Jan. 3, 1939. W. MENDEL 2,142,908

ELASTIC FABRIC

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Fig. 3



Fig. 1.

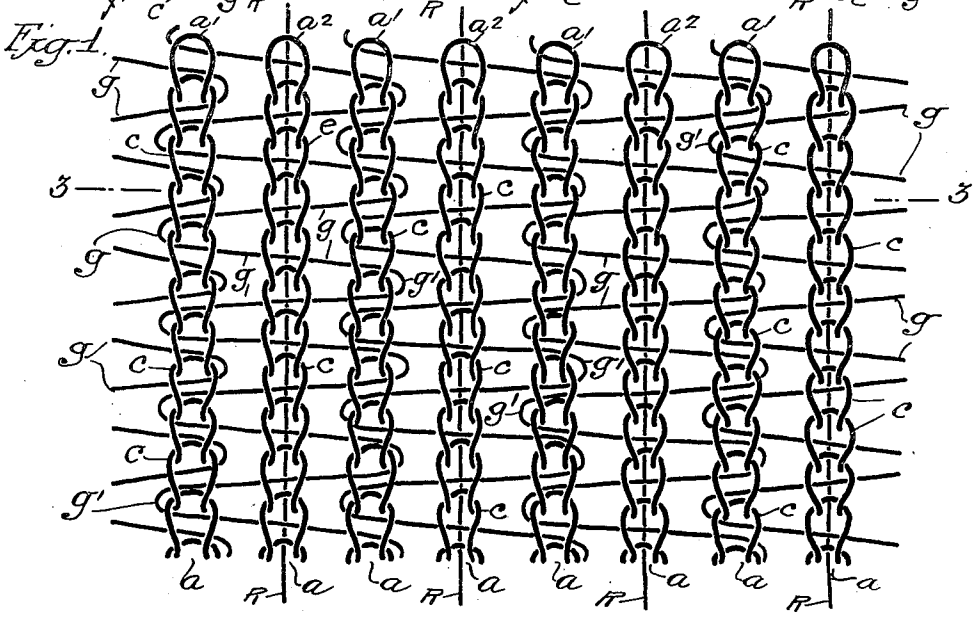
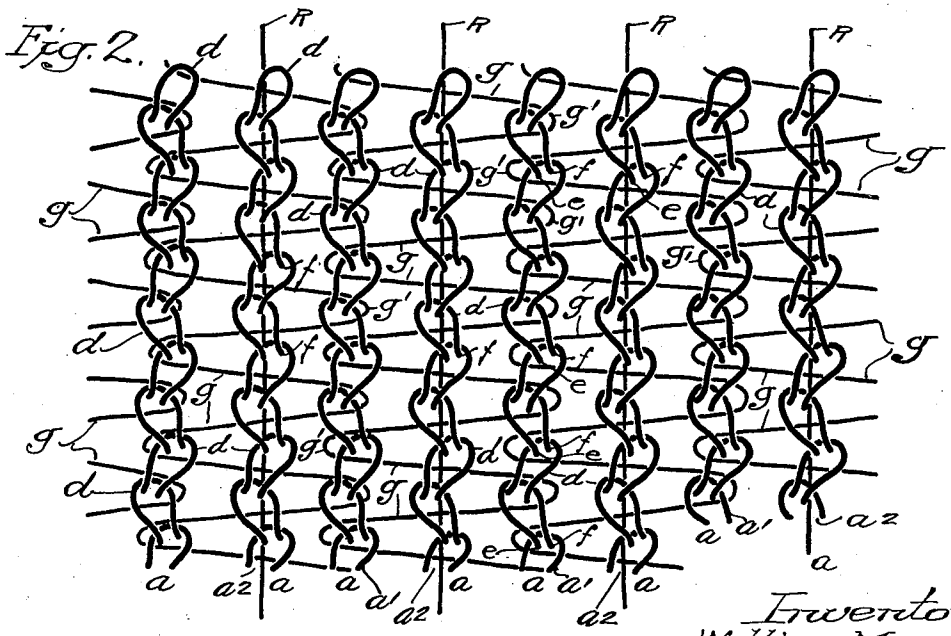


Fig. 2.



