July 12, 1960 B. P. COLEMAN 2,944,337

METHOD OF FORMING FLEXIBLE TUBING

Filed Feb. 18, 1955 3 Sheets-Sheet 1

Fig. 1.

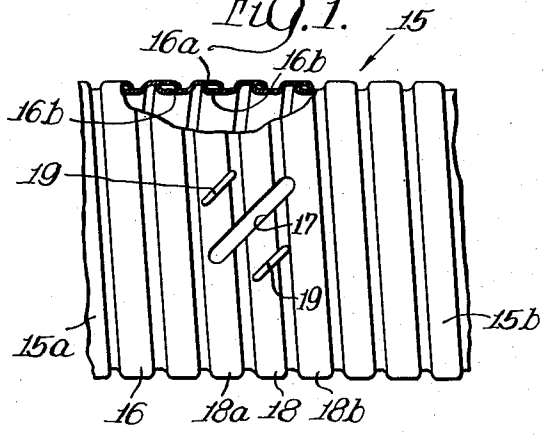


Fig. 2.

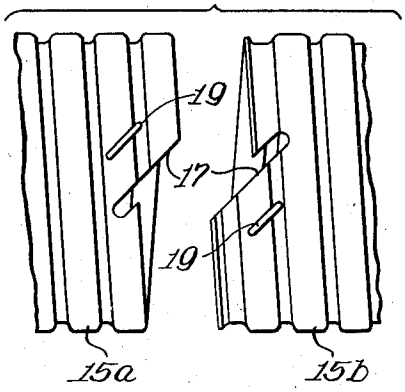


Fig. 4.

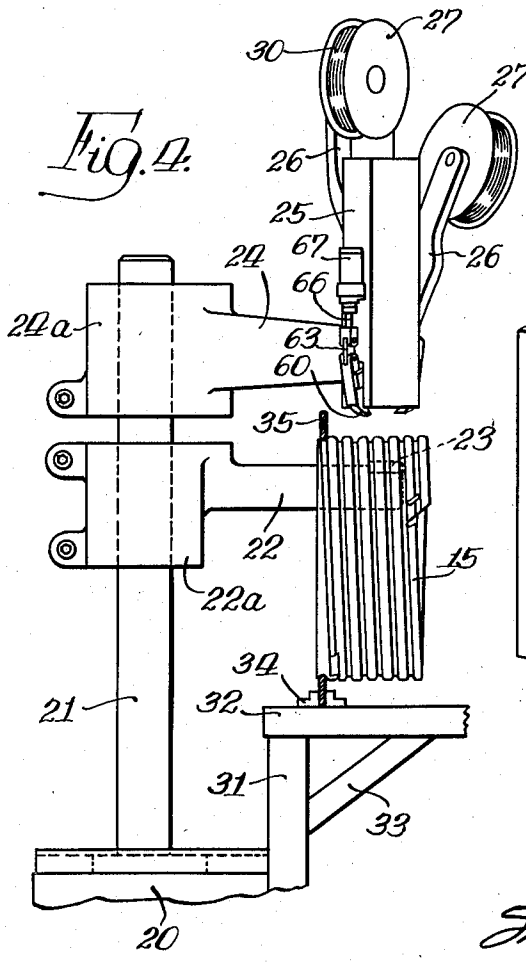
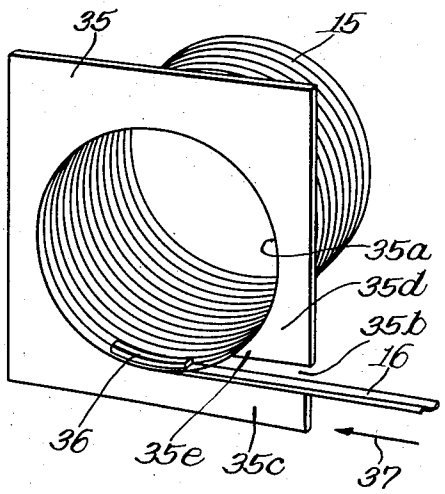


Fig. 3.



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Filed Feb. 18, 1955 3 Sheets-Sheet 2

Fig. 5.

