June 11, 1946. T. MARINER 2,401,949

FLEXIBLE TUBE

Filed Sept. 2, 1944

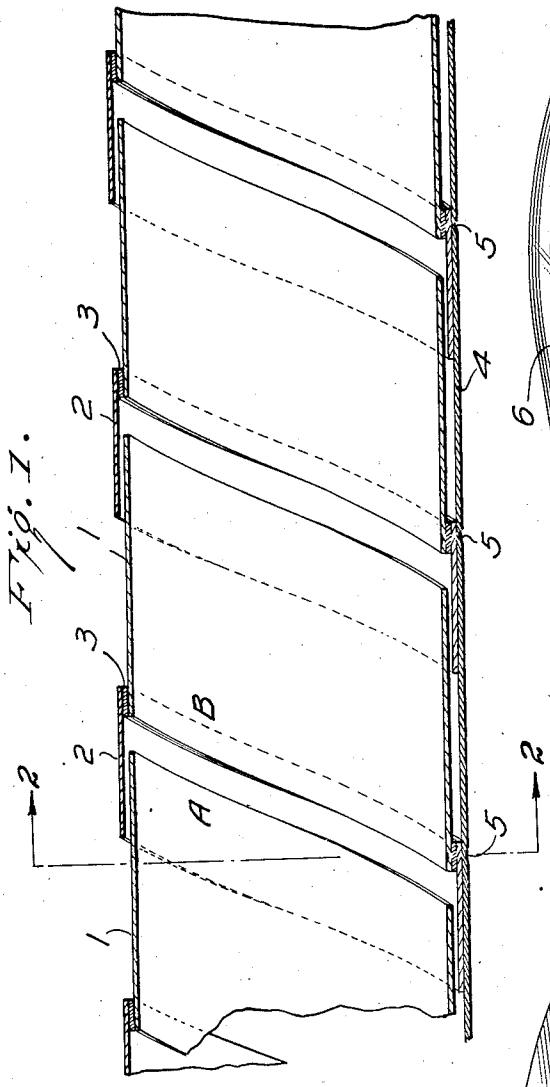



Fig. 1.

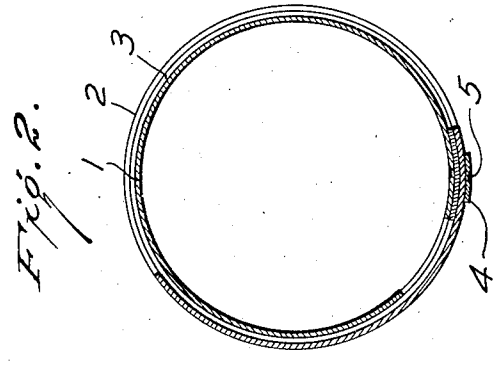



Fig. 2.

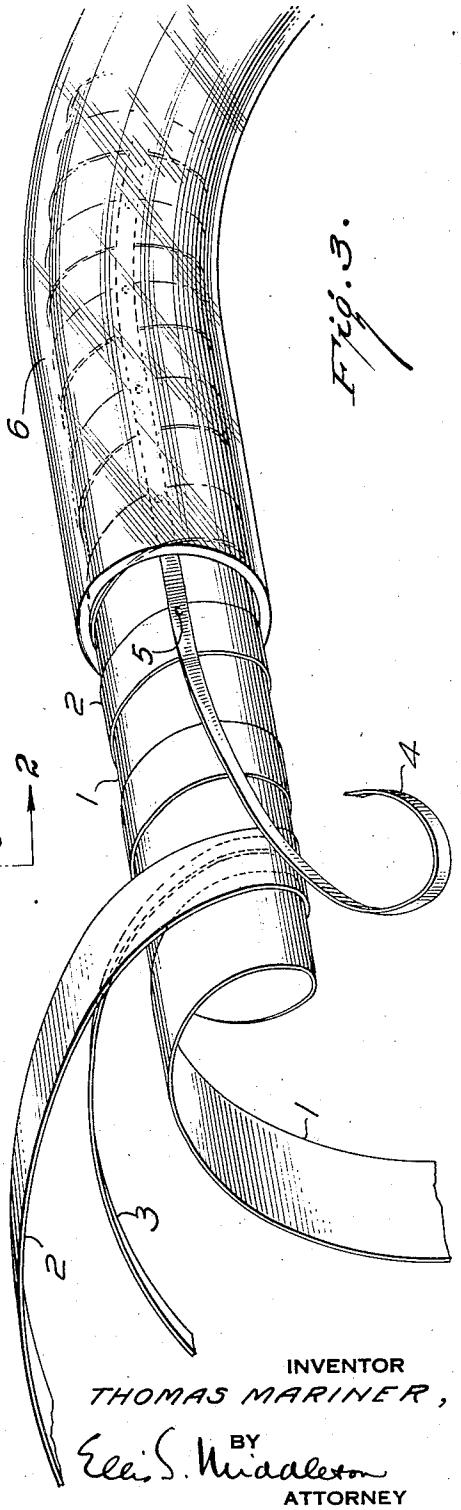



Fig. 3.

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Patented June 11, 1946

2,401,949

# UNITED STATES PATENT OFFICE

2,401,949

## FLEXIBLE TUBE

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Application September 2, 1944, Serial No. 552,500

6 Claims. (Cl. 138—59)

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The present invention relates to a flexible multi-part tube.