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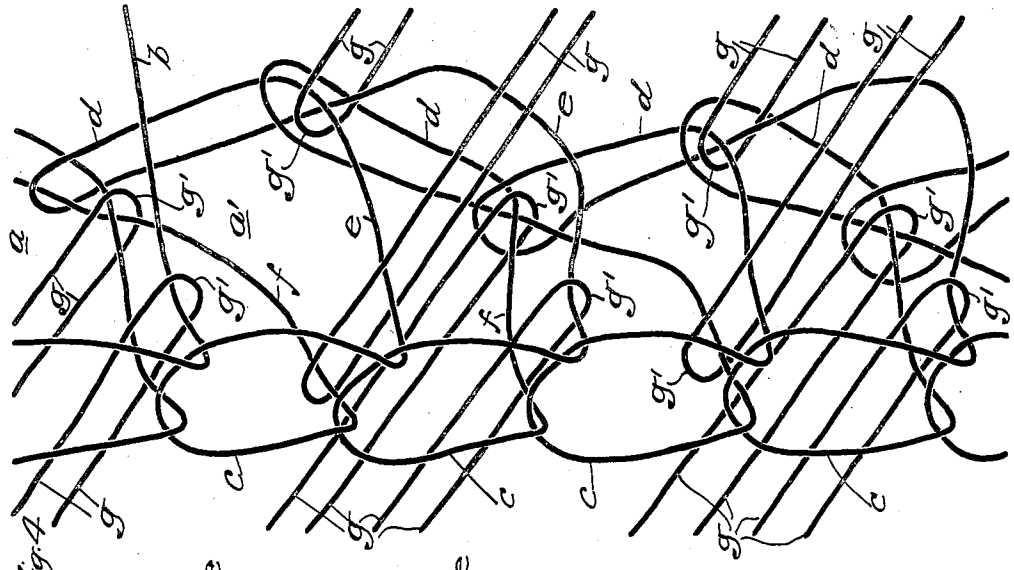