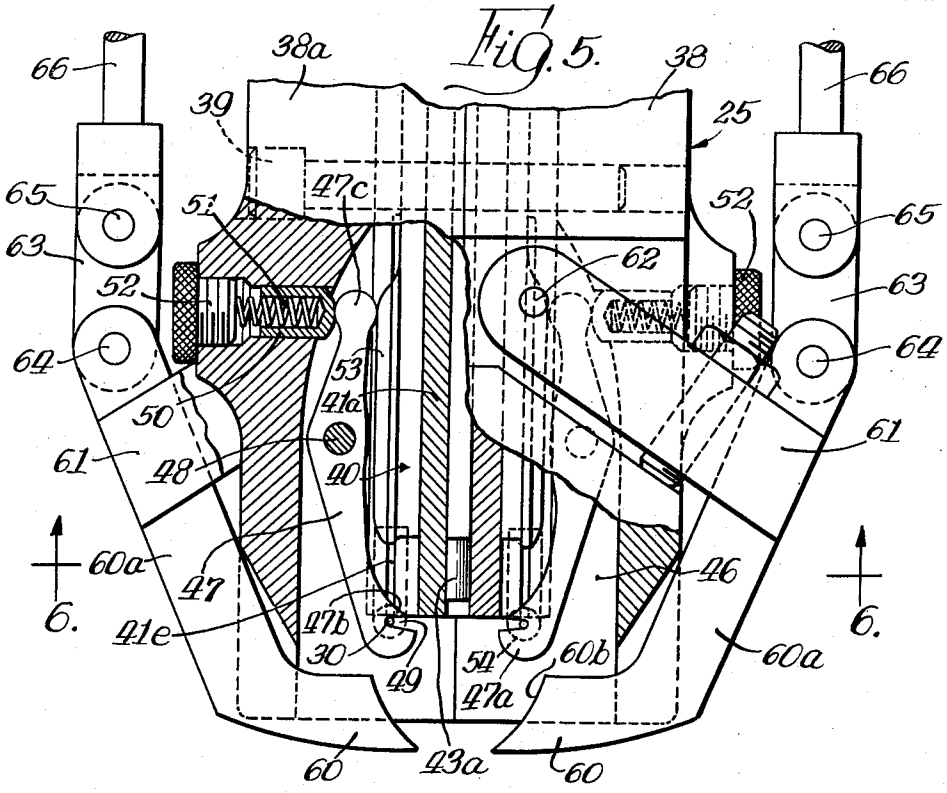


Fig. 6.

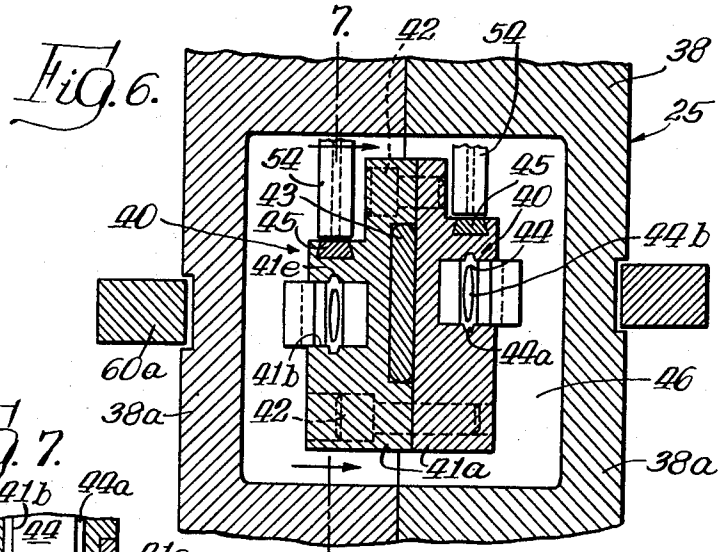
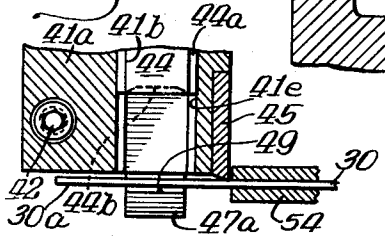


Fig. 7.



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Filed Feb. 18, 1955 3 Sheets-Sheet 3

Fig. 8.

