April 16, 1957 W. LARKIN 2,788,804

FLEXIBLE HOSE

Original Filed July 20, 1950

FIG. 1.

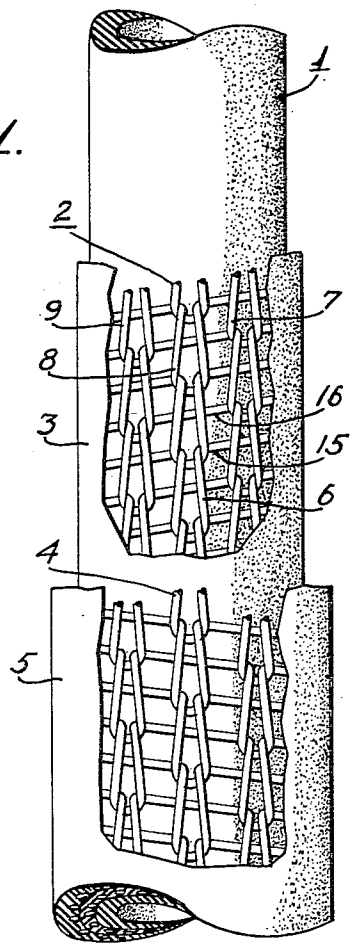


FIG. 4.

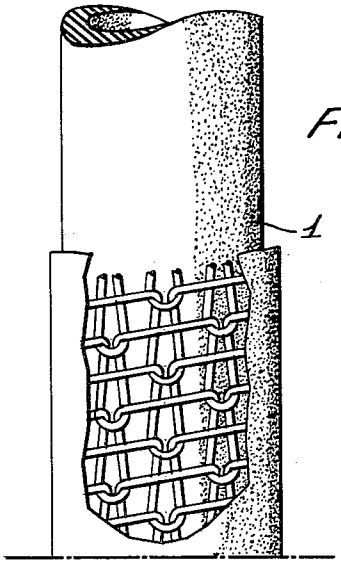
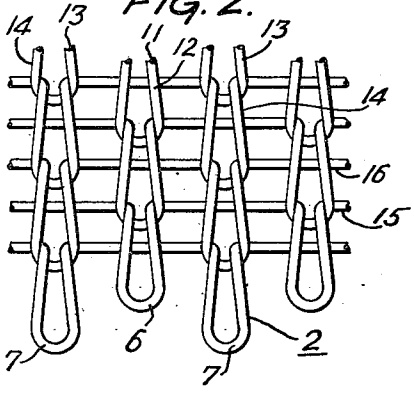


FIG. 2.



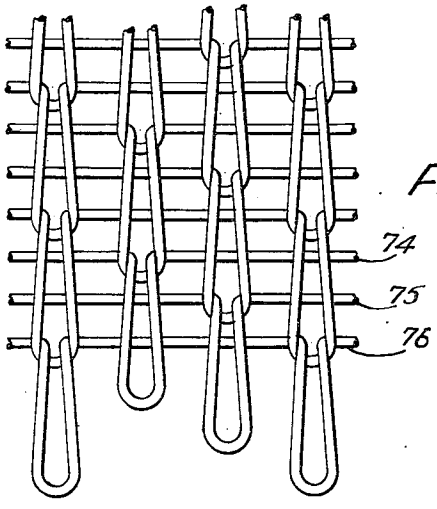


FIG. 3.

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United States Patent Office 2,788,804 Patented Apr. 16, 1957

2,788,804

FLEXIBLE HOSE

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Original application July 20, 1950, Serial No. 174,949. Divided and this application March 30, 1954, Serial No. 419,708

4 Claims. (Cl. 138—55)

This invention relates primarily to improvements in flexible tubular products and more particularly to tubular products of the class employing tubular knitted fabrics as elements of the wall structure of the said product.

A principal object of the invention is to provide a tubular product of the stated class having generally improved physical characteristics coupled with improved economy of manufacture.

More specifically, an object of the invention is to provide a tubular product of the stated class employing knitted tubular components of special form conferring materially improved characteristics upon the finished product.

