

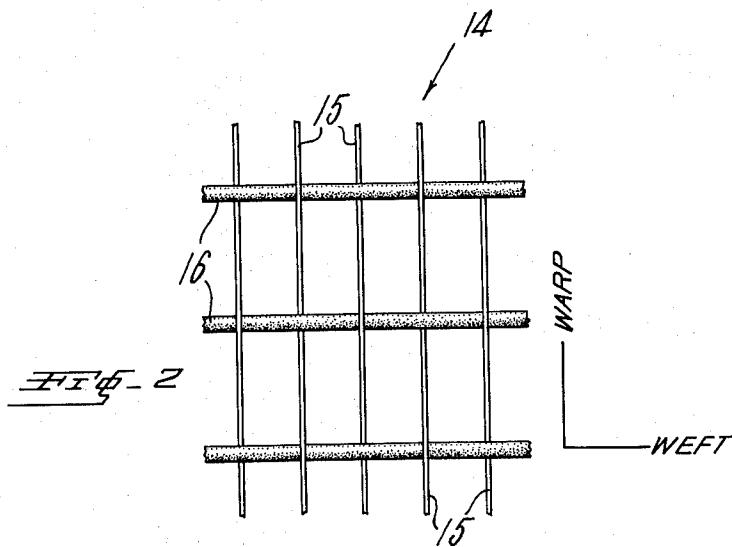
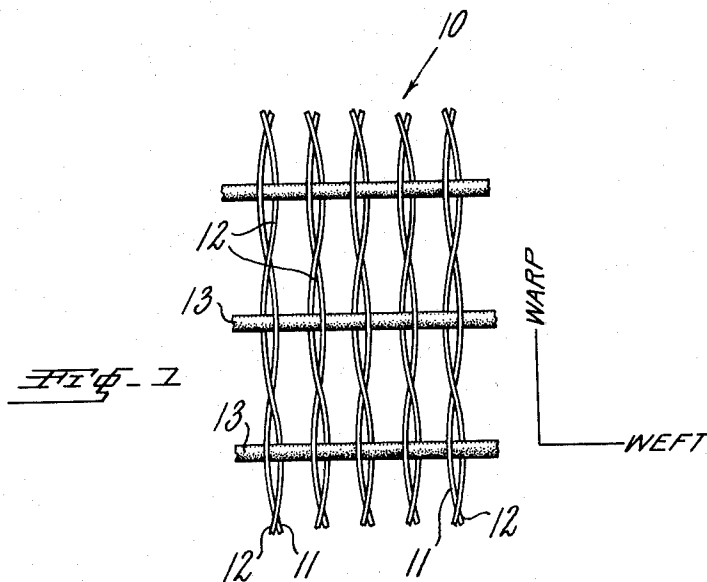
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WIRE FABRICS AND METHODS OF PRODUCING THE SAME

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WIRE FABRICS AND METHODS OF PRODUCING THE SAME

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This invention relates to woven fabrics, and in particular to woven wire fabrics and to processes of producing the same.

Wire fabrics as such have already been introduced for use in a variety of articles. Merely by way of example, it may be desirable to employ wires or wire fabrics in the manufacture of automobile tires, fuel cells and the like, for the purpose of providing high strength individual plies or auxiliary reinforcement means for such articles. It has heretofore been proposed, for example, to employ individual strands of wires made of steel or a similarly strong metal incorporated in the various fabric or rubber plies employed in building up tires or fuel cells. This, however, has been found to be highly impractical due to the great amount of labor required and the resultant almost prohibitive cost of the finished article.