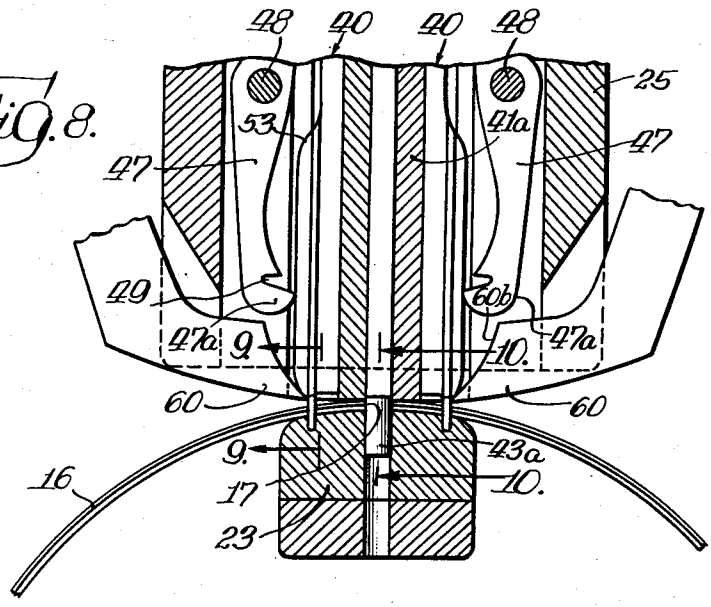


Fig. 9.

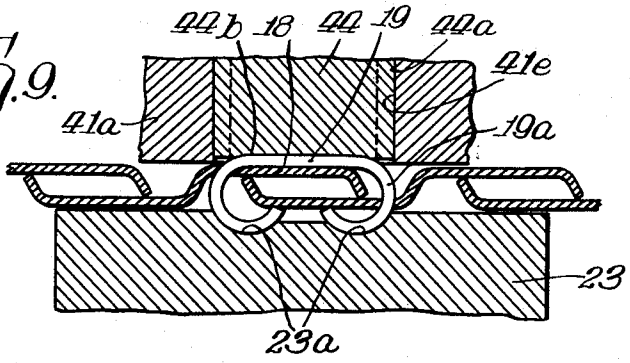
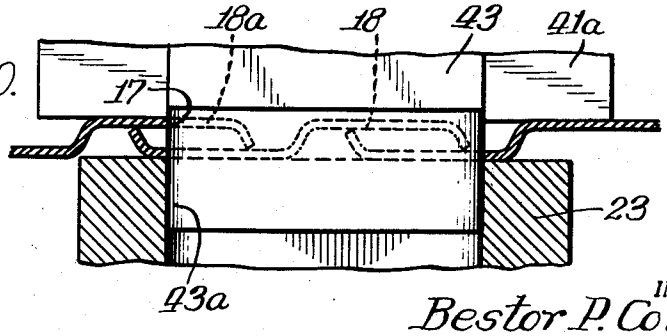


Fig. 10.



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METHOD OF FORMING FLEXIBLE TUBING

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10 Claims. (Cl. 29—417)

This invention relates to improvements in flexible tubing and its purpose is to provide a novel method of severing flexible tubing to form sections of the required lengths and then fastening the cut ends.

Flexible tubing formed of galvanized steel strips wound in helical fashion is now in use for a variety of purposes including uses as air ducts in heating systems and the like, and it is necessary to cut the tubing to form sections of various lengths. When the tubing is cut the steel strip of which it is formed tends to unwind due to the resilience of the metal so that the ends of the cut lengths are unsatisfactory for use. So far as is known, no suitable means for overcoming this difficulty has heretofore been devised.

The principal object of the present invention is to provide an improved method and means for severing the tube by cutting a convolution of the metal strip and stitching the cut ends of this convolution to adjacent portions of the tube. A further object is to provide a method according to which the flexible tubing is severed by cutting it transversely to a convolution of the helical winding and then uniting the cut ends to adjacent convolutions by stitching or other fastening means which is diagonally arranged so that it acts to resist the tendency of the cut end to uncoil itself due to its own resiliency. Another object is to provide a helically wound metal tube having its ends secured in a novel manner. Other objects relate to various features of the improved method and tubing which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one example of the invention is illustrated. In the drawings,

Figure 1 shows a side elevation of a section of flexible tubing formed according to the present invention with parts thereof cut away, illustrating the method of cutting a convolution of the tubing and showing two wire stitches by which the end portions of the tubing on opposite sides of the cut are united with adjacent convolutions;

Fig. 2 shows a side elevation of the portions of tubing illustrated in Fig. 1 after they have been separated by relative rotation of the two sections;

Fig. 3 shows a perspective view of a portion of the tubing illustrated in Fig. 1 before it has been cut or stitched, illustrating one method of winding a flexible metal strip to form a helically wound tube;

Fig. 4 shows a side elevation of one form of machine which may be used in forming the tubing illustrated in Fig. 1 with the use of the forming die which is illustrated in Fig. 3;

