

July 17, 1956

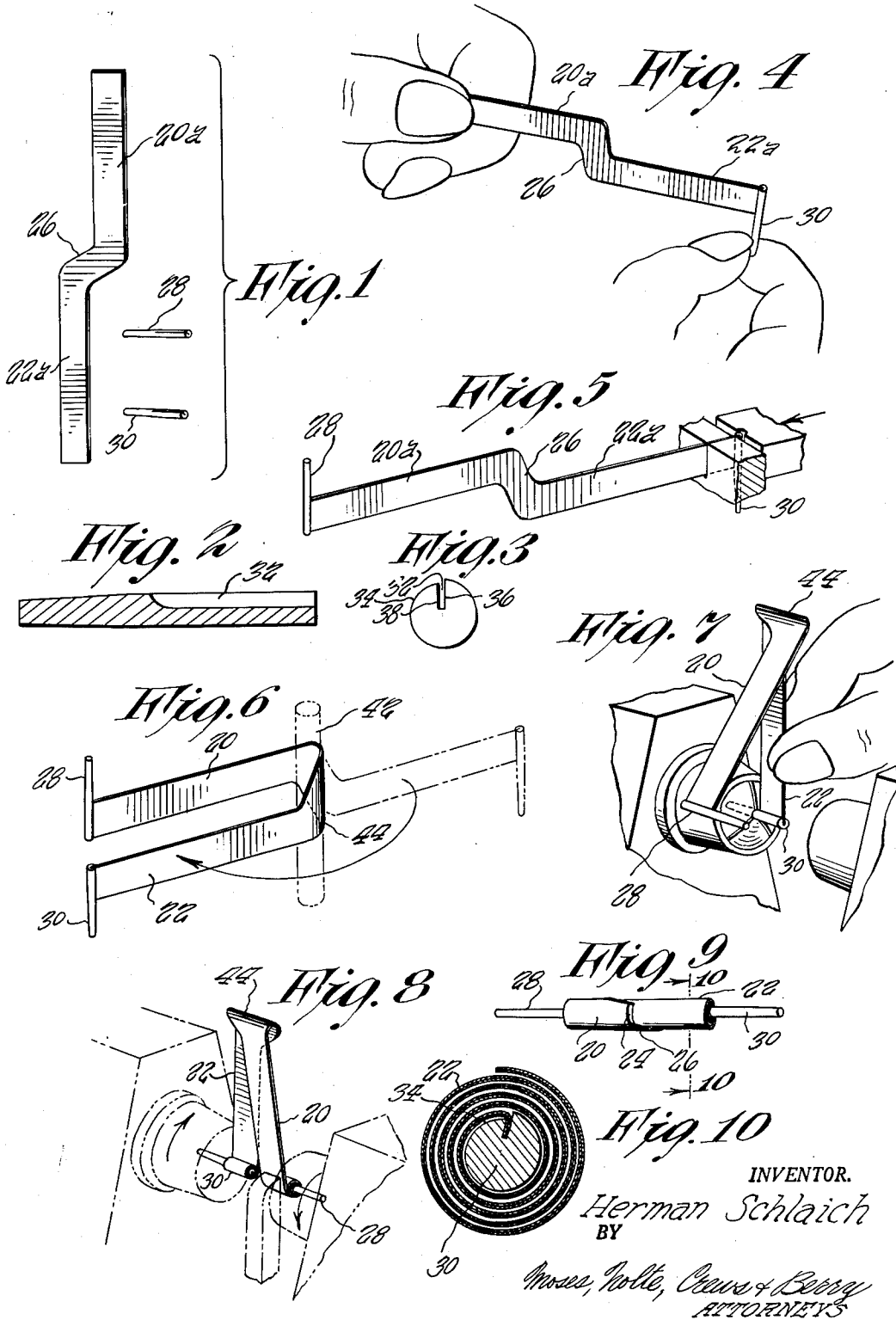
H. SCHLAICH

2,754,580

METHOD, BLANK AND APPARATUS FOR MAKING BIMETALLIC COILS

Filed Oct. 18, 1951

3 Sheets-Sheet 1



July 17, 1956

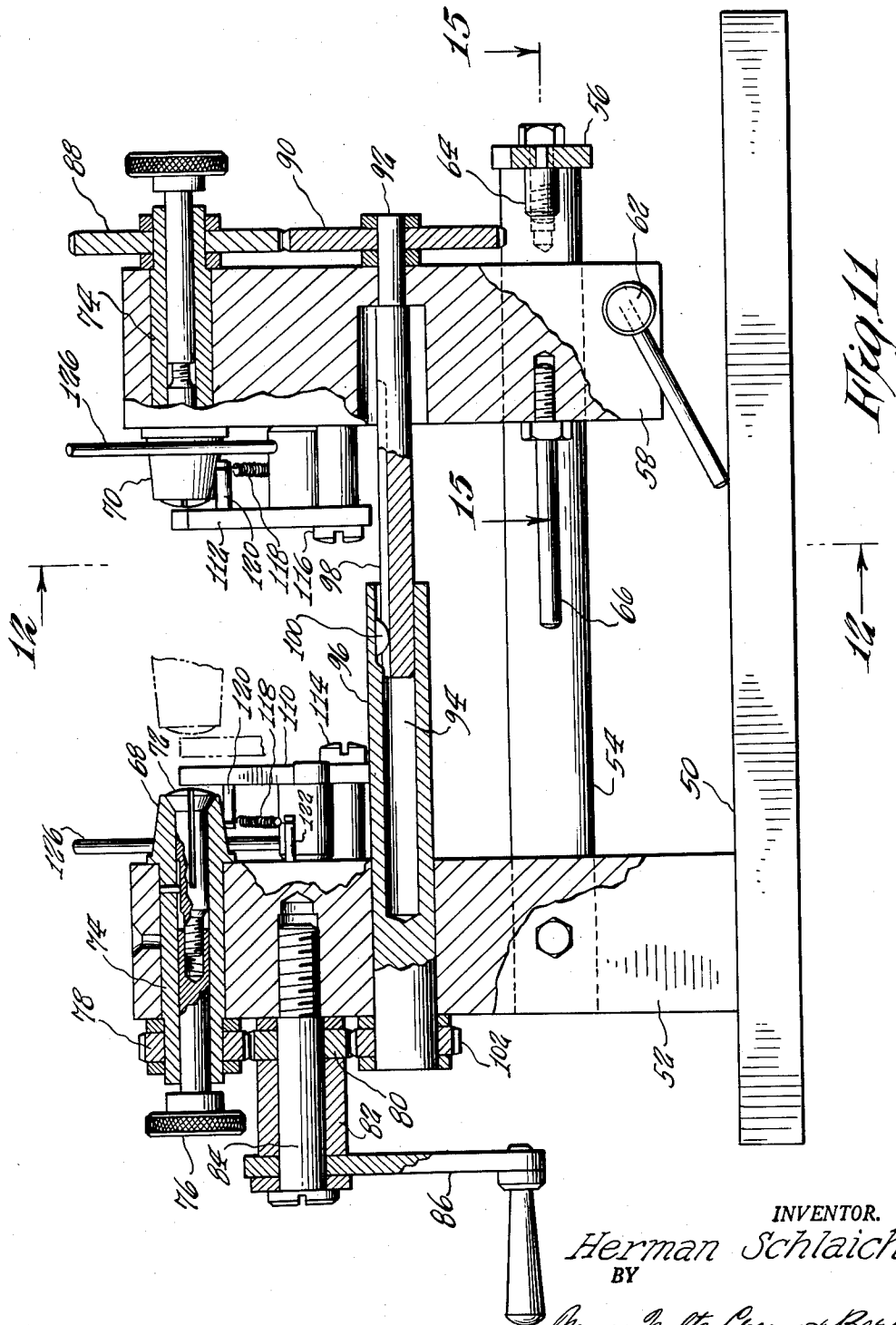
H. SCHLAICH

2,754,580

METHOD, BLANK AND APPARATUS FOR MAKING BIMETALLIC COILS

Filed Oct. 18, 1951

3 Sheets-Sheet 2



July 17, 1956

