Oct. 10, 1961 F. J. FULLER 3,003,525

WIRE WINDING APPARATUS

Filed Oct. 12, 1956 5 Sheets-Sheet 1

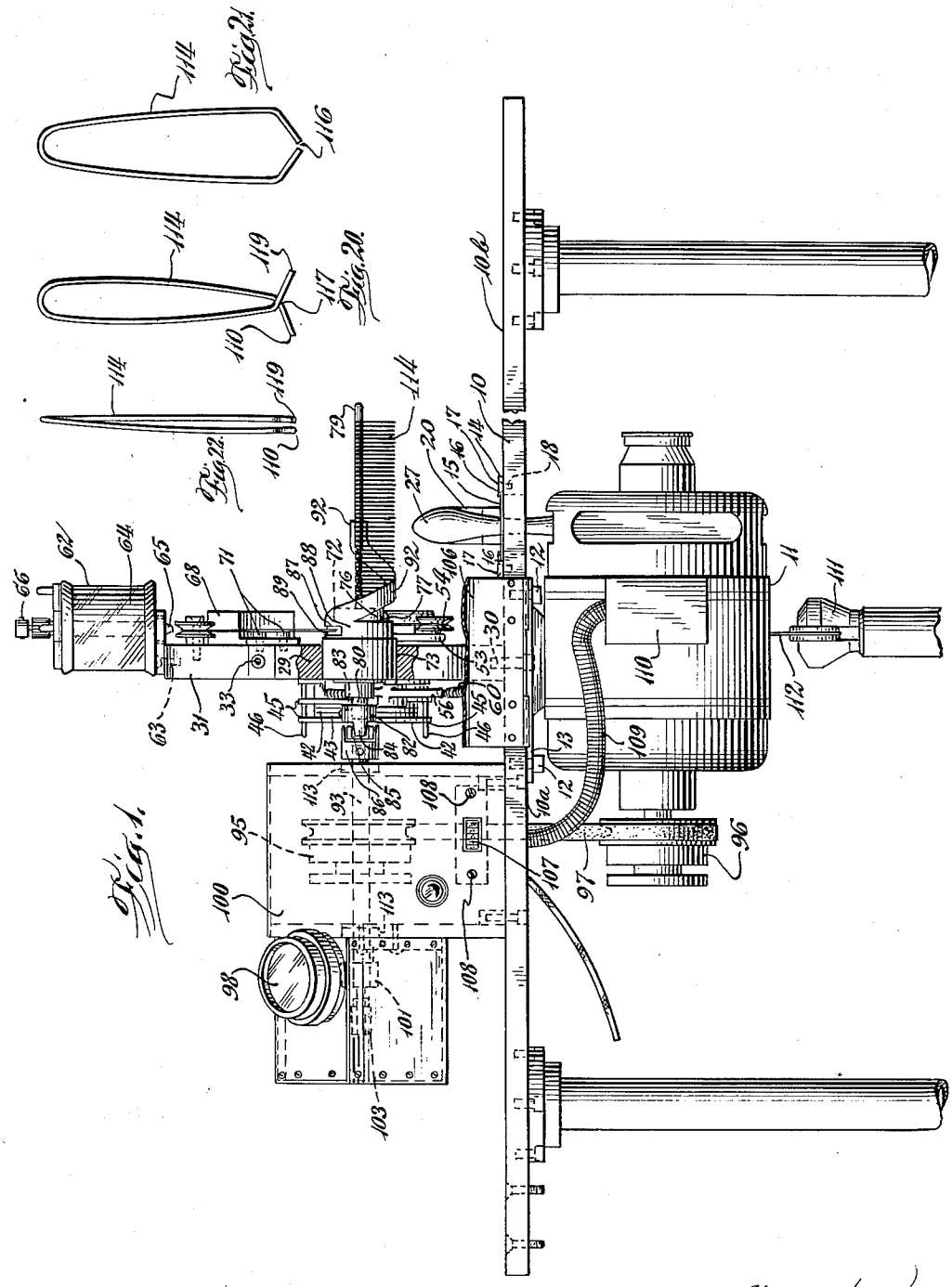


Fig. 1.

Fig. 2A.

Fig. 2B.

Fig. 2C.

Inventor:
Frederick J. Fuller
By Schroeder, Hoffgren, Brady & Wegner
Attorneys.

