed arts and need no further explanation. It has been found, however, that "Teflon," is not suitable for injection molding due to its excessively high melting point, and hence other means must be employed. Likewise die-molding or extrusion molding would obviously not be suitable for working laminated stock.

FIGURE 5 merely illustrates another ring-traveler design in which spinning ring 28 has traveler 29 movably mounted thereon. The traveler 29 may be constructed in the same manner and from the same compositions described in connection with the preceding embodiments.

Although specific results have been given with respect to the final composition of Example 1, the tests made upon the remaining final compositions show that each and all fall within very definite critical ranges of kinetic frictional coefficient, flexural modulus, tensile strength, hardness and abrasion resistance. By maintaining the matrix-aggregate ratio within the respective percentage ranges stated in Examples 1 through 22, it has been found that the final composition in each case will possess a kinetic coefficient of friction ranging between 0.1 and 0.5, a flexural modulus ranging between 100,000 lbs./sq. in. and 985,000 lbs./sq. in., a tensile strength ranging between 7,000 lbs./sq. in. and 24,000 lbs./sq. in., a Rockwell hardness ranging between M-30 and M-100 as defined in the American Society for Testing Materials, and an abrasion resistance as defined in the Tabor Test ranging from 6 milligrams to 40 milligrams per 1,000 cycles.

It is within the above-stated ranges that the final compositions are most suitable for traveler applications. In each of the final compositions in Examples 2 through 22, an unexpected improvement occurs, similar to that described with reference to Example 1, when filled within the respective specified ranges.

It has also been found that polycarbonate resins which are polycarbonates of p,p'-dihydroxydiphenyldimethylmethane are particularly suitable for traveler applications even when unfilled since this unfilled composition also falls within the above-stated critical ranges of kinetic coefficient of friction, flexural modulus, tensile strength, hardness and abrasion resistance.

While this invention has been described with particular reference to numerous specific examples of suitable com-

positions, it is to be understood that such showings are for illustrative purposes and are not to be construed as imparting limitations upon the invention, which is best defined by the following claims.

We claim:

1. A molded traveler for ring spinning and twisting comprising a thermoplastic resinous matrix material in which an aggregate material is uniformly dispersed to form a continuous composition, the latter material being relatively harder than the former, said traveler having a kinetic coefficient of friction ranging between 0.1 and 0.5; a flexural modulus ranging between 100,000 lbs./sq. in. and 985,000 lbs./sq. in.; a tensile strength ranging between 7,000 lbs./sq. in. and 24,000 lbs./sq. in.; a Rockwell hardness ranging between M-30 and M-100 as defined in American Society for Testing Materials test D785-51; and an abrasion resistance as defined by the Tabor Test ranging from 6 milligrams to 40 milligrams per 1,000 cycles.

2. A traveler for ring spinning and twisting as defined in claim 1 wherein said continuous composition comprises a plurality of first laminations, and further comprising a plurality of second laminations of relatively hard fabric material alternately positioned and having its faces cemented to the face of said first laminations.

3. A traveler for ring spinning and twisting the wearing surface portions of which comprise a thermoplastic resinous matrix material in which an aggregate material is uniformly dispersed to form a continuous composition, the latter material being relatively harder than the former, said surface portions having a kinetic coefficient of friction ranging between 0.1 and 0.5; a flexural modulus ranging between 100,000 lbs./sq. in. and 985,000 lbs./sq. in.; a tensile strength ranging between 7,000 lbs./sq. in. and 24,000 lbs./sq. in.; a Rockwell hardness ranging between M-30 and M-100 as defined in American Society for Testing Materials test D785-51; and an abrasion resistance as defined by the Tabor Test ranging from 6 milligrams to 40 milligrams per 1,000 cycles.

4. A molded traveler for ring spinning and twisting comprising a matrix of a thermoplastic synthetic linear polyamide polymer in which an asbestos staple aggregate is uniformly dispersed in amounts ranging between 2% and 30% to form a continuous composition.

5. A molded traveler for ring spinning and twisting comprising a matrix of a thermoplastic synthetic linear polyamide polymer in which a glass fiber aggregate is uniformly dispersed in amounts ranging between 2% and 30% to form a continuous composition.

6. A molded traveler for ring spinning and twisting comprising a matrix of a thermoplastic synthetic linear polyamide polymer in which an aggregate consisting of spun metal fibers is uniformly dispersed in amounts ranging between 2% and 30% to form a continuous composition.

7. A traveler for ring spinning and twisting comprising a thermoplastic linear polypropylene matrix in which a glass fiber aggregate is uniformly dispersed in amounts ranging between 10% and 35% to form a continuous composition.

8. A traveler for ring spinning and twisting comprising a thermoplastic polycarbonate of p,p' dihydroxydiphenyldimethylmethane matrix in which a glass fiber aggregate is uniformly dispersed in amounts ranging between 0.5% and 15% to form a continuous composition.

9. A traveler for ring spinning and twisting comprising a thermoplastic polycarbonate of p,p' dihydroxydiphenyldimethylmethane matrix in which an asbestos staple aggregate is uniformly dispersed in amounts ranging between 0.5% and 15% to form a continuous composition.

10. A traveler for ring spinning and twisting comprising a thermoplastic polycarbonate of p,p' dihydroxydiphenyldimethylmethane matrix in which a spun metal aggregate is uniformly dispersed in amounts ranging between 0.5% and 15% to form a continuous composition.

11. A traveler for ring spinning and twisting comprising a continuous filled composition composed of a thermoplastic resinous matrix material having an aggregate material uniformly dispersed therein, the latter material being relatively harder than the former.

12. A traveler for ring spinning and twisting the wearing surface of which comprises a continuous filled composition composed of a thermoplastic linear polyamide matrix having a glass fiber aggregate material uniformly dispersed therein.

13. A traveler for ring spinning and twisting the wearing surface of which comprises a continuous filled composition composed of a thermoplastic linear polyamide matrix having an asbestos staple aggregate uniformly dispersed therein.

14. A traveler for ring spinning and twisting the wearing surface of which comprises a continuous filled composition composed of a thermoplastic linear polyamide having a spun metal fiber aggregate uniformly dispersed therein.

15. A traveler for ring spinning and twisting the wearing surface of which comprises a continuous filled composition composed of a thermoplastic linear polypropylene matrix having a glass fiber aggregate uniformly dispersed therein.

16. A traveler for ring spinning and twisting the wearing surface of which comprises a continuous filled composition including a thermoplastic polycarbonate of p,p' dihydroxydiphenyldimethylmethane matrix having a glass fiber aggregate uniformly dispersed therein.

17. A traveler for ring spinning and twisting the wearing surface of which comprises a continuous filled composition including a thermoplastic resinous material having an aggregate material uniformly dispersed therein, the latter material being relatively harder than the former.

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