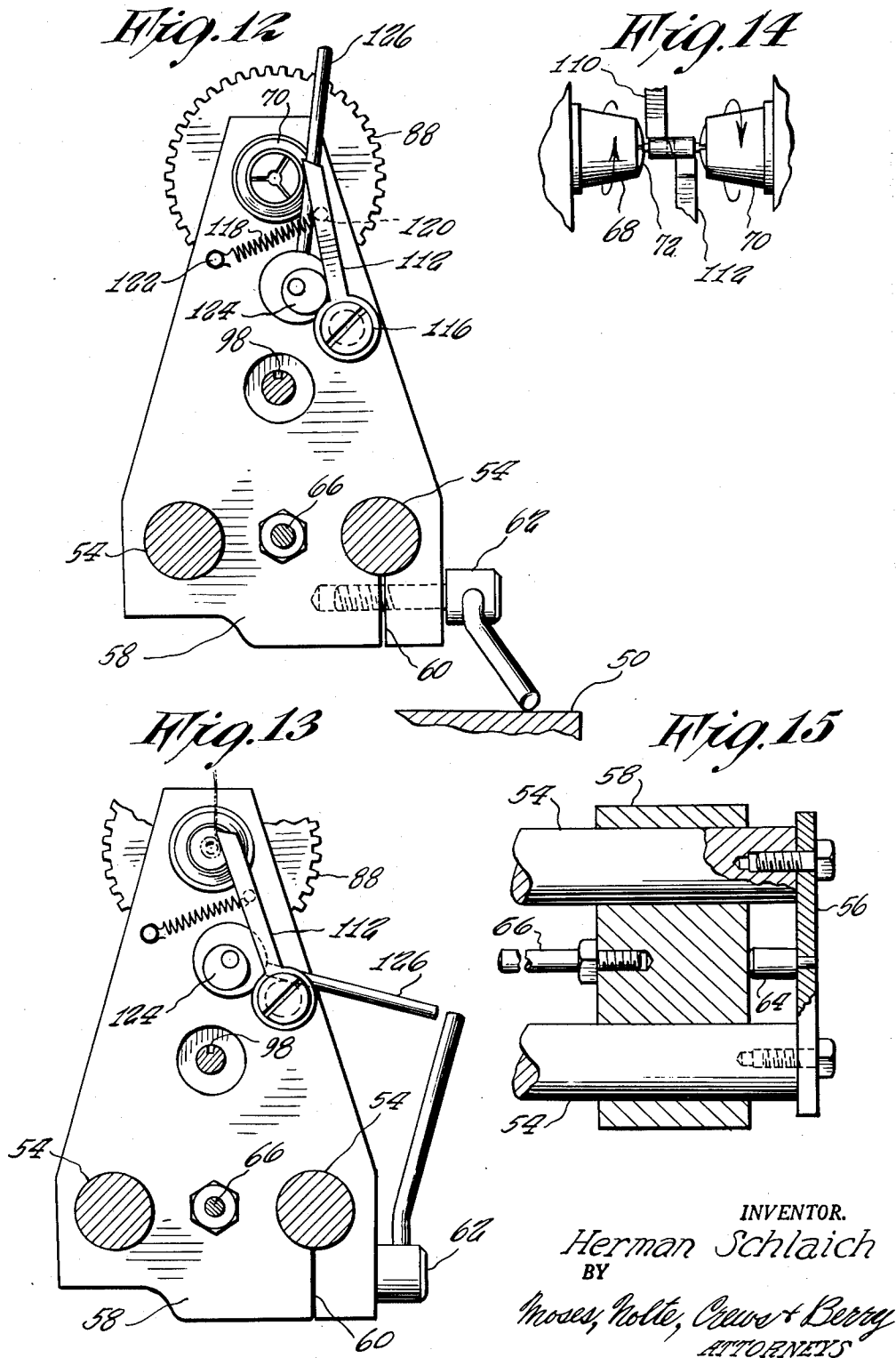
H. SCHLAICH

2,754,580

METHOD, BLANK AND APPARATUS FOR MAKING BIMETALLIC COILS

Filed Oct. 18, 1951

3 Sheets-Sheet 3



INVENTOR.
Herman Schlaich
BY
Moses, Nolte, Crave & Berry
ATTORNEYS

1

2,754,580

METHOD, BLANK, AND APPARATUS FOR MAKING BIMETALLIC COILS

Herman Schlaich, Elmhurst, N. Y.; Lottie Schlaich and president and directors of The Manhattan Company, executors of said Herman Schlaich, deceased

Application October 18, 1951, Serial No. 251,873

12 Claims. (Cl. 29—548)

This invention relates to bimetallic coils of the type described in my applications for Letters Patent, Serial No. 733,944, filed March 11, 1947, now Patent No. 2,572,059 and Serial No. 207,890, filed January 11, 1951, and to the manufacture thereof.