Oct. 10, 1961 F. J. FULLER 3,003,525

WIRE WINDING APPARATUS

Filed Oct. 12, 1956 5 Sheets-Sheet 2

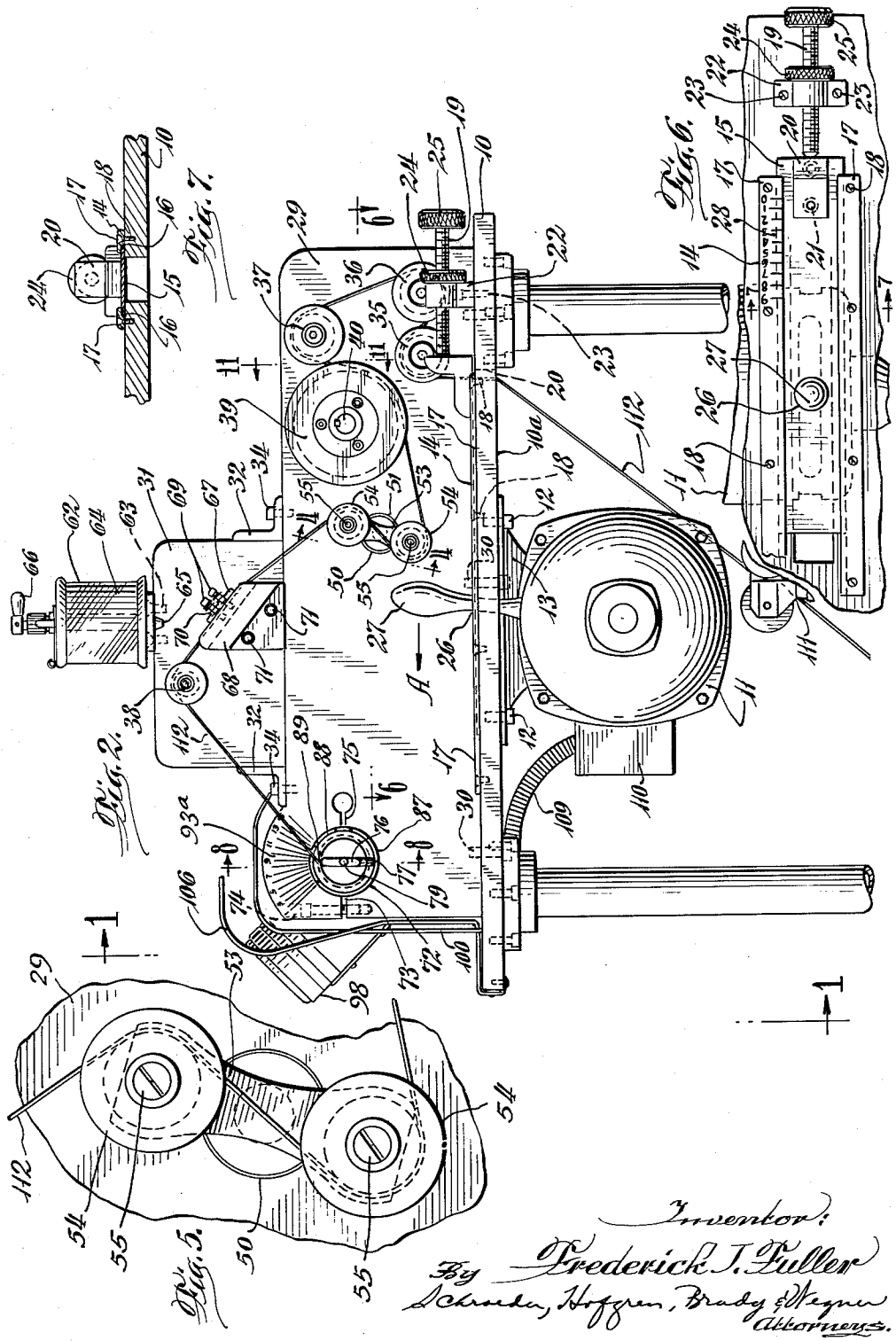


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Inventor:
Frederick J. Fuller
By Schroeder, Hoffgren, Brady & Wegner
Attorneys.