It has further been proposed to weave an all-metal wire cloth on a conventional textile loom. Theoretically, such a cloth or fabric should give a maximum reinforcing action both in the warp direction and in the weft direction of the fabric. Nevertheless, this has been found not to be the case, and all wire fabrics have, in fact, unless woven on specially built looms and with special procedures, given decidedly unsatisfactory results despite the fact that they are relatively expensive to produce. The major cause of this fault of such known conventionally loomed wire fabrics appears to lie in the inherent resilience or springiness of the wire which renders the woven wire fabric dimensionally unstable. In other words, such a wire fabric has a great tendency to curl and will readily change its shape and the angular relationship between the warp and weft strands in a more or less haphazard fashion upon application thereto of only a very small force, and there is no tendency in the fabric to return to its original shape unless and until a force counter to the first applied force is again applied to the fabric. This defect has even been noted in all wire fabrics of the leno type, despite the fact that the leno weave is one of the best known methods for imparting dimensional stability to a woven fabric.

With the relatively recent emergence of synthetic fibers as materials suitable for use in the weaving of fabrics, attempts have been made to overcome the deficiencies of the all-metal fabric by weaving a fabric of filaments of such synthetic fibers, for example linear or low pressure polyethylene. Such fabrics have, however, come into considerable disrepute of late due to the presence of what is in many instances an undesirable property, to wit the complete lack of resilience of such fabrics. Thus, whereas metal fabrics are defective due to being too "live," the known fabrics made of polyethylene or like synthetic fiber filaments are defective due to being too "dead."

It is, therefore, an important object of the present invention to provide a wire fabric which is possessed of the advantages inherent in known wire and synthetic fiber filament fabrics and yet is free of the disadvantages of the same.

By the same token, it is an object of the present invention to provide wire fabrics which combine the structural characteristics of known wire and synthetic filament fabrics without sacrificing any of the potential strength of such wire fabrics.

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Another object of the present invention, consequently, is the provision of wire fabrics woven from both metallic and synthetic filament strands, with the wire strands extending warpwise of the fabric and the synthetic filament strands extending weftwise of the fabric.

Concurrently it is an object of the present invention to provide wire fabrics as aforesaid which may be produced either in the form of a plain weave or in the form of a leno weave.

A further object of the present invention is the provision of processes of producing wire fabrics of the aforesaid types as economically as possible and in such a manner that the fabrics are dimensionally stable, both in the plain weave form and in the leno weave form thereof.

Still a further object of the present invention is the provision of processes of making composite wire fabrics in which a plurality of plies of a basic wire fabric produced in accordance with the present invention are suitably combined with and adhered to one another to thereby impart maximum strength characteristics to the composite fabrics in all directions thereof.

More specifically, in accordance with the present invention, a wire fabric is obtained by weaving on a conventional textile loom, either in plain or in leno form, a warp of an appropriate metallic wire and a filling of strands made from a synthetic thermoplastic fiber material in monofilament form wherein the said monofilaments have a diameter ranging from about 0.003" to about 0.050". The resultant fabric is found to be dimensionally extremely stable, since there is little if any shifting of the warp and filling strands past one another. Moreover, the fabrics according to this invention are characterized by the fact that even if such shifting should occur due to the application of some external stress to the fabric, the strands tend to revert immediately back to their original positions.

The foregoing as well as other objects, advantages, characteristics and uses of the fabrics according to the present invention will be more fully understood from the following detailed description when read in conjunction with the accompanying drawing, in which:

FIG. 1 is a schematic plan view of a wire fabric of the leno type according to the present invention; and

FIG. 2 is a schematic plan view of a wire fabric of the plain weave type.

Referring first to FIG. 1, it will be seen that a fabric 10 according to one embodiment of the present invention is woven from a plurality of warp strands 11 and 12 made of stainless steel wire, and from a plurality of weft strands 13 made of any suitable synthetic thermoplastic fiber material in monofilament form, such as linear polyethylene, Saran, polypropylene or nylon. It will be understood that other metals may be employed in lieu of stainless steel if conditions permit. The wire strands 11 and 12 are arranged in pairs and in a leno weave, with the wires 11 always passing over the filling strands 13 and under the associated wires 12, and with the latter always passing under the filling strands and, of course, over the associated wires 11. The use of a leno weave as such is well known to the art, but to my knowledge no use has ever been made prior to my invention of wires woven in leno with filling strands of synthetic fiber monofilaments as set forth hereinbefore.