The form of coil to which the present invention particularly relates comprises two spiral coil portions connected at their circumferences by a bridge portion. Viewed as a completed article the convolutions start from the center of the first coil portion and progressively increase in diameter to the maximum diameter of the coil where the outer convolution merges into the connecting bridge portion and the latter in turn merges into the second coil portion, the convolutions of which progressively decrease in diameter to the center of the second coil portion. Thus the curvature is in the same direction from one end to the other and the coil acts as a unit when subjected to temperature changes. It is difficult, if not impossible, however, to wind a coil of this double form by progressing from one end to the other as an ordinary coil or spring is wound.

In accordance with the present invention a method has been devised for making this kind of a coil which is characterized by winding the two coil portions each from the center outwardly, starting at the opposite ends of the blank. One coil portion must therefore be wound in the opposite direction of rotation from the other coil portion. Preferably the winding of the two coil portions proceeds simultaneously about centers located in axial alignment, the two coil forming portions being wound up until the central bridge portion is drawn closely down upon the spiral coils. The bridge portion also has to be shaped to fit the curvature of the coils so as to make a compact substantially cylindrical structure which can be enclosed in a casing of minimum dimensions. Best results are secured by bending the bridge portion, which is wider and therefore stiffer than the portions of the blank which forms the spiral coils, to the final curvature desired, as a first step in forming the coil before winding the end portions of the blank into spiral form.

A further feature of the improved method consists in securing the arbors or shafts which form the supporting and operative connections for the coil to the ends of the blank before the coil is formed, and utilizing such arbors or shafts as winding arbors upon which the spiral convolutions are wound. When the winding of the coil is complete, therefore, the coil is ready for immediate insertion into the temperature responsive instrument, thermostat or other mechanism in which the coil is to be utilized.

It is a particular advantage of the type of bimetallic coil described that it lends itself to embodiment in a very small and compact form. This result is facilitated by utilizing an improved form of arbor which can be made of very small dimensions, in a form to permit of an easy and firm attachment to the end of the coiled blank, but still with sufficient strength to withstand the forces applied

2

in winding the coil, holding it in position in the instrument and transmitting movement therefrom.

One object of the invention is the provision of such improved arbor and the coil embodying the same.

Another object of the invention is the provision of the improved processes by which the coils may be formed with accuracy and quickness.

Another object of the invention is the provision of novel instrumentalities by which certain steps of the improved process may be performed, and the manufacture of the coil greatly facilitated.

Other objects and advantages of the invention will appear in the course of the detailed description of one preferred embodiment of the invention chosen to illustrate the principles thereof.

In the accompanying drawings:

Figure 1 is a perspective view of a blank for forming the coil and of two arbors or shafts for attachment to the ends of the blank.

Figure 2 is a longitudinal sectional view on an enlarged scale of one of the arbors.

Figure 3 is an end view of one of the arbors on a still further enlarged scale.

Figure 4 is a perspective view showing the blank with one of the arbors being applied to the end thereof.

Figure 5 is a perspective view showing the step of clamping one of the arbors to the end of the blank.

Figure 6 is a perspective view showing the step of bending the blank at the central offset portion thereof, prior to coiling the offset legs of the blank.

Figure 7 is a perspective view showing the step of inserting one of the arbors into a collet chuck of a coiling device.

Figure 8 is a perspective view showing the blank with both arbors gripped and being rotated in opposite directions so as to start the simultaneous winding of the two coils, the gripping and rotating means being shown in broken lines.

Figure 9 is a perspective view of the completed coil on a somewhat larger scale than Figs. 1, 4, 5, 6, 7 and 8.