Fig. 5 shows an enlarged side elevation of and partial vertical section through the stitching mechanism which is embodied in the machine shown in Fig. 4;

Fig. 6 shows a horizontal section taken on the line 6—6 of Fig. 5;

Fig. 7 shows a vertical section taken on the line 7—7 of Fig. 6;

Fig. 8 is a view similar to that of Fig. 5 showing the relative positions of the parts during the driving of the staples;

Fig. 9 shows an enlarged vertical section taken on the line 9—9 of Fig. 8; and

Fig. 10 shows an enlarged vertical section taken on the line 10—10 of Fig. 8.

As illustrated in Figs. 1 and 2 of the drawings the flexible tubing 15 of the present invention is made up of a series of convolutions of a metal strip 16 which has a flattened S-shaped cross section. This metal strip is wound in helical fashion so that the outwardly projecting portion 16*a* at one edge of the strip interlocks with the underlying edge portion 16*b* at the other edge of the strip in an adjacent convolution of the winding. The strip 16 is formed preferably of galvanized steel having considerable resiliency so that the convolutions of the tube have a natural tendency to unwind in an outward direction, thus maintaining a tight connection between adjacent convolutions of the strip while permitting some relative endwise and angular movement of adjacent convolutions so that the tubing is flexible and may be caused to occupy a variety of positions as required by the use to which it is put.

The present invention involves a novel method of severing the tubing 15 into sections of the desired length, while at the same time fastening the ends of the sections at the place where the cutting occurs so that the unwinding of the convolutions at the ends of the sections is prevented. For this purpose, the tubing is cut at one place around its periphery in order to sever one of the convolutions and this is preferably done by punching a portion of the metal out of the convolution along a diagonal line to form an elongated hole 17. This hole extends at an angle to the longitudinal axis of the tube 15 and is of such length that it extends beyond the convolution 18 which is severed and projects into adjacent convolutions 18*a* and 18*b*. Before punching the hole 17 to cut the convolution 18, or simultaneously with the operation of punching the hole 17, the convolution 18 is stitched to the adjacent convolutions 18*a* and 18*b* by elongated wire stitches 19 which are located on opposite sides of the place where the hole 17 is to be formed and parallel to the longitudinal axis of this hole. Thus, when the hole 17 is punched through the convolution 18 and partially through the adjacent convlutions 18*a* and 18*b*, the ends of the convolutions 18 on opposite sides of the hole 17 are secured to the adjacent convolutions 18*a* and 18*b* by the stitches 19. When the stitching and punching operations have been completed, the two sections 15*a* and 15*b* of the tubing may be rotated with respect each other about their longitudinal axes, thus causing the convolutions on opposite sides of the hole 17 to be unscrewed from each other so that the interlocking connection between the sections 15*a* and 15*b* is broken and these two sections are then separated as shown in Fig. 2. Although it is preferable to form the stitches 19 before or simultaneously with the operation of punching the hole 17, the hole 17 may be punched first, provided the two sections 15*a* and 15*b* are not separated prior to the formation of the stitches, because each convolution interlocks with the edge of an adjacent convolution and this interlocking connection holds them together.

When the convolution 18 to be severed is stitched to the adjoining convolutions, the staples 19 are clinched on the inside of the tubing 15 against a suitable anvil and a supporting anvil may be located on the inside of the tube to permit a portion of the metal to be punched out to form the hole 17 simultaneously with the act of forming the stitches 19 or immediately following the stitching operation.

The cutting of the convolution 18 of the tubing and the driving of the staples 19 may be performed manually