Fig. 4

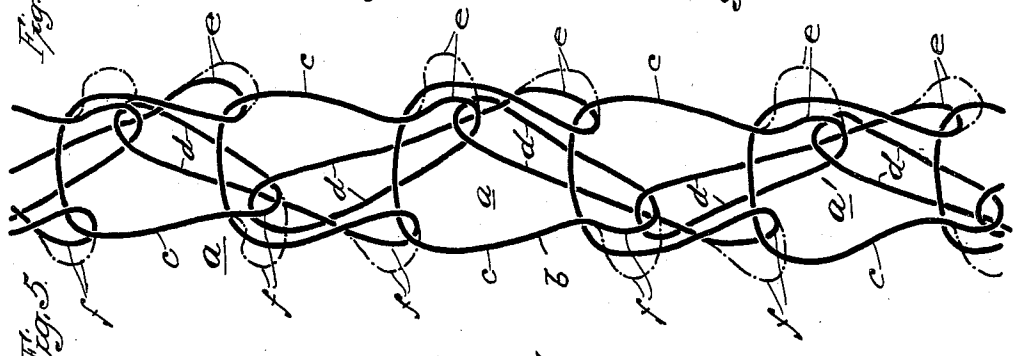


Fig. 5

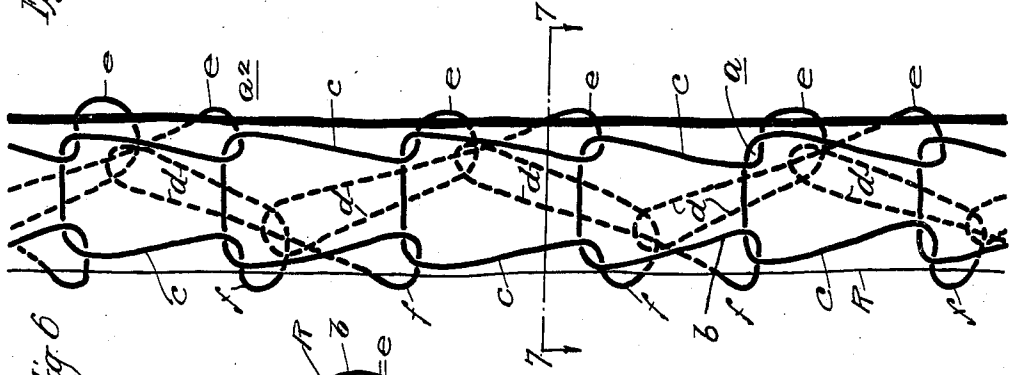


Fig. 6

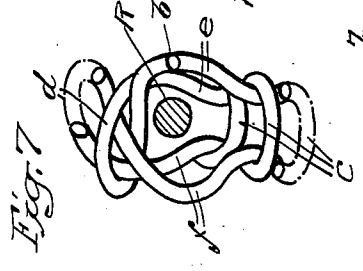


Fig. 7

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UNITED STATES PATENT OFFICE

2,142,908

ELASTIC FABRIC

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Application March 17, 1937, Serial No. 131,484

10 Claims. (Cl. 66—193)

This invention relates to elastic fabrics, and particularly to knitted fabrics in which strands of rubber or other elastic yarn are incorporated and normally extend in parallel relation to each other, in one general direction through the entire fabric or predetermined portions thereof.

Elastic fabric manufacturers are constantly confronted with the problem of making elastic fabrics lie flat when finished. The problem arises from variations occurring in the elasticity or in the tension of the various elastic strands during manufacture of the fabric, which causes the fabric to bulge in spots when the fabric is permitted to contract after it is completed.

Another problem confronting the elastic fabric art is that the elastic strands, and particularly when bare rubber strands are used, usually pull back into the fabric to a considerable extent, from the cut edge of the fabric, when the fabric is severed along a line extending transversely to the rubber strands.

Another problem confronting those skilled in the art resides in difficulties encountered in attempting to bury bare rubber strands in a fabric, to keep the rubber from normally being seen on either face of the fabric.

In order to overcome the last of the above noted problems the use of pre-covered rubber has been adopted to a considerable extent. The rubber strands, prior to being incorporated in the fabric, are frequently wound spirally with one or more layers of relatively inelastic fibrous or other thread or filament, usually of the same kind and color as the other threads or filaments which are to be employed in the making of the fabric.

The pre-covering of the rubber strands serves an additional function in that it maintains each rubber strand in a more or less stretched condition when the fabric in which such covered rubber strands are incorporated is in its normally, fully contracted state.

Covered rubber is relatively expensive, and increases the cost of the fabric proportionately over fabrics employing bare rubber. While the pre-covering of the rubber solves the hiding problem, it does not prevent the rubber from pulling back into the fabric from a cut edge, nor does it cause the fabric to lit flat when finished.

One object of the present invention is to provide an elastic fabric in which bare or covered rubber or other elastic strands are used; and which is of such a construction that the rubber strands will be hidden in the fabric; and which will keep the elastic strands from pulling back into the fabric from a cut edge; and which will cause the fabric to lie flat when completed and permitted to contract.

The object of the invention is attained primarily by encasing each elastic strand individually in a novel covering during knitting of the fabric and by connecting the covered strands together in a manner which will permit each strand to move independently in the fabric and adjust itself therein without placing any restrictions on the self-adjustability of any other strands, whereby all strands assume a common neutrality which permits the fabric to lie flat.

One feature of the invention resides in the novel covering for bare rubber strands. Another feature resides in the novel hinge-like construction of the fabric, by which the common neutral condition of the strands is made possible.

The construction of the fabric and the covering of the rubber strands will be fully disclosed hereinafter, reference being had to the accompanying drawings, of which:

Fig. 1 is a diagrammatic view of one face of a piece of fabric made in accordance with the principles of the present invention;

Fig. 2 is a similar view of the reverse face of the fabric;

Fig. 3 is a diagrammatic transverse sectional view taken on the line 3—3, Fig. 1;

Fig. 4 is a detached perspective view of a portion of the fabric showing the hinge-like construction noted above;

Fig. 5 is a diagrammatic view of the stitch formation in that portion of the fabric shown in Fig. 4;

Fig. 6 is a view similar to Fig. 5 with a strand of rubber incorporated in the stitch-chain construction shown in Figs. 4 and 5 by which the rubber strand is covered; and

Fig. 7 is a transverse sectional view taken on the line 7—7 of Fig. 6.