Figure 10 is an enlarged transverse sectional view on line 10—10 of Fig. 9.

Figure 11 is a view partly in side elevation and partly in central vertical longitudinal section showing one form of machine which may be utilized for winding the coil.

Figure 12 is a transverse vertical section on line 12—12 of Fig. 11.

Figure 13 is a view similar to Figure 11 showing one of the guide arms in a different position from that shown in Fig. 12.

Figure 14 is a plan view showing the collet chucks of the machine with the arbors clamped therein, the partially wound coil being shown with the guide arms pressing thereagainst.

Figure 15 is a fragmentary horizontal sectional view on line 15—15 of Fig. 11.

Referring to the drawings in detail, and particularly to Figs. 9 and 10, it is seen that the general form of coil to which this invention relates comprises two coil portions 20 and 22 arranged in axial alignment with a small space 24 between them, the two coil portions being connected by an integral bridge piece 26. The inner end of each coil portion is fixed to an arbor shaft or axle, the end of the coil portion 20 being fixed to the arbor 28, and the end of the coil portion 22 being fixed to the arbor 30. The coils are formed of bimetal, that is two thin layers of metal having different coefficients of expansion which are permanently united throughout their area. As a very thin bimetal is preferably used, no attempt has been made in most of the figures to show the two layers.

The coil is preferably formed out of a blank which may be of the general form shown in Figs. 1, 4 and 5, the

3

two coil forming parts 20^a and 22^a being offset sufficiently so that the space 24 will be left between their adjacent edges when they are coiled. The blank is preferably cut with the grain of the metal, that is with its length extending in the direction in which the sheet of bimetal was rolled during its formation.

The coils are preferably rolled tightly upon the arbors during formation, the springiness of the metal causing the adjacent convolutions to separate just enough after release from the winding instrumentalities to permit movement of the convolutions in response to temperature changes. The arbors are so shaped as to anchor the ends of the blank and also are given partially spiral curvature, as shown in Figs. 3 and 10, so as to fit the inner convolution of the coil portion and permit the coil to be made of minimum dimensions without any waste space. In order to firmly anchor the ends of the blank to the arbors, each arbor is preferably provided with a longitudinal slot 32 just wide enough to receive the end of the blank, and extending radially only part way through the arbor, preferably not more than half way through. The length of the slot is sufficient to receive the width of the blank. After the end of the blank has been inserted in the slot, the sides of the latter are forced together or more or less deformed with a punch or staking tool so as to lock the blank in the slot while winding takes place. The formation of the slot only part of the way through the arbor is very important, as the unslotted part of the arbor retains its strength and it is thereby possible to clamp the end of the blank firmly. If the arbor were slotted all the way across it would lack sufficient strength or rigidity to properly hold the blank, particularly in the case of arbors of very small diameter. For example, arbors of one millimeter diameter are applied in some instruments which I have made, and, if the end of such an arbor were split all the way across, the parts would be incapable of effectively retaining the end of the blank. As shown in Fig. 10, the end of the blank is inserted in the slot 32 and clamped therein, the blank being then wound around the spiral surface 34 away from the higher wall 36 of the slot 32. As the higher wall 36 projects beyond the lower wall 38 of the slot preferably by an amount equal to the thickness of the blank, the latter will wind smoothly around the arbor, successive convolutions fitting over one another without forming any shoulder or leaving waste space. By clamping the end of the blank into the slot of the form described, a very firm and quick attachment between the arbor and blank is effected and there is no projecting roughness as may be the case if welding, riveting or other fastening means were employed to secure the end of the blank to the arbor.

Figure 5 shows the step of attachment of the arbor to the end of the blank, a suitable clamping tool or press indicated diagrammatically at 40 being provided for squeezing the walls of the arbor groove against the blank.