As the downward movement of the former 40 continues, the ends of the sections 30*a* of the stitching wire which project on opposite sides of the anvil 47*a* are bent downwardly to form the legs of the staples. These downwardly bent portions of the stapling wire then travel in grooves 41*e* which are formed in the sides of the members 41*a* within the slots in which the driving members 40 are adapted to travel. As the formation of the staples is completed, the former 40 will have reached a stage of its downward movement where the portions 47*c* of the members 47 ride inwardly over the cams 53 under the influence of the spring actuated plungers 50 so that they are then retracted to positions such as those shown in Fig. 8. The driving of the staples through the tubing 15 is then effected by the downward movement of the driving members 44 and, during this operation, the staples are supported on their lateral sides by means of the supporting shoes 60 which are carried by arms 60*a* supported on the bars 61 which are pivoted at 62 on the casing 38. The supporting shoes 60 are thus adapted to swing about the pivot 62 to and from staple supporting positions and this movement is effected by a mechanism including links 63 pivotally connected at 64 to the upper ends of the arms 60*a* and pivotally connected at 65 to a piston rod 66 extending downwardly from cylinders 67 in which pistons are operated by spring pressure, compressed air, or the like, in order to cause the staple supporting members 60 to occupy their innermost positions wherein they are adapted to extend between the legs of the staples and to support these legs as the staples are driven by the members 44. As the driving of the staples nears completion, the outwardly and upwardly inclined faces 60*b* on the shoes 60 are engaged by the lower outer edges of the former 40 and these shoes are thereby cammed out of position until they occupy the retracted positions shown in Fig. 8. As the staples are driven the legs thereof are extended through the convolutions of the tubing 15 so that each staple 19 occupies the position shown in Fig. 9 with the top wall of the staple resting against the outer face of the convolution 18 of the tubing and with the legs 19*a* of the staple extending through the convolutions and clinched on the inner side of the tubing. This clinching is effected by the die 23 which is provided on its upper face with curved guide surfaces 23*a* adapted to engage the ends of the legs 19*a* of the staple and to curve them inwardly as the staple is approaching the end of the driving operation.

At the same time that the stapling of the convolutions of the tubing is performed by the downward movement of the staple drivers 44, the punch 43 is moved downwardly and it is actuated to form the hole 17 in the tubing at the same time, or immediately after, the completion of the formation of the stitches 19 as shown in Fig. 9. When the hole 17 and the stitches 19 have been completed in the manner just described the staple former 40 and the other parts are retracted in readiness for a new operation and the section 15*b* of the tubing which has been severed is removed by relative rotation with respect to that portion of the tubing which is still in engagement with the die plate 35. The formation of an additional length of tubing by pushing the metal strip 16 in the direction of the arrow 37, through the use of suitable power driven feeding mechanism, is then continued until a new length of tubing of the desired extent has been formed.

The machine described above for carrying out the operation of cutting the flexible metal tubing and fastening the ends thereof does not in itself constitute a part of the present invention but will be made the subject matter of a copending application.

It will be observed that the present invention has the advantage of providing means for severing the helically wound tube by cutting a single convolution thereof and for uniting the ends of the tubing on opposite sides of the cut with adjacent convolutions of the tubing so that the tightly wound condition of the tubing is maintained even at those points which are in proximity to the place where the cut has been made. In this connection it is important to locate the stitches 19 so that they extend in diagonal directions with respect to the longitudinal axis of the tubing and do not permit any substantial pivotal movement which might allow an outward deflection of the extremities of the convolutions in proximity to the place where the cut has been made. To accomplish these results it is desirable that the punch by which the hole 17 is formed and the staples 19 be located in parallel planes which are diagonal to a plane containing the longitudinal axis of the tubing.

Although one form of the improved tubing and one method of forming this tubing have been illustrated and described, it will be understood that the invention may take various forms and be practiced in various ways without departing from the scope of the appended claims.

I claim:

1. The method of severing metal tubing formed by a helical winding of a metal strip so as to provide separate lengths of the tubing which comprises the steps of cutting a convolution of the winding transversely, and securing the respective cut ends of the said convolution to next adjacent unsevered parts of the tube by stitches extending parallel to the plane of the cut.

2. The method of severing metal tubing formed by a helical winding of a resilient metal strip so as to provide separate lengths of the tubing which comprises the steps of cutting a convolution transversely and diagonally to the longitudinal axis of the tube, and securing the respective severed ends of said convolution to next adjacent unsevered convolutions by elongated stitches extending parallel to the plane of the cut.

3. The method of severing metal tubing formed by a helical winding of a resilient metal strip so as to provide separate lengths of the tubing which comprises the steps of punching an elongated hole through the tube to sever one convolution thereof, and securing the respective severed ends of said convolution to next adjacent unsevered convolutions by elongated wire stitches extending parallel to said hole on opposite sides thereof.

4. The method of severing metal tubing formed by a helical winding of a resilient metal strip so as to provide separate lengths of the tubing which comprises the steps of punching an elongated hole through the tube at an angle to the longitudinal axis of the tube to sever one convolution thereof, and securing the respective severed ends of said convolution to next adjacent unsevered convolutions on opposite sides of said hole by stitches extending parallel to said hole.

