

(No Model.)

H. WITZENMANN.
FLEXIBLE TUBE OF METAL.

No. 542,300.

Patented July 9, 1895.

Fig. 1.

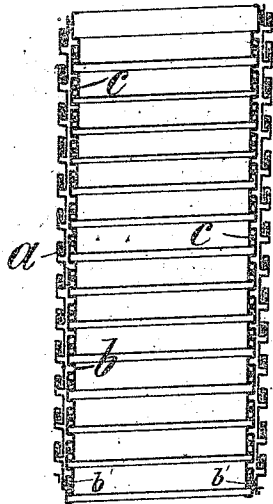


Fig. 2.

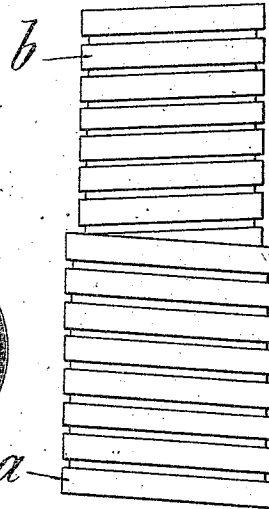
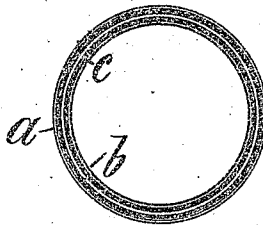


Fig. 3.



WITNESSES:

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HEINRICH WITZENMANN, OF PFORZHEIM, GERMANY.

FLEXIBLE TUBE OF METAL.

SPECIFICATION forming part of Letters Patent No. 542,300, dated July 9, 1895.

Application filed February 20, 1894. Serial No. 500,876. (No model.) Patented in Germany February 2, 1894, No. 76,745; in France February 12, 1894, No. 236,225; in Austria February 27, 1894, No. 44/547; in Hungary March 5, 1894, No. 169; in Italy May 10, 1894, No. 36,359/214, and in Switzerland May 21, 1894, No. 8,538.

To all whom it may concern:

Be it known that I, HEINRICH WITZENMANN, a subject of the Emperor of Germany, residing at Pforzheim, Germany, have invented certain new and useful Improvements in Flexible Metal Tubes, (for which I obtained Letters Patent in Germany February 2, 1894, No. 76,745; in Italy May 10, 1894, No. 36,359/214; in Switzerland May 21, 1894, No. 8,538; in France February 12, 1894, No. 236,225; in Austria February 27, 1894, No. 44/547, and in Hungary March 5, 1894, No. 169,) of which the following is a specification.

The object of my invention is to provide a flexible metal tube capable of being bent and twisted in any direction without liability to rupture or disarrangement of parts, by which leakage of the tube is or may be caused and which flexible metal tube is adapted to convey steam, gases, liquids, such as water, acids, oils, &c., or to conceal electric wires, cables, &c., and at the same time act as a flexible bracket for incandescent or other lamps.

My invention consists of a flexible metal tube composed of two spirals of channeled metal strips, fastened together at their respective ends, one spiral being wound in one direction and the other spiral in an opposite direction and one placed within the other.

The invention further consists of the improvements hereinafter more fully described, and pointed out in the claims.

My invention will be more fully understood taken in connection with the accompanying drawings, in which—

Figure 1 is a longitudinal section of my improved flexible metal tube, showing the inner and outer spirals formed of channeled metal strips or bands, and also showing a packing of any suitable material in the spiral cavities formed by the inner spiral. Fig. 2 is an elevation of the two spirals, showing the respective winding of the channeled metal bands forming the inner and outer spirals; and Fig. 3 is a cross-section of the improved tube.