According to a second embodiment of the present invention, a fabric 14 (see FIG. 2) may be composed of wire warp strands 15 interwoven in a plain weave with filling strands 16 identical with the filling strands 13 of the fabric shown in FIG. 1. Thus, the strands 16 may be made of linear polyethylene, Saran, nylon or polypropylene monofilaments, by way of example.

A number of wire fabrics according to the present in-

vention have been produced both in the leno weave form and in the plain weave form illustrated in FIGS. 1 and 2, respectively. Some of the physical characteristics of these fabrics are set forth in the following table.

Filling	Equivalent Denier	Weave	Width, inches
.010" L.P.E.....	400	Leno....	10 1/2
.010" Saran.....	750	do....	10 5/8
.008" Nylon.....	325	do....	9 1/2
.010" L.P.E.....	400	Plain....	10 1/2
.010" Saran.....	750	do....	10 5/8
.008" Nylon.....	325	do....	10 1/2

The wire warp in each fabric was .0036-T-316 HD drawn stainless steel wire. In each case the fabric was found to be possessed of good strength characteristics in the warp direction.

It will be readily appreciated, of course, that the only limiting factor, as far as the number of wire ends per inch is concerned, is the thickness of the wire itself. Accordingly, the weight, tear strength, tensile strength, and other physical properties of the fabric may be easily predetermined and controlled by the choice of wire diameter. The wire gauge should generally range from about 0.002" to about 0.030".

Although the dimensional stability of each of the above fabric specimens was found to be of an extremely high order, it will be understood that, as in any woven fabric, the possibility of some shifting of the warp strands relative to the weft strands (or vice versa) may still be present. This possibility can be substantially eliminated, according to the present invention, by slightly warming the woven fabric so as to soften the filling strands and then impressing the wire warp strands into the filling strands. Alternatively, if such warming of the fabric is to be avoided, it is possible to pass the fabric through a conventional fabric calender, as a result of which the wire warp strands will be sufficiently pressed into the filling strands to accomplish the desired purpose, the calendering operation being carried out preferably at room temperature in order to avoid any adverse effect on the physical properties of the filling strands. A further beneficial result is also obtained by such a calendering operation in that the gauge of the fabric is generally reduced by as much as 50%.

The present invention further contemplates the provision of composite wire fabrics in which wire strands extend both warpwise and weftwise of the ultimate fabric so as to provide the desired mechanical strength both longitudinally and transversely of the fabric while avoiding the lack of dimensional stability heretofore always inherent in all-wire fabrics. To this end, two plies of the fabric 10 shown in FIG. 1 or of the fabric 14 shown in FIG. 2 may be superimposed on one another with the wire warp strands of one fabric ply extending at right angles to the wire warp strands of the other ply. The two plies are then subjected to heat and pressure (or, if desired, only to heat) to cause the filling strands to melt to a certain extent and flow around the wire strands. As the fabric is thereupon cooled, the filling strands resolidify, whereby the two fabric plies are firmly bonded to one another and result in the formation of a fabric which has both wire warp strands and wire filling strands while at the same time being dimensionally stable to a very high degree. Moreover, the composite fabric has almost the same appearance as conventional wire screening. It can readily be seen that if maximum strength of the composite fabrics is desired in other than the longitudinal and transverse directions, the two plies may be joined with the wire warps of one ply at an angle other than 90° to the wire warps of the other ply.

As an alternative to the foregoing, the composite multiple ply wire fabric may be produced by pressing two fabric layers 10 or 14 together with the warp strands

11-12 or 15 at right angles to the warp strands in the other fabric layer. A suitable coating material, such as a vinyl resin plastisol or any one of a number of well known rubber adhesives or like compounds, is then applied to the fabric layers and cured, whereby the coating will hold the two wire fabric layers firmly together. Again, the composite fabric will have the appearance of being provided with wire warps and wire filling. Likewise, the angle between the warps of the two plies need not necessarily be a right angle if strength along a particular pair of non-perpendicular directions is desired.