Oct. 10, 1961 F. J. FULLER 3,003,525

WIRE WINDING APPARATUS

Filed Oct. 12, 1956 5 Sheets-Sheet 3

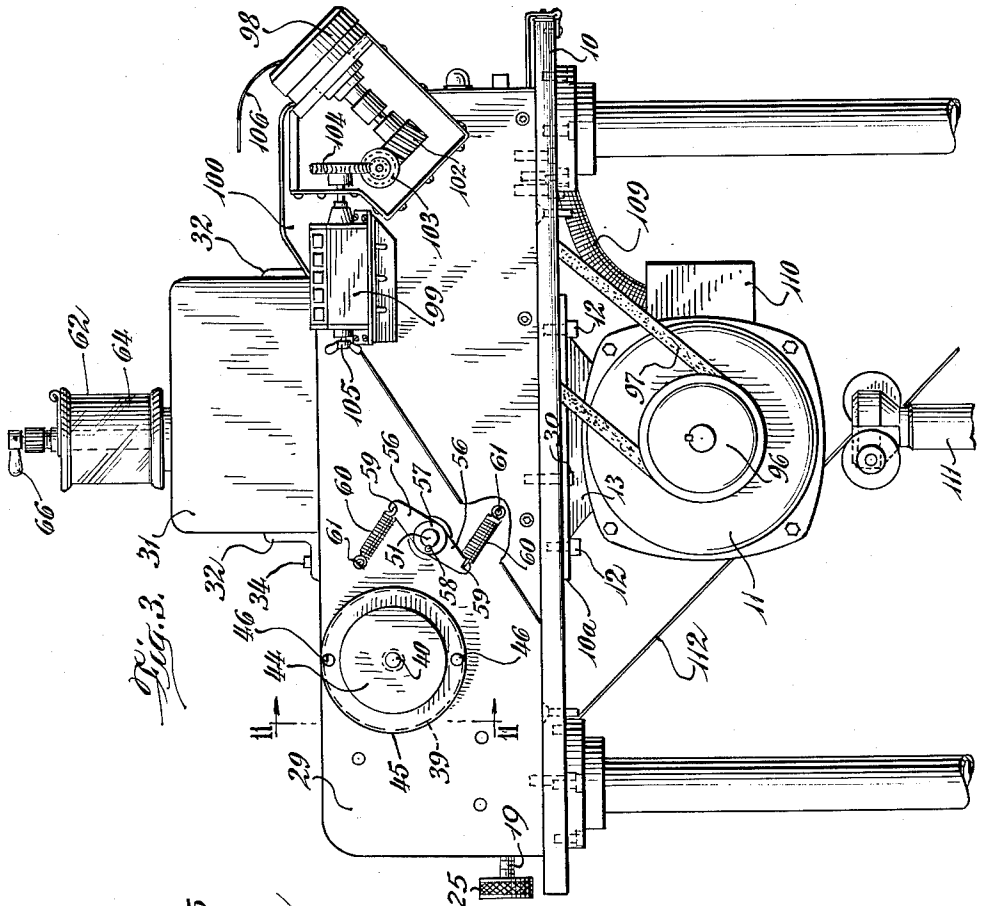


Fig. 3.

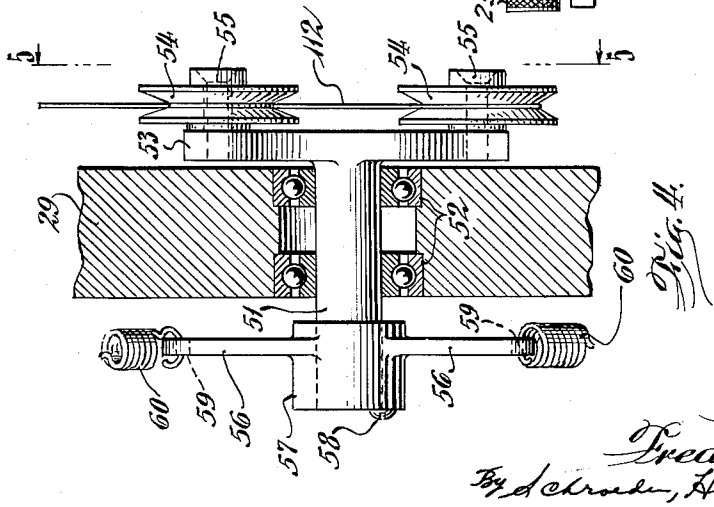


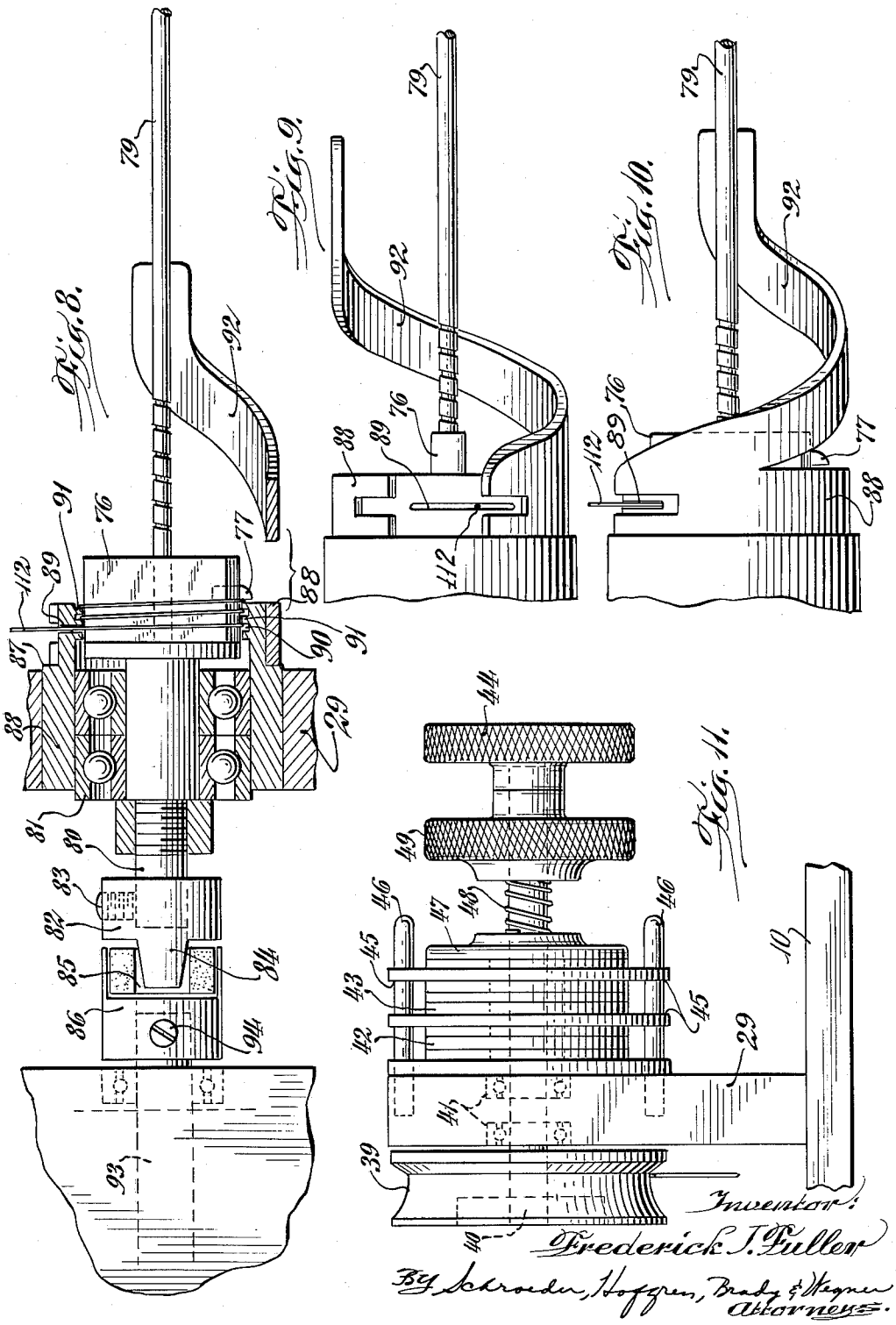
Fig. 4.