Referring now to the drawings for a further description of my invention, *a* is the outer spiral wound in one direction and made from a band of metal of any desired cross-section;

but preference is given to a section by which the edge of one coil or spiral engages the edge of the adjacent coil or spiral, as, for instance, shown in Fig. 1, so that the continuous lower edge of a band interlocks with the continuous upper edge of the same band to prevent derangement of single coils of the said outer spiral. It will be observed from the drawings that the lower edge of the metal strip composing the outer spiral is bent outwardly and back upon itself, and the upper edge of said strip is bent inwardly and back upon itself so that the respective edges overlap considerably in order to allow for extension and contraction of the several or all the coils comprising the spiral when the tube is bent.

b is the inner spiral and is wound in an opposite direction to that of the outer spiral *a*, and this spiral *b* may also be formed of a metal band of any required cross-section. Good results have, however, been obtained by a metal strip of a cross-section, as shown in Fig. 1, which is in the form of two channels, one facing the inside of the tube and the other the outside, the upper flange engaging the lower channel of the next succeeding coil and vice versa, the lower channel-flange engaging the upper channel of the preceding coil of the spiral *b*. The width of the channels is so proportioned as that sufficient play of the flanges of the respective channels is provided to permit of bending the said spiral or the tube.

If desired, the channels may be made wide enough to permit the laying of a packing *c* into the spiral space *b'*, formed by the lower and upper channels of the metal strip forming the spiral *b*, to insure an absolutely-tight flexible tube and yet leave sufficient play of the channel-flanges in the respective channels to allow the bending of the spiral or tube. Such packing may be made of various materials suitable for the purpose for which the flexible tube is intended. For instance, rubber, asbestos, or a lead or other packing, which may be acid, steam, or waterproof, may be inclosed and held in the spiral space *b'*, formed by the channels of the spiral *b*.

A very important feature of my invention is that a flexible tube of my improved con-

struction may not only be bent in its axis but at the same time twisted without causing a leak in the tube, and for this purpose the respective ends of the two oppositely-wound spirals *a* and *b* are soldered or in any other manner fastened together. The fastening of the respective ends of the two spirals *a* and *b*, comprising the double flexible tube, prevents the uncoiling of one or the other spiral when the tube is twisted in one or the other direction. If, for instance, the tube is twisted in one direction, one of the spirals will be strained to uncoil, while the other will be strained to lay its coils tighter; but as a further coiling of a tightly-wound spiral is limited it is evident that the uncoiling of the other spiral and the leak attending the uncoiling of this spiral is also limited. Such leak, however, is always repaired at the instant it occurs by the spiral whose coils are tightened by the twisting of the tube.

It will be understood that modifications may be made in the construction of the tube. For instance, the cross-section of either one of the spirals, or both, may be altered, and the packing-strips of any material may be dispensed with or given a special cross-section without departing from the spirit of my invention.

Having thus described the nature and objects of my said invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A flexible tube comprising an inner and outer tube, each composed of a spirally wound metal band, the spirals of the outer tube being wound in one direction and the spirals of the inner tube in an opposite direction, said inner and outer tubes being fastened together at their respective ends, substantially as and for the purposes set forth.

2. A flexible tube comprising an inner and an outer tube, each composed of a spirally wound metal band having recessed edges, the spirals of the outer tube being wound in one direction and the spirals of the inner tube in an opposite direction said inner and outer tubes fastened together at their respective

ends, substantially as and for the purposes set forth.

3. A flexible tube comprising two spirals one within the other and fastened together at their respective ends, each spiral formed of a continuous metal band, the inner spiral being wound in one direction and the outer spiral in an opposite direction and a packing strip applied to the coils of the inner spiral, substantially as and for the purposes set forth.

4. A flexible tube comprising two spirals one within the other and fastened together at their respective ends, the inner spiral formed of a continuous metal band having a cross-section of two inversely disposed channels, and being wound in one direction, the outer spiral formed also of a continuous metal band, whose cross-section also forms two inversely disposed channels the outer flanges of which are bent so that they interlock one with another when coiled, said outer spiral being wound in an opposite direction to that of the inner spiral, substantially as and for the purposes set forth.

5. A flexible tube comprising two spirals one within the other and fastened together at their respective ends, the said spirals formed of channeled continuous metal bands, one spiral being wound in one direction and the other in an opposite direction, substantially as and for the purposes set forth.

6. A flexible tube comprising two spirals one within the other and fastened together at their respective ends, the said spirals formed of channeled continuous metal bands, the upper flange of one coil of one of the spirals interlocking with the lower channeled portion of the adjacent coil of the same spiral, substantially as and for the purposes set forth.

Signed at Mannheim, in the Grand Duchy of Baden, Germany, this 30th day of January, 1894.

HEINRICH WITZENMANN.

Witnesses:

A. B. BEYRENTHER,
BENEDIKT GOLDFINGER.