Still more specifically, the invention contemplates provision of a tubular product of the class described which by reason of the character of the knitted components exhibits materially improved properties including relatively great flexibility, relatively high burst strength, substantial absence of inherent twist, and relatively high economy of production.

A further specific object of the invention is to provide a rubber or like hose of the stated class exhibiting all of the aforesaid improved characteristics.

The invention resides also in certain novel structural details hereinafter described, and illustrated in the attached drawings wherein:

Fig. 1 shows a section of hose broken out to show the structural details including the tubular knitted fabric components;

Fig. 2 illustrates diagrammatically a piece of fabric of the character shown in Fig. 1;

Fig. 3 illustrates a piece of fabric constituting a modification within the scope of the invention, and

Fig. 4 is a fragmentary view similar to Fig. 1 showing the same form of fabric as in the latter figure but reversed face-wise.

With reference first to Figure 1 of the drawings, the tubular product therein illustrated as an embodiment of the invention consists of an inner tubular member 1 of flexible material, a tubular knit fabric 2 which closely embraces the tube 1; an inner flexible tubular envelope 3 overlying the knitted tube 2; a second tubular knit fabric 4 which closely embraces the envelope 3; and an outer flexible tubular envelope 5 which covers the knitted tube 4 and which forms the outer surface of the end product. The fabric tubes may be composed of cotton, nylon or any suitable natural or synthetic textile strand material; and the inner tubular member 1 and the envelopes 3 and 5 may be of rubber or rubberized or other flexible material impermeable to water. When so constituted the tubular product is adapted for use as hose or for other purposes requiring a tube or duct having water impermeable walls.

The tube illustrated in Fig. 1 and described in general terms above, is distinguished from prior tubular products of the same class primarily by the character and relative arrangement of the textile components 2 and 4. The form of the fabric is best shown in Fig. 2 wherein

it will be noted that the knitted web is composed of two mechanically interlocked but otherwise independent sets of stitches 6 and 7, each set forming a continuous spiral course, 8 and 9 respectively, see Fig. 1, with the convolutions of one spiral being interspersed with those of the other. Similarly, the wales 11 formed by the interlocking loops 12 of the one set of stitches 6 are interspersed with the wales 13 formed by the loops 14 of the other set of stitches 7, as best shown in Fig. 2.

The coursewise runs of yarn 15 and 16 which extend between the adjoining loops in the respective course, cross the loops of the other course at one and the same face of the web so that the two sets of stitches are interlocked as stated above. In effect the individual sets of stitches constitute two independent knitted webs which are mechanically united as described above into a unitary fabric.

A tubular knit fabric of this type has certain characteristics which render it particularly useful in a flexible tubular structure of the type to which the invention relates. It is, for example, highly flexible; is highly resistant to internal bursting stresses; and exhibits economy of manufacture both in materials and in the rate of production. These characteristics are reflected in the end product wherein they have special significance related to the function of the tubular product and the purposes to which it may be applied.

With reference again to Fig. 1, it will be noted that the fabric elements 2 and 4 are formed so that the spiral course of stitches in one extends oppositely to the spiral course of stitches in the other, i. e. right and left hand spirals respectively. A circular knit fabric of this general type exhibits an inherent tendency to twist spirally due to the aforesaid formation of the stitches in a spiral course or courses. This is particularly objectionable in tubular products such as water or other hose wherein the twist tendency of the fabric is transmitted to the end product. I have found that this otherwise undesirable effect can be avoided or effectively neutralized, by the expedient of reversing the spirals in the two fabrics as described above so that the hose or other tubular end product shows substantially no tendency to twist in either direction.