5. The method of forming separate predetermined lengths of helical tubing, comprising the steps of forming a first predetermined length of said tubing and a connected portion only of a second length of said tubing by helically and progressively winding a continuous metal strip, separating said first predetermined length of tubing from said portion of said second predetermined length by severing transversely one of the convolutions of said metal strip at the junction of said lengths, stitching one severed end of the severed convolution to the next adjacent convolution of the metal strip in said first predetermined length, stitching the other severed end of said severed convolution to the next adjacent convolution in said portion of said second predetermined length, and then forming the remainder of said second predetermined length of tubing by resuming said helical and progressive winding of said strip.

6. The method of forming separate predetermined lengths of helical tubing, comprising the steps of forming a first predetermined length of said tubing and a connected portion only of a second length of said tubing by helically and progressively winding a continuous metal strip, separating said first predetermined length of tubing

from said portion of said second predetermined length by cutting transversely one of the convolutions of said metal strip at the junction of said lengths, stitching one of the cut ends of the severed convolution to the next adjacent convolution of the metal strip in said first predetermined length by a stitch extending substantially parallel to the plane of the cut, stitching the other cut end of said severed convolution to the next adjacent convolution in said portion of said second predetermined length by another stitch extending substantially parallel to the plane of the cut, and then forming the remainder of said second predetermined length of tubing by resuming said helical and progressive winding of said strip.

7. The method of forming separate predetermined lengths of helical tubing, comprising the steps of forming a first predetermined length of said tubing and a connected portion only of a second length of said tubing by helically and progressively winding a continuous metal strip, separating said first predetermined length of tubing from said portion of said second predetermined length by transversely cutting one of the convolutions of said metal strip at the junction of said lengths along a plane disposed diagonally with respect to the axis of the tubing, stitching one of the cut ends of the severed convolution to the next adjacent convolution of the metal strip in said first predetermined length by a stitch extending substantially parallel to the plane of the cut, stitching the other cut end of said severed convolution to the next adjacent convolution in said portion of said second predetermined length by another stitch extending substantially parallel to the plane of the cut, and then forming the remainder of said second predetermined length of tubing by resuming said helical and progressive winding of said strip.

8. The method of forming separate predetermined lengths of helical tubing, comprising the steps of forming a first predetermined length of said tubing and a connected portion only of a second length of said tubing by helically and progressively winding a continuous metal strip, separating said first predetermined length of tubing from said portion of said second predetermined length by punching an elongated hole through the tubing at the junction of said lengths to sever one convolution of said strip at said junction, stitching one severed end of the severed convolution to the next adjacent convolution of the metal strip in said first predetermined length, stitching the other severed end of said severed convolution to the next adjacent convolution in said portion of said second predetermined length, and then forming the remainder of said second predetermined length of tubing by resuming said helical and progressive winding of said strip.

9. The method of forming separate predetermined lengths of helical tubing, comprising the steps of forming a first predetermined length of said tubing and a connected portion only of a second length of said tubing by helically and progressively winding a continuous metal strip, separating said first predetermined length of tubing from said portion of said second predetermined length by punching an elongated hole through the tubing at the junction of said lengths to sever one convolution of said strip at said junction, securing one severed end of the severed convolution to the next adjacent convolution of metal strip in said first predetermined length by an elongated wire stitch extending substantially parallel to said hole and along one side thereof, securing the other severed end of the severed convolution to the next adjacent convolution in said portion of said second predetermined length by another elongated wire stitch extending substantially parallel to said hole and along the other side thereof, and then forming the reminder of said second predetermined length of tubing by resuming said helical and progressive winding of said strip.

10. The method of forming separate predetermined lengths of resilient metal helical tubing, comprising the steps of forming a first predetermined length of said tubing and a portion only of a second predetermined length connected to said first length by progressively winding in helical form a continuous strip of resilient metal, separating said first predetermined length of tubing from said portion of said second predetermined length by punching an elongated hole through the tubing at an angle to the longitudinal axis of the tubing and at the junction of said lengths to sever one of the convolutions of said strip at said junction, securing one severed end of the severed convolution to the next adjacent convolution of the metal strip in said first predetermined length by an elongated wire stitch extending substantially parallel to said hole and along one side thereof, securing the other severed end of the severed convolution to the next adjacent convolution in said portion of said second predetermined length by another elongated wire stitch extending substantially parallel to said hole and along the other side thereof, and then forming the remainder of said second predetermined length of tubing by resuming said helical and progressive winding of said strip.

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