Inventor:
Frederick J. Fuller
By Schroeder, Hoffgren, Brady & Wegner
Attorneys

Oct. 10, 1961 F. J. FULLER 3,003,525

WIRE WINDING APPARATUS

Filed Oct. 12, 1956 5 Sheets-Sheet 4



Oct. 10, 1961 F. J. FULLER 3,003,525

WIRE WINDING APPARATUS

Filed Oct. 12, 1956 5 Sheets-Sheet 5

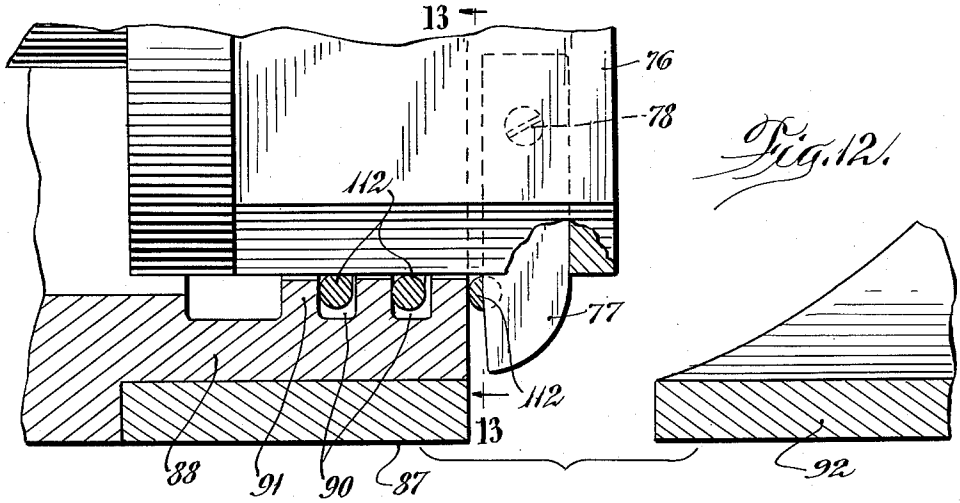


Fig. 12.

Fig. 13.

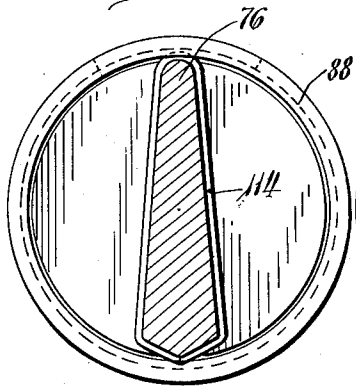


Fig. 14.

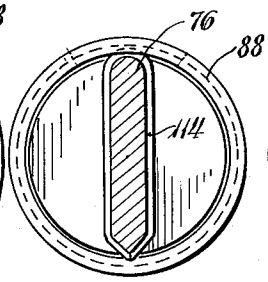


Fig. 15.

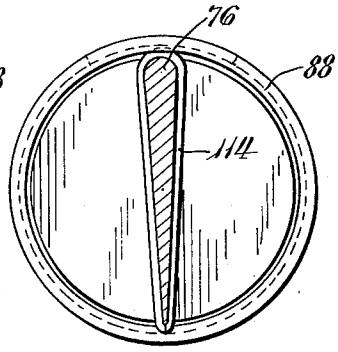


Fig. 16.

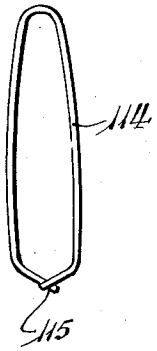


Fig. 17.

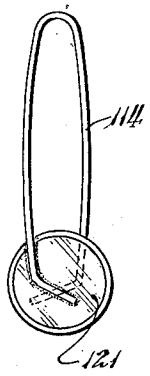
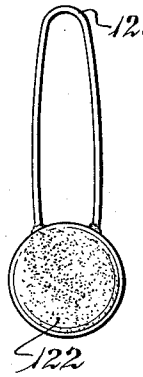


Fig. 18.