By reference to Fig. 1 it will be noted that the ribs formed by the wales in the knitted fabric lie on the outside of the knitted web. This is sometimes desirable as a medium for forming a firmer mechanical connection between the envelopes 3 and 5 and the knitted covers particularly where the envelope 5 is applied in plastic state. It will be noted, however, that the fabric may be reversed so that the ribs will lie on the inside, as illustrated in Fig. 4. Such reversal is illustrated in Figs. 1 and 3 of United States Patent No. 2,201,905. This latter arrangement has advantages in certain classes of hose wherein the inner tube 1 of rubber composition or other flexible plastic material is relatively thick as compared with the outer rubber or plastic envelope or envelopes. In such cases, the projecting ribs on the inner face of the knitted fabric may imbed themselves in the relatively thick body of the inner tube without affecting the inner smooth surface of the latter and the outer surface of the fabric which is relatively flat and smooth will then be capable of receiving a relatively thin outer envelope without adversely affecting the desirable smooth surface of the latter.

Another desirable characteristic of this type of fabric when used in a tubular structure of the character described resides in the fact that the fabric exhibits a much more uniform disposition of interstices over the face area of the fabric than knitted fabrics of other types. This will be apparent from an examination of Fig. 2 for example, wherein it will be noted that the

major portion of the knitted loops in each instance lie in a space between the coursewise loop connecting yarn elements so that the interstices in the fabric formed by the loops are substantially unobstructed; also the interstices between the coursewise extending elements of the yarn and between the adjoining rows of loops are substantially unobstructed. In addition, the loops in the adjoining rows are staggered coursewise with the result that the distribution of small interstices are distributed with a high degree of uniformity. These interstices are an important element of a structure of the character described, in that they afford a passage for interbonding of the plastic or rubber components lying at the respective opposite sides of the knitted fabrics and a substantial uniformity of the small individual bonds which occur at the interstices is an important factor in affording a high uniformity of strength in the wall of the composite tube as a whole.

It will be noted also in the applicant's structure that while the knitted loops are arranged in spiral courses in accordance with conventional knitting practice, the rows of loops themselves extend longitudinally of the tubular structure. This arrangement in conjunction with the particular form of knitted fabric described above is calculated to afford not only a maximum and materially improved burst strength, but also maximum resistance to stretching of the tubular product in the longitudinal direction. This latter effect is of importance not only because it greatly increases the longitudinal or tensional strength of the tubular product, but also prevents the constriction of the diameter of the bore which would necessarily accompany an elongation.

It is to be noted that a lock stitch fabric of this type having desired given characteristics may be produced in machines employing more than two groups of needles with still greater economy of yarn. Such a fabric produced by use of three different lengths of needles in interspersed groups is illustrated in Fig. 3. In this case the fabric comprises three separate spiral courses of stitches 74, 75 and 76 with the loops of each course extending across both of the other courses. A lock stitch fabric of this type has the same desirable characteristics of flexibility and relatively high burst strength as the fabric illustrated in Fig. 2.

This application is a division of my co-pending application Serial No. 174,949, filed July 20, 1950, and since abandoned.

I claim:

1. In a flexible tube of the class adapted for conduction of pressure fluid and whereof the wall is composed of plastic composition having therein a structural component in the form of a seamless knitted tube, the improvement which resides in the fact that the fabric of said knitted tube comprises a plurality of independently formed helical courses of stitches, each of said courses of stitches comprising laterally spaced wale forming loops and intervening lateral loop-connecting strands, the wales formed by the loops of one course being interspersed coursewise with the wales formed by the loops of another course, and each loop-connecting strand in each of the courses extending across at least one loop of another course and on the same face of the knitted web as the loop-connecting strands of the other courses so as to unite the courses into a unitary fabric conferring on the flexible tube a relatively high resistance to bursting by internal fluid pressure.

2. A flexible tube according to claim 1 wherein each of the loop-connecting strands in each course extends across a single loop of another course.

3. A flexible tube according to claim 2 wherein the independently formed helical courses are offset walewise and are uniformly spaced with respect to each other, the said fabric thereby exhibiting a relatively uniform distribution of interstices through which the said plastic composition extends so as to establish continuity of said composition throughout the thickness of the wall of the tube.

4. A flexible tube according to claim 3 wherein the loop wales of the knitted fabric lie at the inner face of the latter, and wherein further the position of the fabric in the said wall affords a relatively great thickness of plastic composition on the wale side of the fabric.

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