

Oct. 22, 1940.

F. C. STEPHENS

2,218,560

ARTICLE OF KNITTED WIRE OR OTHER RESILIENT MATERIAL

Filed June 19, 1939

2 Sheets-Sheet 1

Fig. 1.

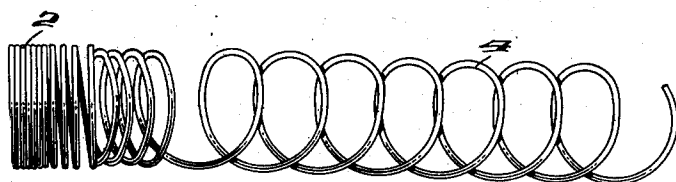


Fig. 2.

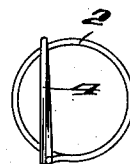


Fig. 3.

Fig. 4.

Fig. 5.

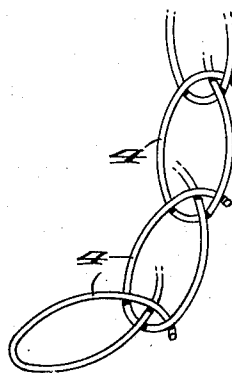
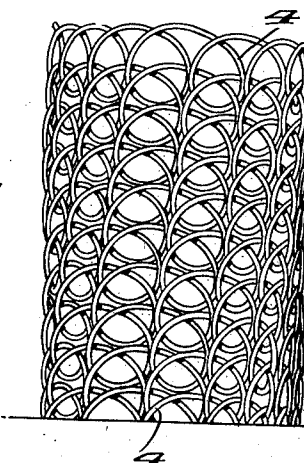
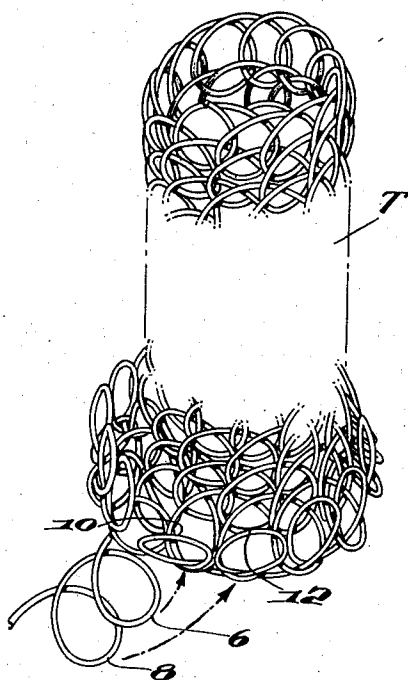


Fig. 6.

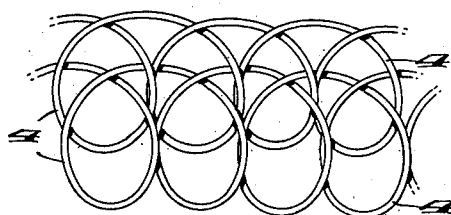
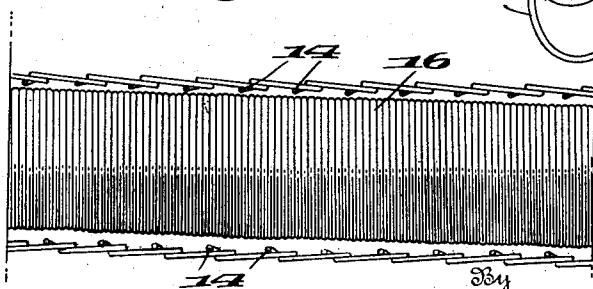


Fig. 7.



