May 28, 1929. H. SCHLAICH 1,714,989

METHOD OF MAKING BOURDON TUBES

Original Filed July 15, 1924

Fig. 1.



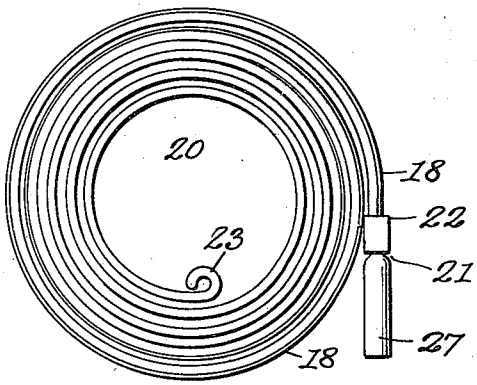


Fig. 2.

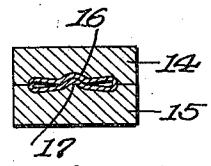


Fig. 5.

Fig. 3.

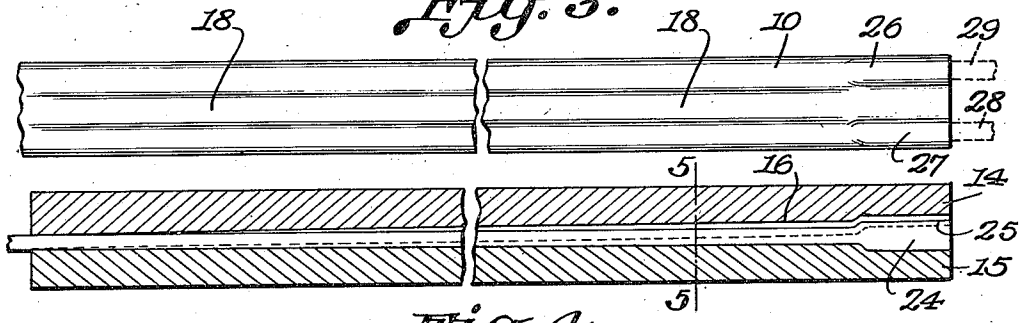


Fig. 4.

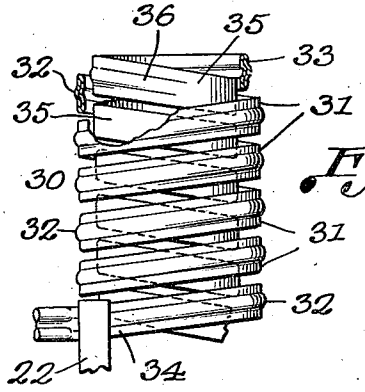


Fig. 6.

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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING BOURDON TUBES.

Original application filed July 15, 1924, Serial No. 726,231, and in Germany March 12, 1925. Divided and this application filed May 2, 1927. Serial No. 188,318.

This invention relates to the manufacture of pressure responsive instruments, and more particularly to a method of making a Bourdon tube of the type, for example, disclosed in my pending application Serial No. 726,231, filed July 15, 1924, for Bourdon tubes. The present application is a division of said pending application.

Certain instruments, such, for example, as distance type thermometers, utilize a Bourdon tube to actuate an indicator in response to the variations of pressure produced by the expansion and contraction of an expansible liquid in a remotely located bulb.

In order to obtain a wide, open, uniform scale and accurate and dependable readings, it has been found necessary to eliminate as many parts which might contribute errors—as by lost motion—as possible. This has resulted in the use of a longer pressure responsive element which has been wound into such forms as a double helix having inner and outer coils or a spiral coil. These forms of pressure responsive element have parts at different diameters. Inasmuch as the flexibility of the Bourdon tube is a function of the radius of curvature, it is not uniform throughout the length of the coil. I have found that this lack of uniformity is quite appreciable and that it results in compelling the outer coils to assume more than their share of the distortion due to pressure changes. The inner coils, on account of the stiffness inherent in the smaller diameter of coil, operate at a much reduced efficiency.

The invention of my co-pending application has to do with the provision of a Bourdon coil having stiffening means in the parts of larger radius so that the inner parts may be rendered more efficient for the intended purpose.

The present invention has to do with the method whereby a Bourdon coil of this character is produced.

In the accompanying drawings, two forms of Bourdon coils made in accordance with the present method are illustrated in detail, and the steps whereby such Bourdon coils are produced are illustrated.

In the drawings forming a part of this specification:

Fig. 1 is a cross section of a flat piece of tubing suitable for making into a Bourdon tube;

Fig. 2 shows a spiral coil made up in accordance with the present invention;

Fig. 3 shows the end of the tubing shaped to form the outer part of the coil;

Fig. 4 is a longitudinal section through suitable dies showing the formation of the part shown in Fig. 3;

Fig. 5 is a cross section on the line 5—5 of Fig. 4; and

Fig. 6 illustrates a double helical coil to which the present invention has been applied.