After the arbors have been clamped to the ends of the blank, the next procedure is to reduce the blank to coil form. I have found that this is preferably done in two stages, the first step being to bend the blank at the bridge portion thereof to substantially the curvature which the bridge portion will have in the finished coil. This step is illustrated in Fig. 6 which shows the blank bent around a shaft or anvil 42, so as to put a curve 44 therein corresponding with the curve of the outside of the coil, as shown in Fig. 9. The importance of making this preliminary bend 44 lies in the fact that the bridge portion 26, when measured in a direction transverse to the length of the blank, is wider than the portions 20^a and 22^a, and therefore, if it be attempted to coil the latter without first bending the bridge portion, the bridge portion will not bend to the same extent as the portions 20^a and 22^a, and a smooth cylindrical coil will not result. The bending of the blank to a U-shape also facilitates its

4

further handling and introduction into the winding fixture.

After the blank has been given the initial bend and is in substantially the form shown in Fig. 6, the arbors may be rotated so as to wind up the respective portions 20^a and 22^a into closely coiled form. This winding may be done with the aid of any suitable instrumentality and the two coils 20 and 22 may be wound one at a time or simultaneously. In the preferred method of carrying out my invention, they are wound simultaneously in opposite directions until the curved bridge portion 44 fits closely over parts coiled on the arbors, resulting in the smooth closely wound cylindrical coil, as shown in Fig. 9.

By bringing the axes of the arbors in alignment and rotating the arbors simultaneously in opposite directions, it will be seen that the winding can be accomplished without any movement of translation of either arbor. Only rotation of the arbors about their axes is necessary. The preliminary bending of the blank at the bridge portion, brings the blank into approximately U-shape with the arbors close together, thereby facilitating the handling of the blank and its insertion into such machine or fixture as may be utilized for winding the coil portions.

For the actual winding of the coil portions 20 and 22, a machine is preferably employed of the general construction illustrated in Figs. 11 to 15, elements of the machine being indicated in Figs. 7 and 8. In this machine a rigid frame is provided which is shown as consisting of a base 50 having a standard 52 thereon which carries a pair of horizontal guide bars 54, the outer ends of which may be connected by a cross brace 56. Mounted to slide on the guide bars 54 is a cross head 58 having holes through which the bars pass, the wall of one of the holes being split as indicated at 60 in Figs. 12 and 13, so that the cross head may be clamped on the guide bars by means of a clamping screw 62. Stops are conveniently provided for limiting endwise movement of the cross head, one such stop 64 being mounted on the brace 56 and the other stop 66 being in the form of a rod carried by the cross head. A pair of collet chucks 68 and 70 are provided which may be of any suitable construction and which are rotatably mounted respectively in the standard 52 and cross head 58. The arbors at the ends of the bimetallic blank are clamped in these two chucks as shown in Fig. 8.

In the particular form of chuck shown each of the chucks comprises a jaw member 72 which may be partly drawn into the tapered end of the sleeve 74 of the chuck by means of a screw having a knurled head 76. Means are provided for rotating the chucks simultaneously in opposite directions at the same speed so as to wind up the coils. In the construction shown, the sleeve 74 of the chuck mounted in the standard 52 is provided with a pinion 78 which meshes with a pinion 80 on a sleeve 82 which is mounted to rotate on a stud 84 set in the standard 52. The sleeve 82 carries a crank 86 by which the pinion may be rotated. The sleeve 74 of the chuck mounted in the cross head 58 has fixed thereto a pinion 88 which meshes with a pinion 90 fixed to the end of a shaft 92 mounted to rotate in the cross head. The shaft 92 slides longitudinally in a hole 94 in a shaft 96 mounted to rotate in the standard 52. The shaft 92 is provided with a spline 98 in which slides a key or feather 100 fixed to the shaft 96 so that the two shafts will rotate together. Shaft 96 carries a pinion 102 which meshes with pinion 80 on the crank rotated sleeve 82. The pinions 78 and 102 are of the same diameter and the pinions 88 and 90 are of the same diameter. Rotation of the crank 86 will thus rotate the two collet chucks at equal speeds in opposite directions. The telescopic arrangement of the shafts 92 and 96 permits the cross head to be adjusted to the desired position upon the guide bars 54 while maintaining the driving connections to the chuck on the cross head. It is necessary to have the cross

5

head adjustable so that the chucks may be operated in different positions, as some coils may be made of wider material than others. The cross head is movable away from the standard a distance sufficient to permit the insertion of the arbors in the chucks.