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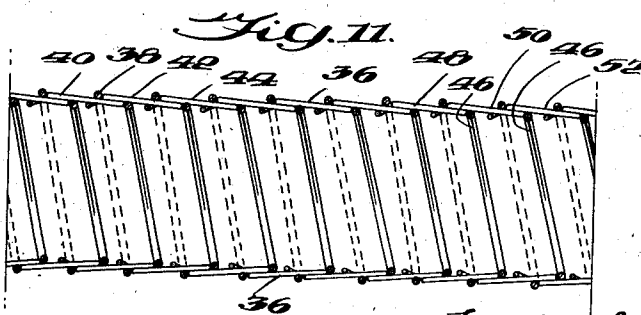
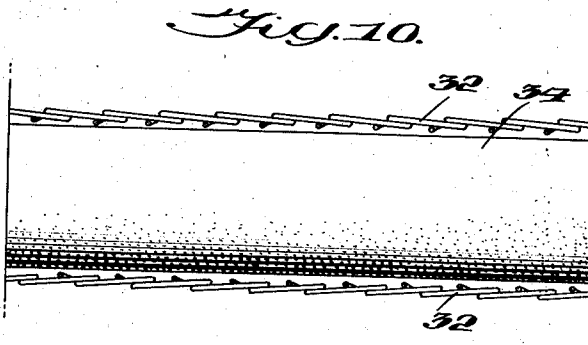
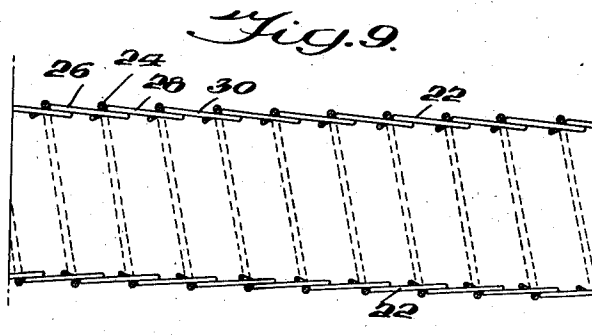
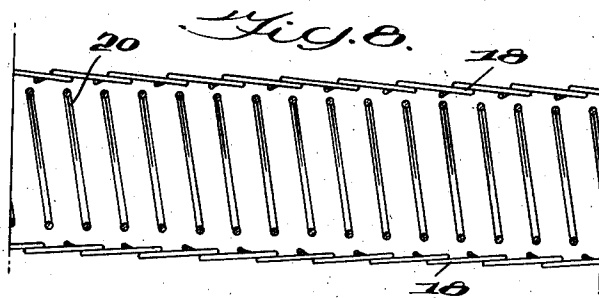
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ARTICLE OF KNITTED WIRE OR OTHER RESILIENT MATERIAL

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,218,560

ARTICLE OF KNITTED WIRE OR OTHER
RESILIENT MATERIAL

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Application June 19, 1939, Serial No. 280,015

14 Claims. (Cl. 245-6)

My invention relates to an improved article of knitted wire or other resilient material.

This application is a continuation in part of my co-pending application Serial Number 78,293 filed May 6, 1936, and from which Figures 1, 2, 3, 5, and 6 have been copied.

By following the teachings of my co-pending application, which is a Method of and means for knitting preformed wire, an article of knitted wire is made. The purpose of this application is to cover the article formed by following the teachings of my co-pending application.

The knitted article formed may be used for innumerable purposes which cannot in this application be completely enumerated because new uses are being found for the article almost daily.

An object of my invention is to provide an article of knitted wire or of any other resilient material.

A further object is to provide a tubular knitted article of wire or other suitable resilient material.

A further object is to provide a resilient knitted article which may be used to reinforce other flexible or elastic articles.

A still further object is to provide an article which is reinforced with an elastic and/or pliant material.

A still further object is to provide an article of knitted material to be used to reinforce and/or cover substantially concentrically other tubular materials of rubber, wire, or other materials.

In the drawings:

Fig. 1 is a side elevation of a spiral coil of wire or other resilient material, a part of which has been preformed into loops;

Fig. 2 is an end view;

Fig. 3 is a perspective view of a knitted tube made of the preformed wire shown in Figs. 1 and 2;

Fig. 4 is a side elevation of the knitted tube shown in Fig. 3 slightly enlarged and more in detail to show the exact position which the preformed loops assume in the knitted article;

Fig. 5 is an enlarged fragmentary detail view of an interlaced or knitted tube as shown in Figs. 3 and 4 after the tube has been cut along the wale in the knitting;

Fig. 6 is an enlarged fragmentary detail view of a piece of fabric illustrating the continuous knitting or interlacing of loops of preformed wire;

Fig. 7 is a longitudinal cross-section through the knitted tube showing a spiral spring inserted substantially concentrically therein;

Fig. 8 is a longitudinal cross-section through the knitted tube showing an open wound spiral spring substantially concentrically positioned within the knitted tube;

Fig. 9 is a longitudinal cross-section through the knitted tube showing an open wound spiral spring positioned around the external periphery of the knitted tube;

Fig. 10 is a longitudinal cross-section through a knitted tube showing a rubber tube inserted therein substantially concentrically therewith; and

Fig. 11 is a longitudinal cross-section through the knitted tube showing open-wound spiral springs engaging both the internal and the external peripheries of the knitted tube.

