Jan. 23, 1940. O. J. BRATZ 2,187,873

FLEXIBLE WIRE TUBING

Original Filed April 9, 1935

Fig. 1.

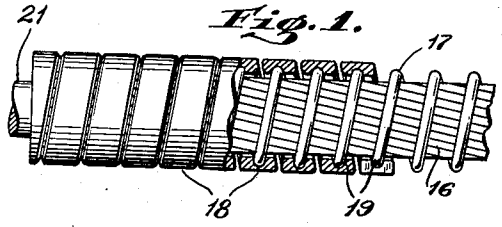


Fig. 3. Fig. 4a. Fig. 4.

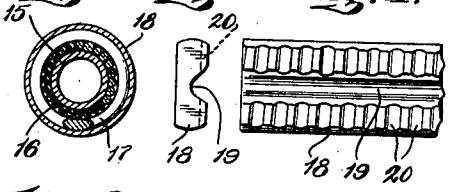


Fig. 2.

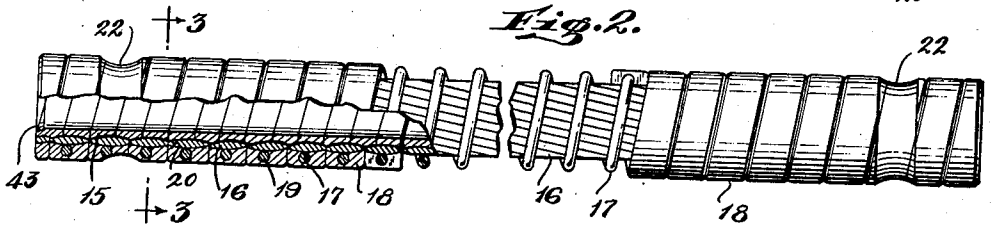


Fig. 5.

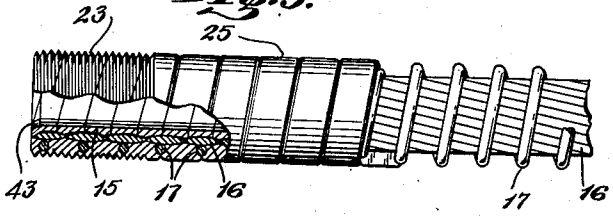


Fig. 6a. Fig. 6.

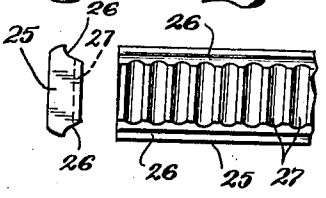


Fig. 7.

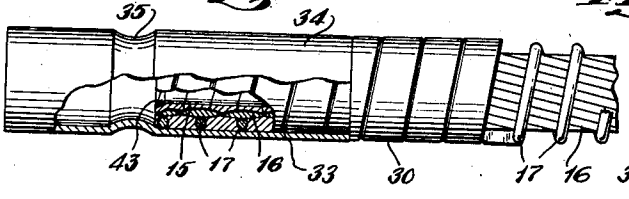


Fig. 8a. Fig. 8.

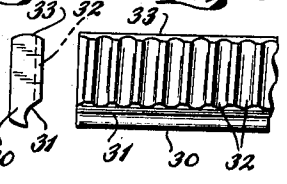


Fig. 9.

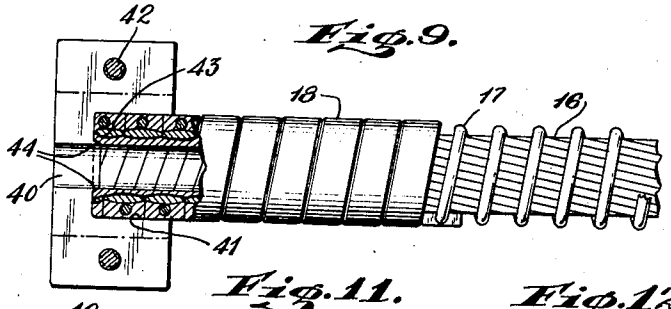


Fig. 10.

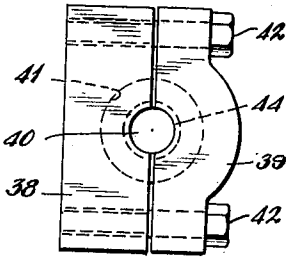


Fig. 11.

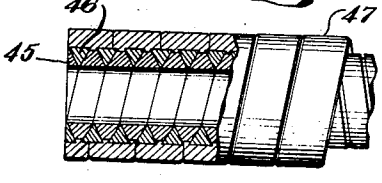
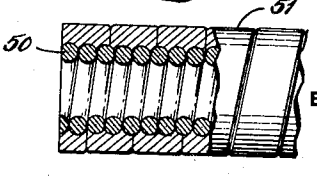


Fig. 12.