Means are preferably provided for guiding and pressing down the coil forming portions of the blank as the successive convolutions are wound up. In the construction shown this guiding and pressing means comprises a pair of presser arms 110 and 112, the arm 110 being mounted on a pivot stud 114 carried by the standard 52 and the arm 112 being mounted on a pivot stud 116 carried by the cross head. The arms are biased in directions to press against the convolutions being wound, by means of coil springs 118 connected to pins 120 on the arms and to fixed pins 122 on the standard and crosshead respectively. For throwing the guide arms out of the way while inserting the arbors in the chucks or removing them therefrom after the coil is wound, eccentric cams 124 are provided, one being pivotally mounted on the crosshead and the other on the fixed standard. These may be rotated by finger levers 126 which may be thrown over so as to move the cams into a position to hold the guide bars out of engagement or permit them to press upon the convolutions under the force of the springs 118.

In the use of the apparatus, the cross head 58 is moved away from the standard 52, the collet chucks are opened and the guide arms 112 are retracted. One of the arbors is then inserted into a chuck which is tightened thereon, the U-shaped blank being preferably set in a substantially vertical position as shown in Fig. 8. The cross head is then moved towards the standard 52 and the second arbor is inserted in its chuck which is then tightened. The guide arms 110 and 112 are released so that they will bear against the surface of the blank, as indicated in Fig. 8. The crank 66 is then rotated in a direction to simultaneously wind up the blank portions 20^a and 22^a, this operation being continued until the curved bridge is drawn down tightly upon the coil portions. The coil is now in the form shown in Fig. 9 and it is merely necessary to retract the guide arms 110 and 112, loosen the chucks, loosen the clamping screw 62 and move the cross head 58 so as to release the finished coil. By following the procedure described coils may be accurately and rapidly formed at very small cost.

While I have described in detail certain improvements in bimetallic coils and parts for forming the same, and certain preferred methods for constructing such coils, and have illustrated one form of apparatus adapted for use in carrying out the improved methods, I do not wish to be understood as limiting myself to the specific form of parts, procedures or details of the apparatus shown and described, as I realize that changes may be made in all such secondary characteristics, and I further intend that each step or sequence of steps or each element or instrumentality recited in any of the following claims be understood to include all equivalent steps, sequences of steps, elements or instrumentalities for accomplishing the same results in substantially the same or equivalent manner.

I claim:

1. The method of forming a bimetallic coil composed of two parallel concentric spirally wound portions connected by a concentrically curved bridge portion, which comprises securing an arbor to each end of a blank of thin bimetal, said arbors when so secured being parallel and transverse to the length of the blank, and simultaneously rotating said arbors about their respective axes in opposite directions but at equal speeds so as to coil the ends of the blank into parallel concentric coils and draw the bridge-forming portion of the blank down upon said coils.

2. In a method as claimed in claim 1, the step which consists in bending the blank at the bridge portion transversely of the length of the blank to a curvature ap-

6

proximating the curvature of the coil when completed, said bending step being performed prior to winding the coils.

3. In the process of making bimetallic coils as set forth in claim 1, the steps which consist in providing an arbor having a longitudinal slot extending only partly through the thickness of the arbor, inserting an end of a coil forming blank in the slot, pressing the walls of the slot towards each other by permanent deformation of the metal into gripping engagement with the end of the blank, and then winding the blank around the arbor.

4. The method of forming a bimetallic coil composed of two axially aligned spirally wound portions connected by a concentrically curved bridge portion which comprises cutting a blank from a flat sheet of bimetal in the form of two straight parallel strips connected at their adjacent ends by a transverse bridge forming portion, attaching arbors to the outer ends of said straight portions, said arbors being parallel to each other and at right angles to the length of the blank, and simultaneously rotating said arbors about their respective axes in opposite directions, but at equal speeds, so as to coil said straight blank portions into parallel axially aligned coils and bring said bridge portion into concentric relationship therewith.

5. In the method as claimed in claim 4, the step which consists in bending the blank at the bridge portion transversely of the length of the blank to a curvature approximately the curvature of the coil when completed, said bending step being performed prior to the winding of the coils.