Figs. 1, 2, 3, 5, and 6 have been copied from the drawings of my co-pending application Ser. No. 78,293 of which this application is a continuation in part.

Fig. 4 has been added to more clearly show the exact configuration of the loops of preformed wire after they have been knit into a tube. This figure is in reality a copy of the knitted tube as disclosed in Fig. 3 but rather than being in perspective is shown in side elevation, and shows only the near side of the tube rather than showing both sides of the tube, which of necessity would cause a greater confusion of lines of wire.

Figs. 7 to 11 inclusive disclose the use of my knitted wire in combination with a spiral spring and/or other elastic or resilient tubes or elements, and constitute a continuation in part of my original and co-pending application Ser. No. 78,293.

In the specification and claims where I use the word "resilient," I intend it to have the generally accepted meaning given in Webster's New International Dictionary, except that it shall have that meaning only as it would more particularly apply to materials having the characteristics of wire.

Figs. 1 and 2 disclose a spiral of resilient wire 2 which has been preformed into loops 4, which loops are knit, or interlaced into a tube T by the use of the machine and method disclosed in my co-pending application Ser. No. 78,293.

As disclosed in Fig. 3, the loops 6 and 8 are inserted respectively into the loops 10 and 12, these loops at the end of the tube in Fig. 3 being representative of the manner in which each loop is inserted or interlaced into its proper receiving loop.

Fig. 4 which discloses more particularly the exact position assumed by each loop in a tube,

shows clearly that a line of loops does not follow the longitudinal axis of the tube formed, but spirals around the tube. This figure is also illustrative of the fact that each convolution of loops is not exactly perpendicular to the longitudinal axis of the tube, but is at a slight angle thereto. For convenience, I consider the point at which two juxtaposed loops touch in the knitted tube as a wale, which wale clearly spirals around the tube.

The greatly enlarged Fig. 5 shows four loops which have been knit into a tube, and which tube has been cut along a wale. This figure is included primarily to show more clearly the manner in which the knitting, or interlacing is performed, the left side of Fig. 5 representing the outside of the tube. While it is possible to knit a tube differently from the manner described in my co-pending application, it is preferable to knit the tube from the inside out. That is, to introduce a new loop of preformed wire into a loop of the already formed tube from the inside of the tube, to force it through that loop and fold it over so that it will be in position to receive a new loop of preformed wire from the inside of the tube.

Fig. 6 is an enlarged fragmentary detail showing a fabric of knitted preformed material which may either be made from a plurality of pieces of preformed wire or may be made in the form of a tube, cut along a wale thereof as described above relative to Fig. 5, and then flattened out by running it through pressure rolls, or in any other convenient manner.

My knitted tube may be made in any desired length, the limitation to the length being dependent, as far as at present can be determined, on the length to which wire can be drawn, and it is my understanding that wire may be drawn to an infinite length.

As described above, my tube, as it is knit, has wales which spiral around the tube and do not follow in a line parallel with a plane passing through the central axis of the tube. I have found that, generally speaking, I utilize the knitted tube thus formed for most purposes. Through experimentation I have found that by taking a knitted tube of a given length, and by holding the two ends thereof and pulling them apart under great tension, that the tube may be considerably stretched, at which time the individual loops of the tube are permanently elongated (in the direction of the central axis of the tube). If the ends of the tube are twisted during this stretching so that the wales are made to spiral about the tube even more than they did when the tube was first knit, then the resulting tube will not only be longer, and smaller in diameter, but will have become much more flexible and will have lost practically all of its elasticity.

If, on the other hand, the two ends of a similar knitted tube are held and are pulled apart under great tension, and at the same time the wales of this tube are turned so that they will be in a line approximately parallel with a plane passing through the central axis of the tube, the result will be that the individual loops will likewise be greatly elongated in the direction of the central axis of the tube, the diameter of the tube will be lessened, the length and flexibility will be increased, and its elasticity will also be greatly increased.