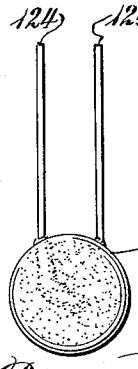


Fig. 19.

Inventor:
Frederick J. Fuller
By Schroeder, Hofgren, Brady & Wegner
Attorneys.

United States Patent Office

3,003,525
Patented Oct. 10, 1961

3,003,525

WIRE WINDING APPARATUS

Frederick J. Fuller, Chicago, Ill., assignor, by mesne assignments, to P. R. Mallory & Co. Inc., Indianapolis, Ind., a corporation of Delaware

Filed Oct. 12, 1956, Ser. No. 615,695
7 Claims. (Cl. 140—71)

This invention relates to an apparatus for forming a plurality of elements having a predetermined pattern and, more particularly, to an apparatus for forming a metal connector into elements having a predetermined pattern which are adapted to be used in making electric condensers.

It is a feature of this invention to provide an improved apparatus for forming an elongated, bendable metal connector, such as a wire, into a plurality of elements having a predetermined configuration or pattern which comprises a shaping means having a surface portion shaped generally to the pattern, means for applying successive sections of the connector in series to the surface portion of the shaping means, and means for separating the formed sections to form the elements from the connector.

It is a further feature of this invention to provide such an apparatus including means for adjusting the overlap of the ends of the shaped elements.

A great need is found in modern electronic devices for small-type condensers which are useful, for example, in printed circuits and the like. The apparatus of this invention is designed to provide a plurality of formed elements which are to be used in the manufacture of such condensers.

Generally these condensers include a dielectric element to either side of which is attached an elongated leg. These legs are arranged to be inserted in openings provided in a printed circuit for making contact. In the prior art methods, the elongated legs have been made as a single unit from a strand of wire formed to an element having the desired shape. The dielectric material is inserted in place between the ends of the element, soldered there, and the bottom loop of the element is trimmed off to provide the legs. This shaped element has formerly been made more or less by hand.

It is an advantage of this invention that the apparatus will rapidly produce a large number of shaped elements for use in condensers. It is a further advantage of this invention that the size and shape of the elements may be varied by changing the shaping means in the apparatus. Moreover, the overlap of the element may be varied to provide the desired amount of available surface for contacting the type of dielectric element to be used.

Other features and advantages will be apparent from the following description taken in conjunction with the accompanying drawings. Of the drawings:

FIGURE 1 is a front elevational view partially broken away of an apparatus embodying the invention taken generally along the line 1—1 of FIGURE 2;

FIGURE 2 is a right end elevational view partially broken away of the apparatus shown in FIGURE 1;

FIGURE 3 is a left end elevational view of the apparatus shown in FIGURE 1;

FIGURE 4 is an enlarged vertical sectional view taken generally along the line 4—4 of FIGURE 2;

FIGURE 5 is a view taken generally along the line 5—5 of FIGURE 4;

FIGURE 6 is a fragmentary top plan view taken generally along the line 6—6 of FIGURE 2;

FIGURE 7 is an enlarged vertical sectional view taken generally along the line 7—7 of FIGURE 6;

FIGURE 8 is an enlarged vertical sectional view taken generally along the line 8—8 of FIGURE 2;

FIGURE 9 is an enlarged top plan view of the elongated spiral member and inlet feed opening;

FIGURE 10 is an enlarged side elevational view of the mechanism shown in FIGURE 9;

FIGURE 11 is an enlarged vertical elevational view of the pulley and brake mechanism taken generally along the line 11—11 of FIGURES 2 and 3;

FIGURE 12 is an enlarged vertical sectional view of the separating means as shown in FIGURE 8;

FIGURE 13 is an enlarged vertical sectional view of an embodiment of the shaping mandrel for producing one shape of connector element as taken generally along the line 13—13 of FIGURE 12;

FIGURE 14 is an enlarged view of a shaping mandrel which may be substituted for the mandrel of FIGURE 13;

FIGURE 15 is an enlarged view of a shaping mandrel which may also be substituted for the mandrel of FIGURE 13;

FIGURE 16 is an enlarged front elevational view of a formed connector element;

FIGURE 17 is an enlarged view of the formed element of FIGURE 16 with a condenser dielectric soldered in place;

FIGURE 18 is an enlarged view of the formed element of FIGURE 17 with a cover in place over the condenser dielectric;

FIGURE 19 is an enlarged front elevational view of a finished condenser;

FIGURE 20 is an enlarged front elevational view of a formed element showing a degree of overlap different from FIGURE 16;

FIGURE 21 is an enlarged front elevational view of a formed element without overlap; and

FIGURE 22 is an enlarged end elevational view of a formed element.

The connector forming apparatus of this invention includes a table 10 which supports a conventional variable speed motor 11 from its underside 10*a* by means of a series of studs 12 through the motor casing extension 13.