6. A blank assembly for forming a bimetallic coil having two concentric coil portions comprising a piece of thin bimetallic sheet having two straight parallel coil forming portions offset laterally by an amount at least equal to the width of one of said portions, said parallel portions being connected by a bridge forming portion, and an arbor fixed to the outer end of each coil forming portion, the axes of the arbors being parallel to one another and at right angles to the straight parallel coil forming portions, said blank, having a transverse bend therein about an axis parallel to the arbor axes at said bridge portion said bend being of approximately 180° angularity so that the parallel coil forming portions lie side by side and extend in the same general direction from the bend to a curvature approximating the curvature which the coil will have when completed.

7. A machine for winding bimetallic coils from blanks of bimetal having two parallel coil forming portions joined by a central bridge portion and having arbors attached to the outer ends of said parallel coil forming portions, said machine including a pair of chucks for receiving and gripping the respective arbors, means for rotatably supporting said chucks in axial alignment, and means for simultaneously rotating said chucks at equal speeds in opposite directions.

8. A machine for winding bimetallic coils from blanks of bimetal having two parallel coil forming portions joined by a central bridge portion and having arbors attached to the outer ends of said parallel coil forming portions, said machine including a fixed support, a cross-head mounted adjacent thereto and movable towards and from said support, a chuck rotatably mounted in said fixed support for holding the arbor at one end of said blank, a chuck rotatably mounted in the crosshead for holding the arbor at the other end of said blank, said chucks being mounted in axial alignment and rotating means including interconnecting gearing for rotating said chucks simultaneously in opposite directions at equal speeds.

9. A machine for winding bimetallic coils from blanks of bimetal having two parallel coil forming portions joined by a central bridge portion and having arbors attached to the outer ends of said parallel coil forming portions, said machine including a pair of chucks for receiving and gripping the respective arbors, means for ro-

tatably supporting said chucks in axial alignment, means for simultaneously rotating said chucks at equal speeds in opposite directions, and guide members for exerting pressure on the blank portions as they are wound on the arbors.

10. A machine for winding bimetallic coils from blanks of bimetal having two parallel coil forming portions joined by a central bridge portion and having arbors attached to the outer ends of said parallel coil forming portions, said machine including a fixed support, a crosshead mounted adjacent thereto and movable towards and from said support, a chuck rotatably mounted in said fixed support for holding the arbor at one end of said blank, a chuck rotatably mounted in the crosshead for holding the arbor at the other end of said blank, said chucks being mounted in axial alignment and rotating means including a gear train on the fixed support for rotating the chuck carried thereby, a gear train on the crosshead for rotating the chuck carried by the crosshead, and a telescopic drive shaft interconnecting the gear trains on the fixed support and crosshead respectively.

11. A machine for winding bimetallic coils from a blank of bimetal including parallel offset coil forming portions extending from a central bridge portion and having parallel winding arbors engaged with the ends of said coil forming portions, said machine being provided with rotary members engaging the respective arbors, and means for simultaneously rotating said rotary members at equal speeds in opposite directions about a common axis

so as to simultaneously wind up said coil forming portions.

12. In a machine for winding bimetallic coils having two concentric coil portions from a blank of bimetal including parallel offset coil forming portions extending from a central bridge portion, parallel arbors engaged with the ends of said coil forming portions, and means for simultaneously rotating said arbors about a common axis at equal speeds in opposite directions so as to simultaneously wind up said coil forming portions.

References Cited in the file of this patent

UNITED STATES PATENTS

15	85,549	Vose	Jan. 5, 1869
	147,679	Nichols	Feb. 17, 1875
	881,772	Canney	Mar. 10, 1908
	926,576	Kneisley	June 29, 1909
	1,725,607	Wolford	Aug. 20, 1929
20	1,790,218	Appleby	Jan. 27, 1931
	2,000,092	Norwood	May 7, 1935
	2,406,130	Boyce	Aug. 20, 1946
	2,406,968	Seher	Sept. 3, 1946
	2,521,795	Kelley	Sept. 12, 1950
25	2,548,735	Meletti	Apr. 10, 1951
	2,572,059	Schlaich	Oct. 23, 1951

FOREIGN PATENTS

966,467	France	Mar. 8, 1950
---------	--------	--------------