June 13, 1933 C. S. HUNGERFORD 1,913,390

FLEXIBLE METAL TUBING

Filed Dec. 23, 1931

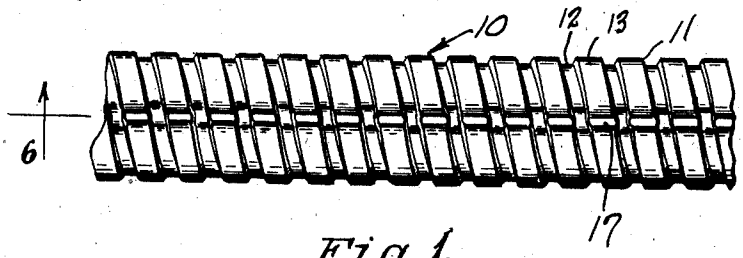


Fig. 1.

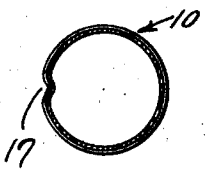


Fig. 2.

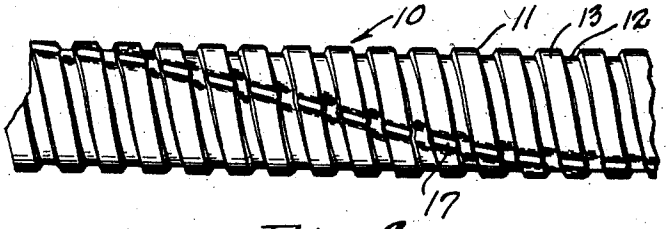


Fig. 3.

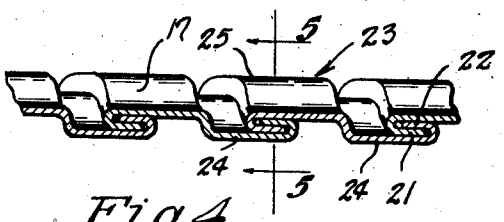


Fig. 4.

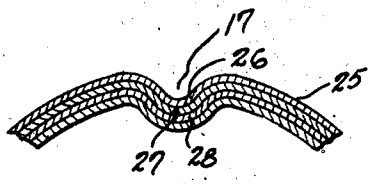


Fig. 5.

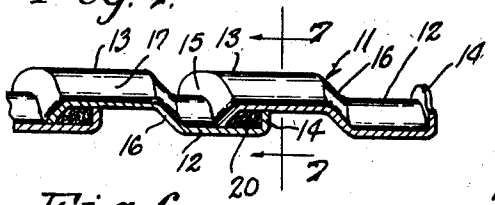


Fig. 6.

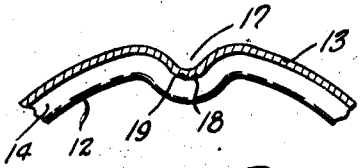


Fig. 7.

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Patented June 13, 1933 1,913,390

UNITED STATES PATENT OFFICE

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FLEXIBLE METAL TUBING

Application filed December 23, 1931. Serial No. 582,891.

This invention relates to flexible metal tubing, and more particularly to means for preventing the overlapping convolutions from spreading and opening up the joint to thereby cause the tube to leak from the twisting of the tube. It will be evident as these tubes are formed by spirally winding a strip of metal so that the convolutions overlap for a portion of their width, that if the tubes are twisted in the reverse direction the overlapped convolutions begin to separate and thus permit the tube to leak. It has been known to prevent this untwisting by winding the strip on a mandrel having flat sides, as for example a hexagonal mandrel, thus producing a hexagonal tube, but these tubes have certain objections and they are more difficult to form properly than a circular tube. It is therefore an object of the present invention to provide an improved and an effective means to prevent untwisting and opening of the joints of a circular flexible tube.

Another object is to provide means for so preventing opening of the joints which can be applied to the tube either after the tube has been wound, or while it is being wound.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawing in which the preferred construction is illustrated, it however being understood that various modifications and changes may be employed without departing from the principles of the invention.

In the accompanying drawing:

Fig. 1 is a side elevation of a section of a flexible metal tube with my improved locking means applied thereto;

Fig. 2 is a transverse section thereof;

Fig. 3 is a view similar to Fig. 1 showing a somewhat different arrangement of locking means;

Fig. 4 is a longitudinal section on an enlarged scale through several convolutions of the interlocked type of conduit;

Fig. 5 is a transverse section thereof substantially on line 5—5 of Fig. 4;

Fig. 6 is a longitudinal section through the locking means of the so-called overlapped type of conduit, the section being substantially on the line 6 of Fig. 1, but on an enlarged scale; and

Fig. 7 is a transverse section substantially on line 7—7 of Fig. 6.