The rotation speed of the motor 11 is controlled by means of a motor speed control assembly 14 as shown in FIGURE 6. This assembly includes a flat elongated metal slide 15 which is arranged to move in the channels 16 defined by the guide members 17. The guide members 17 are rigidly secured to the table 10 by screws 18. A threaded shaft 19 is attached to an L-shaped member 20 which is attached to the metal slide 15 by rivets 21. This shaft 19 passes through a yoke 22 which is attached to the table 10 by the screws 23. A movable knurled knob 24 is arranged to abut the yoke 22, thus determining the position of the slide 15. A second knurled knob 25, which is part of the threaded shaft 19, assists in positioning the knob 24 by allowing the operator to remove the strain on the slide 15. An aperture 26 is provided in the slide 15 which allows a motor control lever 27, which is spring-loaded in the direction shown by the arrow A, to pass through the slide 15. Thus, as the slide is moved in a horizontal direction, it will carry with it the control lever 27, which in turn determines the speed of the motor 11. A graduated scale 28 is provided on one of the guide members 17 for setting the speed of the motor 11.

A vertical frame member 29 is positioned in the center of the table 10 by means of the bolts 30. An extension 31 is mounted on the frame member 29 by means of L-shaped brackets 32, which are attached by rivets 33 to the extension 31 and by studs 34 to the top of the frame member 29.

Three rotatable pulleys 35, 36, and 37 are mounted on the frame member 29 and one pulley 38 on its extension 31. A brake pulley 39 is also mounted for rotation on the frame 29. As shown in FIGURE 11, the brake

pulley 39 is mounted for rotation on a shaft 40 which passes through a ball bearing race 41, a plurality of brake discs 42 and washers 43 which are attached to the shaft 40 and terminates in a knurled knob 44. A second knurled knob 49 is arranged to be moved along the threaded portion (not shown) on the shaft 40. A pair of the brake discs 42 are elongated and drilled at 45 so as to pass over the pins 46. A cap 47 is provided to abut a spring which is located between the cap 47 and the knurled knob 49. As the knurled knob 49 is moved in the direction shown by arrow B, a force will be transmitted through the spring 48 to the cap 47 and onto the brake discs 42, thus spreading the washers 43. As the washers 43 are spread, they will restrict the free rotation of the shaft 40, thus providing a braking force.

A resilient slack take-up assembly 50 is also mounted on the frame 29. This slack take-up assembly 50 includes a shaft 51 which passes through a ball bearing race 52 mounted in the frame 29. A flat figure-eight shaped metal member 53 is welded to one end of the shaft and locates at its ends a pair of pulleys 54, which are arranged for rotation on the studs 55. A pair of arms 56 is attached to a collar 57 which is removably positioned on the other end of the shaft 51 by means of the set screw 58. Holes 59 are provided in the ends of the arms 56 for attaching the springs 60 which are attached to the frame 29 by means of the studs 61.

A reservoir of lubricating oil 62 is attached to the extension 31 by the bolts 63. The reservoir includes a container 64 which is capable of holding a quantity of oil and a drop spout 65 which allows the oil to fall from the container 64 drop-wise when the control handle 66 is in the open position. The control handle 66 determines the position of a connecting hole (not shown) between the oil and the spout 65 inside the container 64. The control handle 66 may also be used to adjust the rate of oil dropping from the drop spout 65.

As the oil drops from the spout 65, it is deposited on an absorbent pad 67 of felt or the like. The pad 67 is held in place on a slanted platform 68 by means of the screws 69 and the springs 70. Thus, a uniform pressure is maintained on the pad 67 at all times. The slanted platform 68 is attached through its base to the extension 31 by means of the screws 71.

A connector element forming assembly 72 is removably positioned in an aperture 73 in the forward end of the frame 29. A transverse slot 75 is provided to allow the screw 74 to rigidly position the forming assembly 72 by tightly drawing the frame member 29 about the assembly.

The forming assembly 72 includes two sub-assemblies which cooperate together to form the desired element and which shall be described separately.

The first sub-assembly is the shaping means which includes the shaping mandrel 76. The end portion of this mandrel is preshaped to give the desired configuration to the resulting connector element. Examples of these shapes are shown in FIGURES 13, 14, and 15. A knife 77 is removably positioned near the outer edge of the mandrel 76 by means of the screw 78 and a striated rod 79 is welded in the center of the mandrel 76.

The mandrel 76 is welded to the shaft 80 which passes through the frame 29 and is mounted for rotation in the ball bearings 81. The bearings 81 are supported by the second sub-assembly which shall be explained later. A removable male coupling 82 is positioned on the outer end of the shaft 80 by means of a set screw 83. A prong 84 on the coupling 82 is arranged to be received by a slot 85 in the female coupling 86 on the end of the drive shaft 93, which will be explained later.

The second sub-assembly is the wire feed mechanism 87 which includes a tubular shaped member 88 in which are rigidly positioned the ball bearings 81 mentioned above. An inlet feed opening 89 is located in the top portion of the tubular shaped member 88 and is arranged so that the opening connects with a continuous channel 90, which is formed by a threaded portion 91 in the interior wall of the tubular shaped member 88. An elongated spiral member 92 is welded on the tubular shaped member 88 extending away from the tubular shaped member in a direction parallel with that of the rod 79.