A knitted tube may be increased in length, and reduced in diameter, by drawing the tube through

a die or series of dies having internal diameters smaller than the diameter of the tube. This method of stretching and reducing the tube diameter may be easily accomplished and the tube may thus be reduced to have the exact diameter desired.

In Fig. 7 I have disclosed the use of the knitted tube of wire or other resilient material into which a closely wound spiral spring has been inserted, it being understood that the spiral spring is attached to the knitted tube at two or more places so that when the tube is stretched, the spiral spring will return the tube to its normal position at the time that the tension is released.

In Fig. 8 I have disclosed a knitted tube into which I have inserted an open-wound spiral spring, which likewise is attached to the knitted tube at two or more places, so that when the tube is either stretched or compressed, the pressure will be transmitted to the spiral spring and on releases of the pressure the tube will resume its normal length.

In Fig. 9 I have disclosed a knitted tube around the external periphery of which I have placed an open-wound spiral spring. The open-wound spiral spring, while it is being wound around tube 22, will always position itself as disclosed in Fig. 9 between the loops 26 and 28, 28 and 30, etc.

By using an open-wound spiral spring of smaller diameter than the diameter of the original knit tube 22 which is to be wound, the diameter of the tube will be decreased and its length will be increased as the open-wound spring is positioned around the external periphery of the knit tube. Obviously if an open-wound spring having the same diameter as the knit tube is used it could not properly be positioned accurately between the loops 26 and 28, 28 and 30, etc. but would merely fit relatively loosely around the exterior of the knitted tube.

The knit tube per se is stretchable and somewhat elastic, but after an open-wound spiral spring has been positioned, as described above, around the external periphery of the knit tube, the stretchability and elasticity is greatly decreased, and the crushability of the tube is practically eliminated.

The same result may be obtained by using a closely wound spiral spring. A closely wound spring, however, of the same diameter as an open-wound spiral spring, will reduce the diameter of the knit tube more. A closely wound spiral spring will assume the same position as described above with respect to an open-wound spiral spring.

In Fig. 10 I have disclosed a knit tube into which I have inserted a rubber tube or hose. It is intended that this rubber tube or hose be representative of a tube which may be either highly elastic, such as gum rubber, or one which is not elastic, such as one made of vulcanized rubber or vulcanized rubber reinforced with fabric.

In the case of the use of a gum rubber hose or tube being inserted within the knitted tube, I have found that a given length may be stretched to approximately double when tension is applied, after which time it will return to its normal length when the tension is released.

When the rubberized tube inserted within my knitted tube is of vulcanized rubber or of fabric reinforced rubber, the knitted tube serves primarily to reinforce the rubber tube so that it

may withhold greater internal pressure or may withstand greater external pressure.

Whether the rubber tube be of gum rubber or vulcanized rubber, the knit tube sheathing serves to prevent the tube from becoming kinked or collapsed in such a manner as to close the tube.

In Fig. 11 I have disclosed a knit tube 36 about which I have placed an open-wound spiral spring 38, which spring is positioned between the loops 40 and 42, 42 and 44, etc. as defined above with respect to Fig. 9. In Fig. 11 I have also disclosed the use of an open-wound spiral spring 46 positioned within a knitted tube 36. This spiral spring 36 is similar to the spiral spring 20 described above and disclosed in Fig. 8, but is larger in diameter relative to the knitted tube into which it is inserted. In the case of the open-wound spiral spring 46 inserted into the knitted tube 36, the spiral spring 46 fits tightly against the internal periphery of the knitted tube 36 and consequently fits snugly between the loops 48 and 50, 50 and 52, etc.

This construction of knitted tube which is reinforced both internally and externally with open-wound spiral springs is very solid, has almost no elasticity, very strongly resists being collapsed, but still is relatively flexible.

It will be understood that various combinations of my several modified forms may be made. For example, I may place a rubber tube within a knitted tube, not only such as the one disclosed in Fig. 10 but also within the knitted tube having either the tightly wound spiral spring as shown in Fig. 7, the open-wound spiral spring as shown in Fig. 8, the knitted tube wrapped externally with an open-wound spiral spring as shown in Fig. 9 or the knitted tube which is reinforced both externally and internally as disclosed in Fig. 11.

It will be understood that I contemplate the use of any combination of these several disclosures.