Referring to Figs. 1, 2, 3, 6 and 7, the tube 10 is shown as formed in the usual manner by spirally winding a strip of metal 11 so that the adjacent convolutions overlap for a portion of their width. One portion of the strip indicated at 12 is off-set inwardly from the other portion 13, and the edge of the portion 12 is provided with an outwardly extending flange 14 while the free edge 13 is provided with an inwardly extending flange 15. When laid in the spiral to form the tube the edge of the flange 15 engages the outer portion of the portion 12 of the adjacent convolution, while the edge of the flange 14 engages the inner portion of the portion 13 of the adjacent convolution. The convolutions are also so wound that when the tube is straight the flanges 14 and 15 are spaced from each other longitudinally of the tube and also from the connecting portion 16 so that as the tube is flexed laterally there is plenty of room for the flanges to slide on the surfaces of the adjacent convolutions.

It will, however, be evident that if the tube is twisted in the opposite direction from the direction in which the convolutions are laid, then the overlapping convolutions will tend to separate in a direction radially of the tube thus opening the joint between the adjacent convolutions and causing the tube to leak. I overcome this objection by providing co-acting means on the adjacent overlapped convolutions which prevents these adjacent convolutions from sliding on each other longitudinally of the convolutions, or that is, in a direction peripherally of the tube, and therefore as the tube cannot untwist, the joints between the convolutions cannot separate and cause the tube to leak.

This untwisting can be prevented by scoring or indenting either inwardly or outwardly the overlapping portions adjacent the convolutions so that one of them has a

recess or depression and the other has a projection extending into said recess to give a sort of locking or keyed effect to prevent the adjacent convolutions from sliding relative to each other in a direction longitudinally of the convolutions, or that is, in a direction peripherally of the tube.

I have found the simplest and the most effective means for so interlocking the convolutions to be a groove indicated at 17 extending longitudinally of the tube. This can be formed by rolling the groove in the surface of the tube after it is formed, or if preferred it can be formed when the tube is being wound. On the drawing the groove is shown as being rolled inwardly from the outer surface, but it will of course be understood the same effect is secured if it is rolled outwardly from the inner surface. The groove may extend straight or parallel to the axis of the tube as indicated in Fig. 1, or it may extend spirally of the tube as indicated in Fig. 3. A single longitudinal groove may be used or more than one may be used if found desirable. The indentations however need not be formed by a continuous groove, but may be formed in the shape of multiple indentations formed in the tube either while it is being wound or after it is wound. It will be seen that this groove provides an inwardly extending projection 18 in the outer convolution and at the same time bends the inner convolution to provide a recess 19 in its surface in which the extension 18 projects. Therefore the co-action of the two gives an interlocking or keyed effect to prevent the two sliding longitudinally on each other, but does not interfere with lateral relative sliding movement of the overlapped convolutions. Therefore while these indentations prevent unwinding or separating of the convolutions by the untwisting of the tube, they do not interfere with the flexing of the tube in the usual manner. In Fig. 6 I have shown the space included between the flanges 14 and 15 as filled with a fiber packing 20, but this can be used or omitted as desired. When used it produces the so called packed tube.

In Figs. 6 and 7 this interlocking means is shown as applied to the so-called overlapped tube, but is equally applicable to the so-called interlocked type of tube, as shown in Figs. 4 and 5. In this type of tube instead of having merely the free edges of the flanges engage the surfaces of the overlapped convolutions, they are folded so as to provide portions 21 and 22 extending longitudinally of the tube which are folded over each other's edges thus providing a so-called interlocked type of tube. The convolutions are formed of a strip of metal 23 wound spirally as in the first form with the inwardly off-set portion 24 having the overlapped portion 22, while the outer portion 25 carries the interlocked portion 21, the longitudinal groove 17 however is formed the same as in the first type and provides interlocking portions on the overlapped convolutions to prevent untwisting the same as in the first form, as will be evident from an inspection of Figs. 4 and 5, the laterally projecting portions 26, 27 and 28 interlocking with corresponding grooves or recesses in adjacent walls of the convolutions. In both types the adjacent convolutions are overlapping.

It has been found in actual use that this construction effectively prevents twisting of the tubes, and therefore prevents overlapping convolutions of the tubes from separating due to this twisting operation. Furthermore, this interlocking construction can be applied without greatly increasing the cost of the tube and without materially decreasing its carrying capacity. As indicated, it is applicable to the so-called overlapped type and the interlocked type of tube, and to packed and unpacked tubes without reducing their flexibility. The tubes are applicable for carrying liquids or gases, or for electrical conduits and the like.

Having thus set forth the nature of my invention, what I claim is:

1. A circular flexible tube comprising overlapping spirally wound convolutions, and the wall of said tube being depressed to provide a longitudinal groove of substantial depth in the overlapping convolutions to secure them against sliding relative to each other in a direction peripherally of the tube.

2. A flexible tube comprising overlapping spirally wound convolutions, and a groove pressed into the overlapped convolutions from the exterior of the tube providing co-acting means on adjacent convolutions to hold them against relative sliding movement in a direction longitudinally of the convolutions.

In testimony whereof I affix my signature.

CHARLES S. HUNGERFORD.