The position of the inlet feed opening 89 may be adjusted with respect to a scale 93*a* by simply loosening the set screw 74 and turning the entire connector element forming assembly 72 in its aperture 73. This is done to determine the amount of overlap of the ends of the formed elements. If a small amount of overlap is desired, the inlet feed opening 89 is positioned at the left or high end of the scale 93*a* and if a large overlap is desired, the inlet feed opening 89 is positioned at the right or low end of the scale 93*a*. The overlap of the ends of the formed elements results from the wire 112 taking a preset as it moves through the connector inlet feed opening 89. As can perhaps best be seen in FIGURE 9, the opening 89 is an elongated or a slit-like construction. The wire 112 moves back and forth in this opening due to the rotation of the mandrel 76. If the opening is positioned to the left or the high end of the scale 93*a*, the wire will strike the right hand edge of the opening causing a preset in the wire which will result in a small amount of overlap of the ends of the formed elements. On the other hand, if the inlet feed opening 89 is positioned at the right, or low end of the scale 93*a*, the wire will strike the left hand edge of the opening 89 causing a preset in the opposite direction which will result in a large overlap of the ends of the formed elements.

The female coupling 86 is removably attached by the set screw 94 to the shaft 93, which is positioned for rotation in the bearings 113 set in the shield 100. A pulley 95 is welded on the shaft 93 to drive the shaft 93 by means of the belt 97 on the motor pulley 96. A tachometer 98 is mounted on the protecting shield 100 along with a counter 99.

A helical gear 101 welded on the shaft 93 is arranged to rotate the helical gear 102 on the tachometer, thus registering the rotational speed of the shaft 93 and a second helical gear 103 on the shaft 93 rotates the helical gear 104 on the counter 99, which is calibrated in elements per revolution, thus recording the number of elements produced. The counter 99 may be set by the wing nut 105.

The center portion of the apparatus is covered by a second protective shield 106 partially broken away in FIGURE 1 which is for the protection of the operator as is the shield 100. A heavy duty electric switch 107 is located on the shield 100 by means of screws 108 and is connected by the cord 109 to the motor starter control 110.

When operating the apparatus to form the desired connector elements, a spool of wire (not shown) is placed below the apparatus with the wire unwinding assembly 111, which is described in my copending application, Serial No. 618,386, filed October 25, 1956. The wire unwinding assembly 111 feeds the wire 112 to a hole (not shown) in the table 10 adjacent the pulley 35, which, cooperating with pulleys 36 and 37, guides the wire to the brake pulley 39. The brake pulley 39 has been adjusted along with the motor control assembly 14 to get the desired rate of travel of the wire 112. From the brake pulley 39, the wire passes about the slack take-up assembly 50. The springs 60 on the take-up assembly 50 work through the arms 56 to keep the slack out of the wire which results from the rotation of the elliptical shaped mandrel 76. After passing about the slack take-up assembly 50, the wire 112 is lubricated by passing under the oil soaked pad 67 after which it is guided to the wire feed inlet opening 89 by the pulley 38. The rotating mandrel 76 applies a continuous pull on the wire 112 and it is wound about the mandrel 76 by the guiding channel 90 so as to shape the wire into continuous

elements. The wire 112 is also moved outwardly along the mandrel 76 by the channel 90 bringing it in contact with the knife 77. Thus, with each revolution of the mandrel 76, the knife 77 severs one side of a formed element and after one cutting a free element drops from the mandrel 76 to the rod 79. At this point, the elongated spiral member 92 serves to slow the movement of the elements which have fallen on the striated rod 79 so that the large number of elements will not become jumbled and tangled before they are deposited on the table at 10*b*.

The resulting element 114, which is shown in FIGURE 16, may have a medium overlap 115, no overlap as shown in FIGURE 21 at 116, or a large overlap 117 as shown in FIGURE 20. This is determined by the position of the inlet feed opening 89 as previously described. Because of the spacing between adjacent sections of the channel 90, the ends of the element 118 and 119 will not be in contact as is shown in FIGURE 22.

The element 114 may then be used to produce a condenser 120 by soldering in place a dielectric 121, applying a plastic cover 122, and by trimming off the top of the element 123 to provide the legs 124 and 125.

Having thus described my invention as related to the embodiments shown in the accompanying drawings, it is my intention that the invention be not limited by any of the details of description unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

I claim:

1. Apparatus for forming an elongated bendable metal connector into a plurality of elements having a predetermined pattern and free ends, comprising: a rotatable shaping mandrel of a predetermined configuration corresponding to said pattern, said mandrel being adapted to wind contiguous loops of said connector thereon during rotation; a wire feed mechanism surrounding said mandrel and including helical guide means positioned adjacent said mandrel and adapted to contact said loops to move the same axially relative to said mandrel during the formation of said loops into said elements; and severing means mounted on said mandrel and having a cutting edge substantially normal to the path of movement of said connector loops, said mechanism being adapted to present said formed connector to said means for severing said loops from each other.

2. Apparatus for forming an elongated bendable metal connector into a plurality of elements having a predetermined pattern and free ends, comprising: a frame; a rotatable shaping mandrel of a predetermined configuration corresponding to said pattern, said mandrel being adapted to wind contiguous loops of said connector thereon during rotation; a wire feed mechanism surrounding said mandrel and mounted in said frame and including helical guide means positioned adjacent said mandrel and adapted to contact said loops to move the same axially relative to said mandrel during the formation of said loops into said elements; means for presenting said wire connector to said feed mechanism in a direction substantially normal to the longitudinal axis of said mandrel; a connector inlet opening leading to said helical guide means, said opening being adjustable with respect to said wire as presented by said presenting means to determine the amount of overlap of the free ends of said elements; and severing means mounted on said mandrel, said mechanism being adapted to present said formed connector to said means for severing said loops from each other.