I can also reinforce my knitted tube by inserting a wire into the preformed loops shown in Fig. 1. When it is desired to make a thus reinforced tube, a strand of wire is inserted into the spiral spring which is to be preformed into loops. Thus, as the loops are formed, the strand of wire will be threaded through each of the loops. As the loops are knit into a tube this strand of wire will spiral around the tube and be held as a reinforcing element between the internal and external peripheries of the tube, or as a part of the tube itself.

My knitted tube may be built directly around any desirable core, such for example as hose or rope which may be fed through the knitting machine so that as the knit tube is being formed, it may be made so that it fits relatively snugly around the core selected. If desired, after the knit tube has been thus fitted snugly around a core or rope, hose, or other desired material, such as for example insulated wire, the knit tube and the core therein may be later pulled through a die, as suggested above, so that the knit tube may be made to fit tightly around that selected core. In this manner, a very satisfactory sheathing may be afforded for a hose or core, and obviously if it is desired a portion of that core may extend out beyond the end of the knitted tube. For example, if a knitted tube is placed around a rope, the ends of the rope may be left to extend out beyond the knitted tube so that a desirable length of rope may be left uncovered for the purposes of tying knots therein, while the remaining

portion of the rope is provided with an external sheathing which would prevent wear on the rope if the rope would be submitted to such wear while being used. For example, if a rope were to be used for the purpose of fastening a boat to another boat or to a wharf, it would be necessary that the end or ends of the rope be tied in some manner, and yet the rope could be properly encased in a wear resisting element at points where the rope wears, say on the gunwale of the boat or on cleats of the dock or wharf.

Where the words "interlaced" or "interlacing" appear in the specification or claims, it will be understood that the meaning shall be that one loop, which is one complete turn of wire crossing over itself, has been passed through another loop so that the two loops are thus interlaced and/or interlocked.

I claim:

1. An article consisting of adjacent portions of resilient material, each portion provided with contiguous crossed loops, the loops of adjacent portions being interlaced.

2. A tube consisting of convolutions of contiguous resilient crossed loops of wire displaced laterally with respect to each other, the convolutions being spirally wound, and the loops of adjacent convolutions being interlaced.

3. A spirally formed tube consisting of adjacent portions of resilient material, each portion provided with contiguous crossed loops, the loops of adjacent portions being interlaced.

4. A tube built up of convolutions of contiguous resilient crossed loops displaced laterally with respect to each other, the convolutions being spirally wound, and the loops of adjacent convolutions being interlaced from the inner surface of the tube outwardly.

5. An article of manufacture consisting of a fabric formed of a continuous series of preformed juxtaposed resilient crossed loops successively interlaced into a continuous interlaced spiral.

6. A fabricated cylinder consisting of preformed resilient spring like crossed loops juxtaposed and interlaced with successive juxtaposed spring-like crossed loops into a continuous interlaced spiral.

7. A fabricated cylinder consisting of juxtaposed resilient expansible crossed loops interlaced with successive resilient expansible crossed loops into a continuous interlaced spiral.

8. An article of manufacture consisting of a fabric formed of juxtaposed resilient crossed loops successively interlaced into a continuous interlaced spiral, and an element connected therewith substantially concentrically.

9. An article of manufacture consisting of a fabric formed of juxtaposed resilient crossed loops successively interlaced into a continuous interlaced spiral, and an element connected therewith substantially concentrically at two or more points.

10. An article of manufacture consisting of a fabric formed of juxtaposed resilient crossed loops successively interlaced into a continuous interlaced spiral, and an elastic tubular member connected substantially concentrically thereto.

11. An article of manufacture consisting of a fabric formed of juxtaposed resilient crossed loops successively interlaced into a continuous interlaced spiral, and securing within said article a spirally wound spring.

12. An article of manufacture consisting of a fabric formed of juxtaposed resilient crossed

loops successively interlaced into a continuous interlaced spiral, said article reinforced by spirally wound resilient material.

13. An article of manufacture consisting of a
5 fabric formed of juxtaposed resilient crossed loops successively interlaced into a continuous interlaced spiral, and a spiral spring positioned around the external periphery of the said article.

14. An article of manufacture consisting of a fabric formed of juxtaposed resilient crossed loops successively interlaced into a continuous interlaced spiral, a helical spring secured at two or more points within the said article, and a heli- 5 cal spring around the external periphery of the said article.

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