The principal object of the invention is to provide a tube of the above type which may be readily manufactured from strips so as to minimize cutting, which will flex easily without binding of one part on another, which will retain its parts in their desired relationship and which has openings therein for ventilation or other purposes.

Tubes of the above type have many uses such as for incasing electrical wires, protecting sheaths for Bowdin control wires and the like. While the tubes of the present invention are useful for any of the above purposes, they are designed primarily for lining of planar tubes in mass-spectrograph mechanisms where electrostatic shielding is desired. Such tubes are usually bent and it has been the custom heretofore to produce a metallic shielding on the interior thereof as by plating or evaporation of metallic materials thereon. These methods heretofore used are not entirely satisfactory due to the fact that the coating is thin, uniform adhesion throughout the tube area cannot be obtained and where subjected to heat and vacuum as in the case of planar tubes of mass-spectrographs is readily subject to deterioration and requires frequent renewal.

To this end the invention comprises a flexible multi-part tube including a main spiral formed of a metallic strip and formed into convolutions, the edges of which are spaced apart any desired distance. An overlap spiral formed of a metallic strip and similarly convoluted overlies the adjacent edges of two convolutions of the main spiral so as to cover the spaces between them with a shim spiral between the main and overlay spirals spacing the former from the latter. An elongated constraining strip is secured to the outside of the tube preferably to the overlaying spiral and conveniently as by spot welding at intervals so as to secure together at one area the constraining strip, the overlay spiral, the shim spiral and the main spiral. Where such tubes are to be used as shielding liners for planar tubes of mass spectrographs, the present invention should be made of a material suitable for the purpose such as Nichrome V.

The invention further consists of the novel combination, arrangement and construction of parts more fully hereinafter described and shown in the accompanying drawing in which:

Fig. 1 is a sectional view of a tube constructed according to the present invention;

Fig. 2 is a sectional view along the lines 2—2 in Fig. 1, and;

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Fig. 3 is a perspective view of the tube of Fig. 1 partially inserted into and serving as a liner for a glass planar tube of a mass-spectrograph and showing the method of a construction of the spirally formed tube of the present invention.

Referring now with particularity to the embodiment illustrated, there is shown at 1 a thin metallic strip bent spirally so as to form a series of convolutions of which A and B are typical with the adjacent edges of two contiguous convolutions spaced apart.

Outside of the main spiral 1 is an overlay spiral 2 covering the space between convolutions A and B of the main spiral 1 and spaced from the latter as by shim spiral 3. The thickness of the shim 3 will be determined by the clearance desired between the main portion of the overlay spiral 2 and the main spiral 1.

An elongated constraining strip 4 is provided, secured at spaced intervals to the outside of the composite tube. This may conveniently be done as by spot welding 5 to one edge portion of the overlay spiral 3. Inasmuch as the shim 3 must be secured between the edges of the main spiral 1 and the overlay spiral 2, it is convenient for the spot welding operation to be of such extent to secure all four of the parts together at any desirable interval.

An inspection of Fig. 1 will show that a tube so constructed is readily flexible in all directions inasmuch as each convolution of the main spiral 1 is permitted to flex freely within the overlay spiral 2 while the parts are retained in their desired relationship and against accidental displacement through the instrumentality of the restraining strip 4.

Due to the extreme flexibility of the construction, it may serve admirably as an electrostatic shielding liner of the bent planar tube of a mass-spectrograph illustrated diagrammatically at 6 in Fig. 3. In such case the composite metallic tube should be of a comparatively thin material say about .005 inch thick or less and made of some such desirable material as Nichrome V. When so used, the flexible tube may be readily put in position or removed as a single unit for cleaning as is frequently necessary.

When used as a casing for electrical wires, Bowdin controls or wires of other types, the composite tube may be made of any desired material commensurate with the strength desired.

In many instances where such a tube is used to incase wires, it is desirable to provide a certain degree of ventilation so as to prevent the condensation of moisture therein. It will be seen

that inasmuch as the main and overlay spirals are definitely spaced apart, this advantageous result is readily accomplished.

Where a composite tube is used to incase a bare electric wire, the strips of which the tube is made may be of insulating material, say, made of a di-electric such as synthetic resins or the like.

While the invention has been described with particular reference to specific embodiments, yet it is to be understood that the invention is not to be limited thereto, but is to be construed broadly and restricted solely by the scope of the appended claims.

What is claimed:

1. A flexible multi-part tube including a main spiral formed of a strip of material the edges of which are spaced apart, an overlay spiral formed of a strip of material overlapping portions of two convolutions of the main spiral and covering the space between their adjacent edges, a shim spiral formed of a strip of material secured between the main and overlay spirals, and an elongated constraining strip secured to the outside of the overlay spiral.



2. The tube of claim 1 in which the constraining strip, the overlay, shim and main spiral strips are secured together at a common area.

3. The tube of claim 1 in which the shim spiral is adjacent one edge of the main spiral.

4. The tube of claim 1 in which the larger portions of the overlay spiral is spaced from the outside of the main spiral.

5. The tube of claim 1 in which all parts are of thin metallic strips.

6. In combination a bent glass planar tube of mass-spectrograph, an electrostatic shielding tube therein comprising a flexible multi-part tube including a main spiral, an overlay spiral formed wih a strip of material overlapping portions of two convolutions of the main spiral and covering the space between their adjacent edges, a shim spiral formed of a strip of material secured between the main and overlay spirals, and an elongated constraining strip secured to the outside of the overlay spiral, the main spiral and the overlay spiral being Nichrome V.

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