It is also possible, for example, to form a composite fabric as aforesaid by sandwiching a sheet of polyethylene between the two fabric layers and then applying heat and pressure to firmly bond the layers to the polyethylene film and thus to one another. Similarly, each of the fabric layers may be coated with a tacky or sticky compound, whereafter the two layers are pressed together with their warps oriented transversely or otherwise angularly to one another. Upon curing of the said compound, the layers will be firmly bonded to one another.

By way of résumé, it is emphasized that the filling strands 13 or 16 must be of the monofilament type. Experiments have shown that wire fabrics produced in accordance with the basic teachings of the instant invention but employing multifilament yarns as the filling were decidedly inferior in dimensional stability to the above-mentioned fabrics produced with monofilament filling strands. Although it is not possible to account strictly for the inapplicability of multi-filament yarns in practicing the present invention, it is believed that the plastic flow characteristics of such yarns are not as suitable as those of comparable monofilament yarns to position and hold wire strands firmly in place. In addition, upon application of pressure to the wire in contact with multifilament yarns, the filaments tend to separate, thus exerting no retarding action on the tendency of the wire to shift. On the other hand, in the case of monofilament yarn in the filling, pressure on the wire warp serves to press the wire more firmly into the monofilaments.

It is to be understood that the invention as herein disclosed is susceptible to a number of modifications, none of which will involve any departure from the spirit of the invention or from the scope thereof as defined by the appended claims.

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

1. The process of producing a wire fabric, comprising the steps of interweaving a first set of metallic wire warp strands with a first set of monofilament synthetic thermoplastic fiber filling strands to form a first ply, interweaving a second set of metallic wire warp strands with a second set of monofilament synthetic thermoplastic fiber filling strands to form a second ply, superposing said plies one on to the other with said first set of warp strands oriented angularly relative to said second set of warp strands, heating said plies to effect a slight melting of said filling strands so as to flow about the warp strands in the several plies and upon resolidification of said filling strands to adhere the several plies to one another.

2. The process of claim 1, said treatment further comprising applying pressure to said plies during said heating thereof.

3. The process of producing a wire fabric, comprising the steps of interweaving a first set of metallic wire warp strands with a first set of monofilament synthetic thermoplastic fiber filling strands to form a first ply, interweaving a second set of metallic wire warp strands with a second set of monofilament synthetic thermoplastic fiber filling strands to form a second ply, placing a sheet of polyethylene between said plies, superposing said plies one on to the other with said sheet of polyethylene therebetween and with said first set of warp strands oriented angularly relative to said second set of warp strands, and applying

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heat and pressure to said plies and said sheet of polyethylene to cause the former to adhere to the latter and thus to one another.

4. The process of producing a wire fabric comprising the steps of interweaving a first set of metallic wire warp strands with a first set of monofilament synthetic thermoplastic fiber filling strands to form a first ply, interweaving a second set of metallic wire warp strands with a second set of monofilament synthetic thermoplastic fiber filling strands to form a second ply, coating said plies with an adhesive compound, superposing said plies one on to the other with a coating therebetween and with said first set of warp strands oriented angularly relative to said second set of warp strands, and curing said compound with said plies in face-to-face contact, whereby said plies are adhered to one another.

5. A wire fabric comprising two adhering plies each composed of interwoven metallic wire warp strands and

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monofilament synthetic thermoplastic fiber filling strands with said warp strands in each of said plies being interwoven in a leno weave with said filling strands of the same ply, said warp strands of one of said plies being oriented angularly relative to said warp strands of the other of said plies.

References Cited in the file of this patent

UNITED STATES PATENTS

1,457,892	Blackwelder	June 5, 1923
2,202,013	Lougheed	May 28, 1940
2,333,618	Strauss	Nov. 2, 1943
2,384,771	Ryan	Sept. 11, 1945
2,569,764	Jones	Oct. 2, 1951
2,604,425	Batchelor et al.	July 22, 1952
2,679,677	Crandall	June 1, 1954
2,787,570	Lott et al.	Apr. 2, 1957