The fabric of the present invention may be made in any desired width and of any desired weight, according to the purpose for which the ultimate fabric is desired. The fabric is of the general type known as "warp-knit" fabric.

As shown in Figs. 1, 2 and 3, the fabric is composed, in the present instance, of parallel chains of stitches *a*, *a*. Each chain *a* is composed of an individual thread *b* formed into a series of interlocking stitches *c* on one face of the fabric and a series of interlocking stitches *d* on the opposite face of the fabric, in the same wale as the stitches *c*, the stitches *c* and *d* of each wale or chain *a* being successively connected by portions *e* and *f* of the thread *b* passing through the fabric from

the one face thereof to the opposite face thereof.

The multiplicity of individual chains *a*, *a* are grouped and tied together transversely of the fabric, by a series of weft or cross threads *g*. The weft threads *g* traverse the groups of chains *a*, *a* and pass around the connecting threads *e*—*f* of alternate wales or chains a^1, as indicated at g^1, and pass across the intermediate chains or wales a^2, between the stitches *c* on the one face of the fabric and the stitches *d* on the opposite face of the fabric.

In the present instance, a strand of bare rubber R is incorporated in each of the intermediate wales or chains a^2. The rubber strands R provide the longitudinal elasticity in the fabric, i. e. in the direction in which the wales or chains *a*, *a* extend.

Each rubber strand R is incorporated in its particular chain or wale a^2 and covered by a thread *b* in the manner clearly disclosed in Figs. 6 and 7, wherein the stitches *c* of the chain a^2 all lie on one face of the rubber strand R and the stitches *d* of said chain all lie on the opposite face of the rubber strand R, while the connecting threads *e* and *f* pass around the rubber strand R at opposite sides respectively of said rubber strand, in connecting the stitches *c* with the stitches *d*. Thus, with the thread *b* being of a proper diameter with respect to the diameter of the rubber strand R, and of a proper nature, the rubber strand is completely covered by the inelastic or fibrous thread *b*, but, due to the formation of the stitch-chain around the rubber strand, the rubber strand, and in fact the chain a^2 in which it is incorporated, are permitted to stretch to a predetermined extent longitudinally.

During the covering of the rubber strand, said rubber strand is maintained under a predetermined tension and stretched to a predetermined extent and the thread *b* is knit around the rubber strand under a predetermined tension. Consequently, the thread *b* is caused to grip the rubber strand R rather firmly while the rubber strand is extended, with the result that, when the stitch-chain a^2 and its rubber strand R are permitted to contract, the knitted thread *b* grips the rubber strand firmly on all sides thereof and prevents the rubber strand from slipping through the knitted chain which has been formed around it. When the chain and the rubber strand are permitted to contract the rubber strand R will be retained in a slightly extended state, under a certain amount of tension, by the stitches knitted around the rubber.

When the stitch-chains a^2 with their incorporated rubber strands R are formed in a fabric, such as that disclosed in Figs. 1 and 2, the rubber strands are completely hidden and are prevented from pulling back into the fabric when the fabric is cut across the wales and the rubber strands incorporated therein.

The hinge-like construction of the fabric at the turnings g^1 of the weft or cross threads *g*, at the non-rubber bearing chains a^1, as shown in Figs. 1 and 2, is such that each rubber-bearing wale a^2 is permitted to stretch and contract without affecting or restricting the stretching or contracting of any of the adjacent rubber-bearing or non-rubber-bearing wales, as a result of which all the wales are capable of self-adjustability in the fabric and the completed fabric, therefore, lies flat. This condition is due to the fact that the weft threads *g* where they loop back and forth from one non-rubber-bearing wale a^1 through a rubber-bearing wale a^2 to the next non-rubber-bearing wale a^1 function as a series of pivot-links or hinges between the wales, the weft turns g^1 being free to pivot around the connecting threads *e* and *f* in the wales. Thus, the whole fabric is permitted to adjust itself without placing one part under strain, by higher tension occurring in portions of one or more of the rubber strands R than in corresponding portions of adjacent strands R. Thus, with each elastic strand free to contract and expand without affecting adjacent portions of the fabric the whole of the fabric lies flat when completed as a result of the hinged construction of the fabric.