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FLEXIBLE WIRE TUBING

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Original application April 9, 1935, Serial No. 15,405, now Patent No. 2,137,712, dated November 22, 1938. Divided and this application November 21, 1936, Serial No. 112,060

6 Claims. (Cl. 138—50)

The present application is a division of my copending application Serial No. 15,405, filed April 9, 1935, now Patent No. 2,137,712, November 22, 1938, in which I claim the method of producing desired lengths of stranded wire structures from a continuous length of stranded structure and reinforcing the ends thereof. The invention forming the subject matter of the present application relates to flexible stranded wire structures preferably made of helically extending wire elements herein disclosed as arranged in layers and has for an object to provide a novel binding for the ends of such stranded wire structure to prevent the wire elements from uncoiling or spreading.

A more specific object of the invention is to provide a stranded wire tubular structure with a reinforcement at an end thereof, such reinforcement consisting of a binding of flat wire or ribbon swedged upon the structure so as to form a substantially continuous sleeve or ferrule.

Another object of the invention is to provide such tubing with an end clamp or fitting that will protect the end of the wire tubing from being caught upon or being frayed by an inner member rotating or sliding in the tubing.

It is common practice to make coiled wire tubing primarily in continuous form and then to cut the tubing into desired lengths. Heretofore, it has been necessary to provide auxiliary clamping means to prevent the severed wires from springing and uncoiling until they could be secured permanently by a sleeve, ferrule or other binding means. My invention dispenses with such auxiliary clamping means and simplifies the process of manufacturing flexible wire casings by providing a binding which may be applied before the tubing is severed, which binding, after the tubing has been severed, may be converted into a ferrule or its equivalent by a swedging operation.

Other objects and advantages of my invention will appear in the following description of a preferred embodiment and thereafter the novelty and scope of the invention will be pointed out in the claims.

In the accompanying drawing:

Figure 1 is a view in side elevation and partly in section of one end of a stranded wire tube with my improved binding or reinforcement applied thereto before swedging;

Fig. 2 is a view in side elevation of both ends of a stranded wire tube with my reinforcement applied thereto and swedged thereon, one end of the tube being partly broken away to show structural details;

Fig. 3 is a view in cross-section taken substantially on the line 3—3 of Fig. 2;

Figs. 4 and 4*a* are plan and end views, respectively, of a reinforcement strip, illustrating the contour of the inner face of the strip;

Fig. 5 is a view in side elevation and partly in section of one end of a stranded wire tube with reinforcement applied thereto, such reinforcement being of different section from that shown in Fig. 2;

Figs. 6 and 6*a* are plan and end views, respectively, of the inner face of the reinforcement strip employed in the structure shown in Fig. 5;

Fig. 7 is a view in side elevation and partly in section of one end of a stranded wire tube reinforced with a metallic strip of different section from that shown in Figs. 2 and 5 and with a metallic sleeve swedged upon the reinforcement;

Figs. 8 and 8*a* are plan and end views, respectively, of the reinforcement strip shown in Fig. 7;

Fig. 9 is a view in side elevation and partly in section of one end of a stranded wire tube with reinforcement applied thereto and with one-half of a split clamp engaging such reinforced end of the tube;

Fig. 10 is an end view looking from the left hand side of Fig. 9 with both halves of the clamp applied to the tube; and

Figs. 11 and 12 are fragmental views in side elevation and partly in section of two other forms of flexible tubing with my reinforcement swedged thereon.

The flexible wire tubing shown in Figs. 1 and 2 is of standard construction and comprises an inner layer 15 consisting of a helix of flat wire, the convolutions of the helix being slightly spaced apart so as to permit of flexing the helix about its axis. A second layer 16 which is applied directly upon the helix 15 comprises a series of contiguous wires coiled with a relatively long pitch. An outer helix 17 serves to bind the wires of the second layer so that when the structure is flexed the wires of the second layer will be constrained to slide lengthwise relatively to each other, but will be maintained at all times in close contact. The outer helix 17 serves merely to retain the wires of the second layer 16 and consequently the convolutions of this helix are widely spaced apart.

To hold the wires of the different layers in place and prevent them from unwinding, I apply a binding or reinforcement strip 18 of the char-

acter shown in detail in Figs. 4 and 4a. The binding strip 18 is formed with a central groove or recess 19 adapted to embrace the wire of the outer helix 17. The width of the strip is slightly less than the center to center spacing of the convolutions of helix 17. The strip 18 when applied to the tubing is wound in the same direction and with the same pitch as the helix 17, as shown in Fig. 1. The strip may also be knurled or formed with transverse depressions 20 to register with and fit upon the wires of the second layer 16.