3. Apparatus for forming an elongated bendable metal connector into a plurality of elements having a predetermined pattern and free ends, comprising: a tubular wire feed mechanism having a helical channel provided in its inner wall; a shaping mandrel of a predetermined configuration corresponding to said pattern journaled for rotation within said tubular wire feed mechanism, said mandrel being adapted to wind contiguous loops of said connector thereon during rotation, said channel being adapted to cooperate with said mandrel to apply said connector thereto in separated loops and to move said loops axially relative to said mandrel during the formation of said loops into said elements; and severing means mounted on said mandrel and having a cutting edge substantially normal to the path of movement of said connector loops, said channel being adapted to present said formed connector to said severing means for severing said loops from each other.

4. Apparatus for forming an elongated bendable metal connector into a plurality of elements having a predetermined pattern and free ends, comprising: a frame; a tubular wire feed mechanism having a helical channel provided in its inner wall mounted in said frame; a shaping mandrel of a predetermined configuration corresponding to said pattern journaled for rotation within said tubular wire feed mechanism, said mandrel being adapted to wind contiguous loops of said connector thereon during rotation, said channel being adapted to cooperate with said mandrel to apply said connector thereto in separated loops and to move said loops axially relative to said mandrel during the formation of said loops into said elements; means for presenting said wire connector to said feed mechanism in a direction substantially normal to the longitudinal axis of said mandrel; a connector inlet opening leading to said channel, said opening being adjustable with respect to said wire as presented by said presenting means to thereby determine the amount of overlap of the free ends of said elements; and severing means mounted on said mandrel, said channel being adapted to present said formed connector to said means for severing said loops from each other.

5. Apparatus for forming an elongated, bendable metal connector into a plurality of elements having a predetermined pattern and free ends, comprising: a frame; a rotatable shaping mandrel of a predetermined configuration corresponding to said pattern mounted in said frame, said mandrel being adapted to wind contiguous loops of said connector thereon during rotation; a wire feed mechanism mounted adjacent said mandrel on said frame and including guide means adapted to cooperate with said mandrel to apply said connector thereto in separated loops and to move said loops axially relative to said mandrel during the formation of said loops into said elements; means for presenting said wire connector to said feed mechanism in a direction substantially normal to the longitudinal axis of said mandrel including a connector inlet opening leading to said guide means; adjustable means cooperating with said means for presenting and adapted to preset said connector to thereby determine the amount of overlap of the free ends of said elements; and means mounted adjacent said mandrel for separating said formed axially moving loops from each other to provide said elements.

6. Apparatus for forming an elongated, bendable metal connector into a plurality of elements having a predetermined pattern and free ends, comprising: a frame; a rotatable shaping mandrel of a predetermined configuration corresponding to said pattern mounted in said frame, said mandrel being adapted to wind contiguous loops of said connector thereon during rotation; a wire feed mechanism mounted adjacent said mandrel on said frame and including helical guide means adapted to contact said loops to move the same axially relative to said mandrel during the formation of said loops into said elements; means for presenting said wire connector to said feed mechanism in a direction substantially normal to the longitudinal axis of said mandrel including a connector inlet opening leading to said helical guide means; adjustable means cooperating with said wire feed mechanism and adapted to preset said connector to thereby determine the amount of overlap of the free ends of said elements; and severing means mounted adjacent said mandrel and

said mechanism, said mechanism being adapted to present said formed connector to said severing means for severing said loops from each other.

7. Apparatus for forming an elongated, bendable metal connector into a plurality of elements having a predetermined pattern and free ends, comprising: a frame; a rotatable shaping mandrel of a predetermined configuration corresponding to said pattern mounted in said frame, said mandrel being adapted to wind contiguous loops of said connector thereon during rotation; a wire feed mechanism mounted adjacent said mandrel on said frame and including helical guide means adapted to contact said loops to move the same axially relative to said mandrel during the formation of said loops into said elements; means for presenting said wire connector to said feed mechanism in a direction substantially normal to the longitudinal axis of said mandrel including a connector inlet opening leading to said helical guide means; adjustable means cooperating with said wire feed mechanism adapted to determine the amount of overlap of the free ends

of said elements; and severing means mounted on said mandrel, said mechanism being adapted to present said formed connector to said means for severing said loops from each other.

References Cited in the file of this patent

UNITED STATES PATENTS

337,588	Kessler	Mar. 9, 1886
959,667	White	May 31, 1910
1,626,915	Buffington	May 3, 1927
1,636,689	Hartshorn	July 26, 1927
1,762,556	Marshall	June 10, 1930
1,868,063	Harter	July 19, 1932
2,324,115	Schultz	July 13, 1943
2,457,705	Moran	Dec. 28, 1948
2,623,550	Artoni	Dec. 30, 1952
2,636,523	Hammerschlag	Apr. 28, 1953
2,685,417	Bartelson	Aug. 3, 1954
2,688,346	England	Sept. 7, 1954