As shown in Figs. 3 and 4, there are two series of weft threads *g*, one being worked into the fabric between the stitches *c* on the one face of the fabric and the rubber strands R, which lie in the center of the fabric, while the second series lies between the stitches *d* on the opposite face of the fabric and the opposite side of the rubber strands R.

The fabric shown in Figs. 1 and 2 is of a plain character. However, designs may be formed in the fabric, if desired, by varying the extent of traverse of the weft or cross threads *g*. For example, instead of a weft thread *g* passing from one inelastic wale a^1 to the next inelastic wale a^1, through an elastic wale a^2, the weft thread *g* may be caused to pass back and forth between an adjacent pair of wales a^1 and a^2 for a certain number of courses and then renew its travel across three wales as shown. In this way, openings may be formed in the fabric throughout predetermined areas of the fabric and the openings may be arranged in a predetermined order to effect the formation of a pattern of desired configuration, without departing from the principles of the present invention.

It will be clear from Figs. 3 and 4 that the fabric is produced on a machine having a double bank of needles, the stitches *c* of each wale *a* being formed on the needles of one bank while the stitches *d* of the respective wales are formed on the needles of the second bank, one needle in each bank cooperating with a corresponding needle of the other bank and both working a single thread *b* to produce each of the wales *a*, the actuation of the needles and of the thread guides which carry the threads *b* and those which carry the threads *g* being arranged to cooperate to produce the fabric disclosed. The machine used in the present instance is of the type commonly known as the Rashel machine.

Obviously, if desired, two or more elastic-bearing wales a^2 may be disposed immediately adjacent each other between the hinge wales a^1 or two or more hinge wales a^1 may be disposed adjacent each other between relatively spaced rubber-bearing wales a^2; and the weft threads *g* may be manipulated back and forth across the fabric to tie predetermined wales together to give the effects desired, without departing from the principles of the present invention.

It will be understood that, while the above description is directed more particularly to the use of bare rubber strands, the invention in its broader scope is not limited to the use of bare rubber as the elastic strands in the fabric; and wherever and whenever the term rubber appears in the specification and appended claims, it is intended to include bare rubber, plain covered rubber, or any other elastic yarn of covered or uncovered construction.

I claim:

1. A knitted elastic fabric comprising a plu-

rality of individual stitch chains, rubber strands incorporated in and extending longitudinally of predetermined chains respectively, cross threads tying selected chains together in groups transversely of the fabric and affording independent movement of the rubber-bearing chains relative to adjacent chains longitudinally of the fabric, each rubber-bearing chain comprising a continuous thread individual to each chain and formed into a series of interknit stitches on one face of the fabric, a series of interknit stitches on the opposite face of the fabric, with portions of said thread connecting said stitch series and extending from face to face of the fabric around the opposite sides respectively of the rubber strands.

2. A knitted elastic fabric comprising a plurality of individual stitch chains, rubber strands incorporated in and extending longitudinally of predetermined chains respectively, cross threads tying selected chains together in groups transversely of the fabric and affording independent movement of the rubber-bearing chains relative to adjacent chains longitudinally of the fabric, each chain comprising a continuous thread individual to each chain and formed into a series of interknit stitches on one face of the fabric, a series of interknit stitches on the opposite face of the fabric, with portions of said thread connecting said stitch series and extending through the fabric from the interknit stitches on the one face to the interknit stitches on the opposite face thereof.

3. A knitted elastic fabric comprising a plurality of individual stitch chains, rubber strands incorporated in and extending longitudinally of predetermined chains respectively, cross threads tying selected chains together in groups transversely of the fabric and affording independent movement of the rubber-bearing chains relative to adjacent chains longitudinally of the fabric, each chain comprising a series of interknit stitches on one face of the fabric, a series of interknit stitches on the opposite face of the fabric, and threads connecting said stitch series and extending through the fabric from the interknit stitches on the one face to the interknit stitches on the opposite face thereof, said cross threads each traversing a group of said chains and passing around the connecting threads of the extreme chains of the group.