As a strip 18 is wound upon the tubing it is preferably preformed to a smaller diameter than the outside diameter of the tubing so that it will tightly hug the tubing. Such binding or reinforcement may be applied at predetermined points on a continuous length of tubing and the tubing may then be severed at such points by sawing or cutting through the binding so as to leave a part of the binding on each of the severed ends. Since the binding is preformed it will hold the layers temporarily against uncoiling or spreading. The hold of the binding strip will be increased if the parts are so proportioned as to effect engagement of the transverse depressions 20 with the wires of layer 16.

Each end of the tube is now subjected to a swedging operation, an arbor 21 being inserted in the end under treatment. The swedging operation compresses the binding from the condition illustrated in Fig. 1 to that illustrated in Fig. 2, in which it will be observed that the binding strip is forced into intimate contact with the tubular structure, substantially enveloping the convolutions of helix 17 and being to a certain extent molded upon the wires of the second layer 16. The swedging operation also causes the helix 17 to be partly embedded in corrugations of layer 16, thereby tying the wires of layer 16 together, and since the helix 17 is also embedded in the binding strip 18 the latter is thus firmly anchored to the layer 16 as well. It will also be observed from an inspection of Fig. 2 (which shows the finished tube after the arbor 21 has been withdrawn) that in the swedging operation the strip 18 is spread so that adjacent convolutions are in tight contact and the result is a substantially continuous sleeve forming a reinforcement on the end of the tubular structure. This sleeve is preferably of such thickness that an annular groove 22 may be formed therein for attachment purposes. Also, the sleeve may be threaded, if desired, as shown at 23 (Fig. 5).

The structure shown in Figs. 5, 6 and 6a differs from that already described mainly in that a binding strip of different cross-section is employed. This binding strip which is indicated by the reference numeral 25 is of the same width as the binding strip 18 but instead of having a central groove is formed with two quarter-circle grooves 26 along each margin which are adapted to engage adjacent convolutions of the layer 17. Between the grooves 26 the inner face of the strip is formed with depressions 27 adapted to fit upon the wires of layer 16. Fig. 5 shows the strip after it has been applied to the tubing and swedged thereon. As explained above, this reinforcement may be formed with threads 23 for attachment purposes, or, if desired, it may be formed with an attachment groove 22. When the binding strip is swedged upon the tubing the wire of layer 17 is embedded in the binding strip at the junction between adjacent convolutions of the strip. In this case, as in that described above, the swedging operation serves to cause partial embedment of layer 17 into layer 16 and also partial embedment of layer 16 and binding strip 25 so that the parts are all rigidly united.

In the construction shown in Figs. 7, 8 and 8a a still different section of binding strip is employed. This strip which is indicated by the reference numeral 30 is formed with a groove 31 along one margin only, while the opposite margin is rounded, as shown at 33. The groove 31 is adapted to receive the wires of layer 17 and transverse depressions 32 in the face of the strip are adapted to receive the wires of layer 16. After the strip 30 has been swedged upon the tubing the parts assume the position shown in Fig. 7 with the wire of layer 17 embedded in one edge of the strip 30. This strip may be formed with threads 23 or annular groove 22 for attachment purposes.

In Fig. 7 I show still another form of attachment fitting. This consists of a sleeve 34 which is fitted over the binding 30 and then is swedged thereon. The sleeve is thus made fast to the reinforcement 30 and hence to the tubing by frictional engagement therewith and also by partial embedment. Such embedment is due to the fact that the strip is formed with a rounded edge 33 so as to provide a groove between adjacent convolutions of the strip 30 into which the metal of the sleeve 34 is forced by the swedging operation. The sleeve 34 may be provided with an annular groove 35 for attachment purposes.

Another means of attaching the tubing to a fixed support is shown in Figs. 9 and 10. The structure of the tubing and reinforcement corresponds to that shown in Figs. 1 and 2. The fixture to which the tubing is attached consists of a clamp comprising a member 38 and a member 39. This clamp has a bore 40 formed between the members which is of the same diameter as the inside diameter of the tubing at the point where it has been swedged. The bore has an enlargement 41 to receive the tubing, and the latter is clamped between the member 38 and 39 by means of bolts 42. The tubing serves usually as a guide for a rotary and/or sliding power transmitting element and there is the danger that the inner layer may present a sharp or jagged wire end which will engage said element, fraying the tubing or causing a serious jam. To avoid this I bevel the inner layer of the tubing, as indicated at 43, and provide an annular flange 44 on the members 38 and 39 at the junction of bore 40 and enlargement 41, this flange being beveled to fit the bevel 43. Thus, the end of the inner layer is bound and held in place by the flange 44.