In making up pressure responsive elements in accordance with the present invention one may utilize a flattened tube of the proper material and size for the particular instrument in which the Bourdon tube is to be used. A cross-section of such a flattened tube is illustrated at 10 in Fig. 1, where it will be noted that the flattened tube is opened slightly at 11 and 12.

It has heretofore been the practice to wind such flattened tubing directly into the coil, but the present invention contemplates an intermediate step which is illustrated in Figs. 4 and 5. One end of the flattened tubing is placed between a pair of cooperative dies 14 and 15 one of which is provided with a longitudinal depression 16 which is opposite a longitudinal rib 17 on the other die. When pressure is applied to the dies, a longitudinal rib is produced in the end portion of the strip of flattened tubing. Such a ridge is shown at 18. Where the strip of tubing is to be used in making a spiral coil (such as shown in Fig. 2) I prefer to gradually taper the depression 16 and rib 17 in the dies, as more clearly shown in Fig. 4, so as to produce a tapering longitudinal rib or ridge along the tubing.

The proper length of tubing is then wound into a coil 20 of the predetermined diameter. Such a coil is illustrated in Fig. 2. Here the outer end 21 of the coil is mounted in a fixed support 22 while the inner end 23 is adapted for connection with an indicating hand, not shown. The tapering ridge or rib 18 extends from the support around the outer convolutions of the coil, thereby rendering these convolutions somewhat more rigid than the inner ones. When the rib is made taper-

ing the rigidity of the convolutions varies inversely with the distance from the outer or supported end of the complete coil.

I have found that coils made up as above described provide a very open and uniform scale, and that all parts of the coil may be made to function in the intended manner by varying the stiffness by means of the rib or ridge which is formed in the tubing before the tubing is wound into the coil.

If desired, one may provide the dies 14 and 15 with opposed depressions 24 and 25 and, in conjunction with other dies (not shown), form enlargements 26 and 27 having enlarged openings therein which are adapted to receive the pressure tubing 28 and the sealing tube 29.

Fig. 6 shows a double helical coil form of pressure responsive element 30. In making up such a coil according to the present invention, one provides the length of strip which is to go into the outer convolutions 31 with a long ridge or rib 32 which extends from the end convolution 33 down to the other end 34 of the coil where it is suitably supported in the instrument. The end convolution is spirally wound and has a decreasing diameter to reach to the inner convolutions 35. This convolution is preferably provided with a rib 36 of varying height so that there will be a gradual variation in the rigidity of this convolution as its radius of curvature changes. In this form of coil one may, however, omit the tapering feature in the end coil 33 and rely upon the difference in rigidity in the inner and outer coils which would be produced by uniform ridge or rib 32.

It is obvious that the invention may be practiced with reference to may forms and constructions, and I wish it to be understood that the particular forms shown are but a few of the many forms. Various modifications and changes being possible, I do not limit myself in any way with respect thereto, except as indicated in the following claims.

I claim:

1. The method of making a Bourdon tube which comprises providing a flattened tube, forming a longitudinal rib extending from one end of the flattened tube part way to the other end, and winding the flattened tube into a coil with the rib portion in the outer convolutions of the coil.

2. The method of making a Bourdon tube which comprises providing a flattened tube, forming a longitudinal rib extending from one end of the flattened tube toward the other end, the height of the rib varying inversely as the distance from said first end, and winding the flattened tube into a coil with the highest rib portion in the outer convolutions of the coil.

3. The method of making a Bourdon tube which comprises providing a flattened tube, forming a longitudinal rib extending from one end of the flattened tube part way to the other end, and winding the flattened tube into a coil with the rib portion in the outer convolutions of the coil, the rib being outwardly disposed on the outer convolutions.

4. The method of making a Bourdon tube which comprises providing a flattened tube, forming in both sides thereof a centrally disposed longitudinal stiffening rib extending from one end of the flattened tube part way to the other end, and winding said tube into a coil with said other end at the inside of the coil so as to bring the ribbed portion to the outside of the coil.

5. The method of making a Bourdon tube which comprises providing a flattened tube, simultaneously forming in both sides of the flattened tube centrally disposed longitudinal stiffening ribs extending from one end of the flattened tube toward the other end, the heights of the ribs varying inversely as the distance from said first end, and winding said tube into a coil with said other end at the inside of the coil so as to bring the highest ribbed portion to the outside of the coil.

6. The method of making a Boudon coil, which comprises providing a straight, flattened, metallic tube, stamping, a stiffening rib of gradually diminishing height in said tube at a single operation, and forming the tube into a coil of variable diameter with the portion including the highest part of the rib at the outside of the coil.

In testimony whereof I have affixed my signature to this specification.

HERMAN SCHLAICH.