4. A knitted elastic fabric comprising a plurality of individual stitch chains, rubber strands incorporated in and extending longitudinally of predetermined chains respectively, cross threads tying selected chains together in groups transversely of the fabric and affording independent movement of the rubber-bearing chains relative to adjacent chains longitudinally of the fabric, each chain comprising a series of interknit stitches on one face of the fabric, a series of interknit stitches on the opposite face of the fabric, and threads connecting said stitch series and extending through the fabric from the interknit stitches on the one face to the interknit stitches on the opposite face thereof, said cross threads each traversing a group of said chains and passing around the connecting threads of the extreme chains of the group intermediate the stitches on the opposite faces of the fabric.

5. A knitted elastic fabric comprising a plurality of individual stitch chains, rubber strands incorporated in and extending longitudinally of predetermined chains respectively, cross threads tying selected chains together in groups transversely of the fabric and affording independent movement of the rubber-bearing chains relative to adjacent chains longitudinally of the fabric, each chain comprising a series of interknit stitches on one face of the fabric, a series of interknit stitches on the opposite face of the fabric, and threads connecting said stitch series and extending through the fabric from the interknit stitches on the one face to the interknit stitches on the opposite face thereof, said cross threads each traversing a group of said chains and passing around the connecting threads of the extreme chains of the group intermediate the stitches on the opposite faces of the fabric and passing between said face stitches and the rubber strands in the rubber-bearing chains.

6. A knitted elastic fabric comprising a plurality of individual stitch chains, rubber strands incorporated in and extending longitudinally of predetermined chains respectively, cross threads tying selected chains together in groups transversely of the fabric and affording independent movement of the rubber-bearing chains relative to adjacent chains longitudinally of the fabric, each chain comprising a series of interknit stitches on one face of the fabric, a series of interknit stitches on the opposite face of the fabric, and threads connecting said stitch series and extending through the fabric from the interknit stitches on the one face to the interknit stitches on the opposite face thereof, said cross threads each traversing a group of said chains and passing around the connecting threads of the extreme chains of the group and transversely through the chains disposed intermediate said extreme chains.

7. A knitted elastic fabric comprising a plurality of individual stitch chains, rubber strands incorporated in and extending longitudinally of predetermined chains respectively, cross threads tying selected chains together in groups transversely of the fabric and affording independent movement of the rubber-bearing chains relative to adjacent chains longitudinally of the fabric, each chain comprising a series of interknit stitches on one face of the fabric, a series of interknit stitches on the opposite face of the fabric, and threads connecting said stitch series and extending through the fabric from the interknit stitches on the one face to the interknit stitches on the opposite face thereof, said cross threads each traversing a group of said chains and passing around the connecting threads of the extreme chains of the group and transversely through the chains disposed intermediate said extreme chains and passing between said face stitches and the rubber strands in the rubber-bearing chains.

8. A rubber strand encased in a textile covering comprising two series of individually distinct interknit stitches formed of a single continuous yarn with successive stitches respectively disposed on opposite sides of the strand and connected by portions of said thread extending around opposite sides of the strand alternately from the one to the other of said series of stitches.

9. The method of covering a rubber strand which consists in knitting a single textile thread into series of successively interlooped stitches alternately at oppositely disposed sides respectively of said strand and passing said knitting thread around the strand from the one series of stitches to the other series of stitches.

10. The method which consists in simultaneously knitting a plurality of textile threads separately into a plurality of chains respectively, feeding a plurality of rubber strands to the points of

knitting of predetermined chains respectively, forming successive stitches of the respective chains to which the rubber is fed alternately on opposite sides respectively of the rubber strands, passing the knitting threads of the chains to which the rubber strands are respectively fed around the rubber strands respectively from the stitches on the one side of the rubber strands to the stitches on the opposite side of the rubber strands, forming corresponding stitches of the knitting threads of the chains to which no rubber strands are fed simultaneously with the forming of the stitches around the rubber strands, traversing the knitted chains with other textile threads as the knitting progresses, and reversing the direction of traverse of said threads after knitting a stitch in each of said chains and before the knitting of the next stitches of the respective chains, whereby the knitted chains are connected together to form a fabric and cover the rubber strands.

WILLIAM MENDEL.