Fig. 11 shows one end of the piece of tubing made of two helices of wire 45 and 46 respectively which are of triangular cross-section with the base of the triangle of wire 45 forming the inner face of the tubing and the base of the triangle of wire 46 forming the outer face of the tubing. Upon this tubing is wrapped a binding strip 47 which is of rectangular section. The wires 45 and 46 form right-hand helices whereas the strip 47 forms a left hand helix so that the joints between successive convolutions of the strip 47 are disposed transversely to the joints between the convolutions of the helix formed from wire 46. The tubing and binding strip are subjected to a swedging operation which binds the strip 47 tightly to the tubing, forcing it into the crevices formed between successive convolutions of the helix formed from wire 46. This serves to bind the strip 47 upon the tubing and to form a sub-

stantially rigid sleeve portion at the end of the tubing. While I prefer to reverse the binding with respect to that of the helices formed from wires 45 and 46 I do not wish to limit myself to this arrangement, since it will be obvious that by using a binding strip which is much wider than the wire 46, such binding strip must be wound with a greater pitch if adjacent convolutions are contiguous and consequently the joint between successive convolutions of the strip 47 cannot coincide with the joint between convolutions of wire 46 but must traverse such joint and bind the convolutions of wire 46 together even if the lay is not reversed.

In Fig. 12 I show still another form of my invention in which the binding is applied directly to a flexible tube consisting of a single wire helix 50. The end of this tube is bound with a strip 51 which may be of the same section as strip 47 and as in the structure shown in Fig. 11, the lay of the strip 51 is preferably although not necessarily reversed with respect to that of the helix 50. The tubing and binding strip 51 are subjected to a swedging operation which forces the strip 51 into the crevices between adjacent convolutions of the helix 50, thus binding said convolutions and forming a rigid sleeve at the end of the tubing.

I have shown my invention as applied to a tubular casing comprising contacting layers of coaxial helices, the outer layer comprising a helix of spaced convolutions laid on the intermediate layer which comprises a plurality of wires laid helically and in contact with an inner helix within which a wire or wire stranded structure may operate. Insofar as certain aspects of the invention are concerned the tubular casing may be constructed of one or more layers of coiled or braided wires and the stranded structure to which the invention is applied may be provided with a core as is well understood.

While I have described several embodiments of my invention, it will be understood that these are to be taken as illustrative and not limitative and I reserve the right to make various changes in form, structure, and arrangement of parts without departing from the spirit and scope of my invention as clearly set forth in the following claims.

I claim:

1. A flexible tubular structure comprising at least one helical coil of wire, and a fitting on the coil comprising a helical wrapping of metal ribbon in a state of impactment on the coil and in which the convolutions of the coil are embedded at least in part, the lay of the wrapping being reversed with respect to that of the coil.

2. A flexible structure formed of a body layer of contiguous wires helically coiled with a long pitch, an open helical coil of reverse lay wound upon said layer of wires and adapted to hold the latter in place, a binding on the structure consisting of a close helical coil of metal ribbon, the inner face of the ribbon being contoured to fit over the convolutions of said open coil and into the depressions formed between the wires of said body layer.

3. A flexible structure formed of a body layer of contiguous wires helically coiled with a long pitch, an open helical coil of reverse lay wound upon said layer of wires and adapted to hold the latter in place, a binding on the structure consisting of a close helical coil of metal ribbon, said ribbon having the same lay and pitch as said open coil, the inner face of the ribbon being contoured to envelope the convolutions of said open coil and fit into the depressions formed between the wires of said body layer.

4. A flexible structure formed of a body layer of contiguous wires helically coiled with a long pitch, an open helical coil of reverse lay wound upon said layer of wires and adapted to hold the latter in place, a binding on the structure consisting of a close helical coil of metal ribbon of the same pitch and lay as said open coil, the inner face of the ribbon being longitudinally grooved to envelope the convolutions of said open coil and being transversely corrugated to fit into the depressions formed between the wires of said layer.

5. A flexible structure comprising at least one helical coil of wire, and a tubular fitting on the coil, said tubular fitting comprising a helical wrapping of metal ribbon in a state of impactment upon the coil and in which the convolutions of the coil are embedded at least in part, said wrapping being formed exteriorly with an annular depression for attachment purposes.

6. A flexible tubular structure comprising at least one helical coil of wire, a tubular fitting on the coil, said tubular fitting comprising a helical wrapping of metal ribbon in a state of impactment upon the coil and in which the convolutions of the coil are embedded at least in part.

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