July 2, 1957 J. R. MARCUS 2,797,879

CONDENSER WINDING MACHINE

Filed July 8, 1953 4 Sheets-Sheet 1

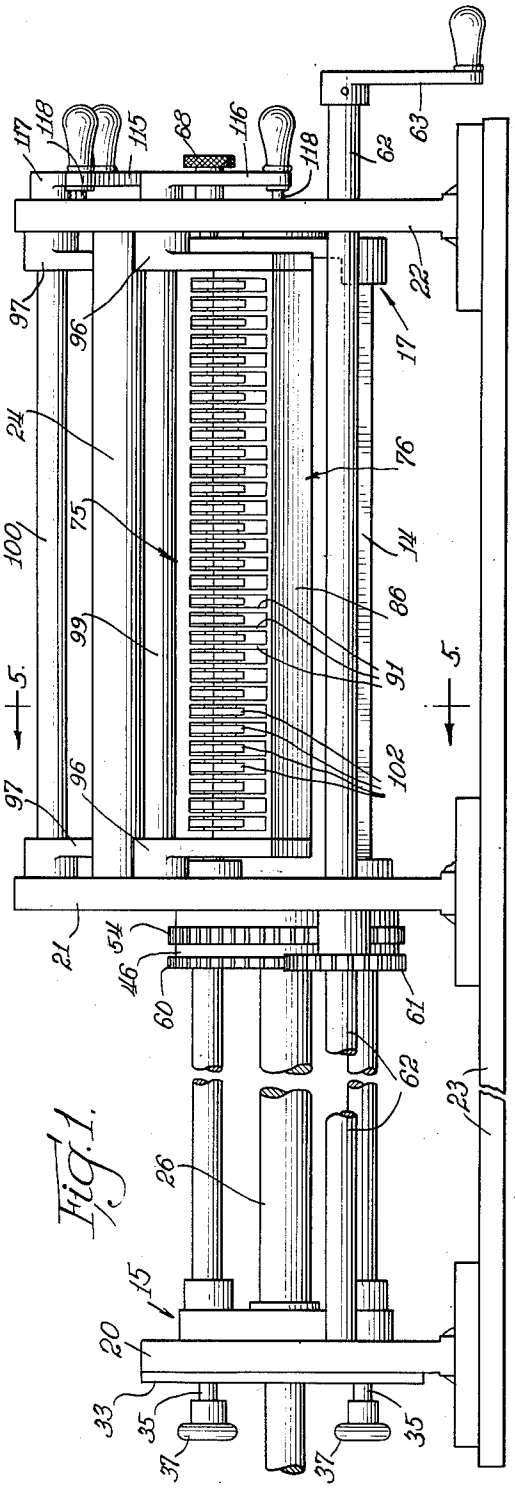


Fig. 1.

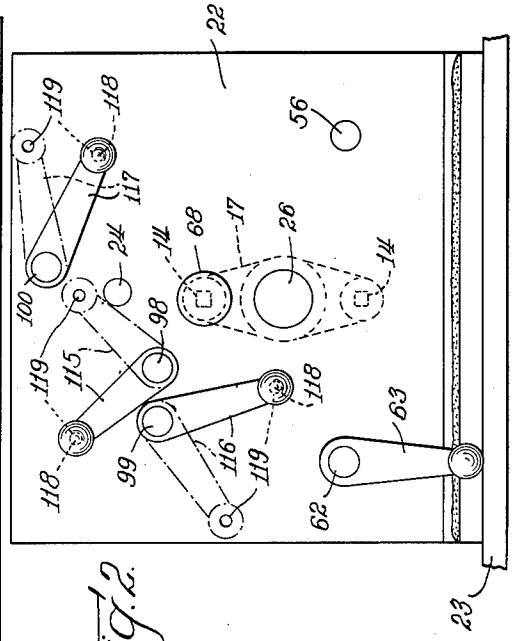


Fig. 2.

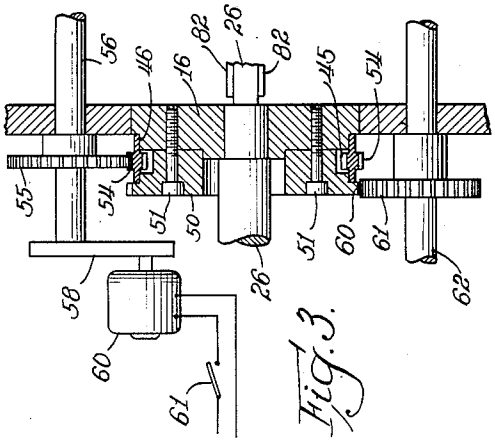


Fig. 3.

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CONDENSER WINDING MACHINE

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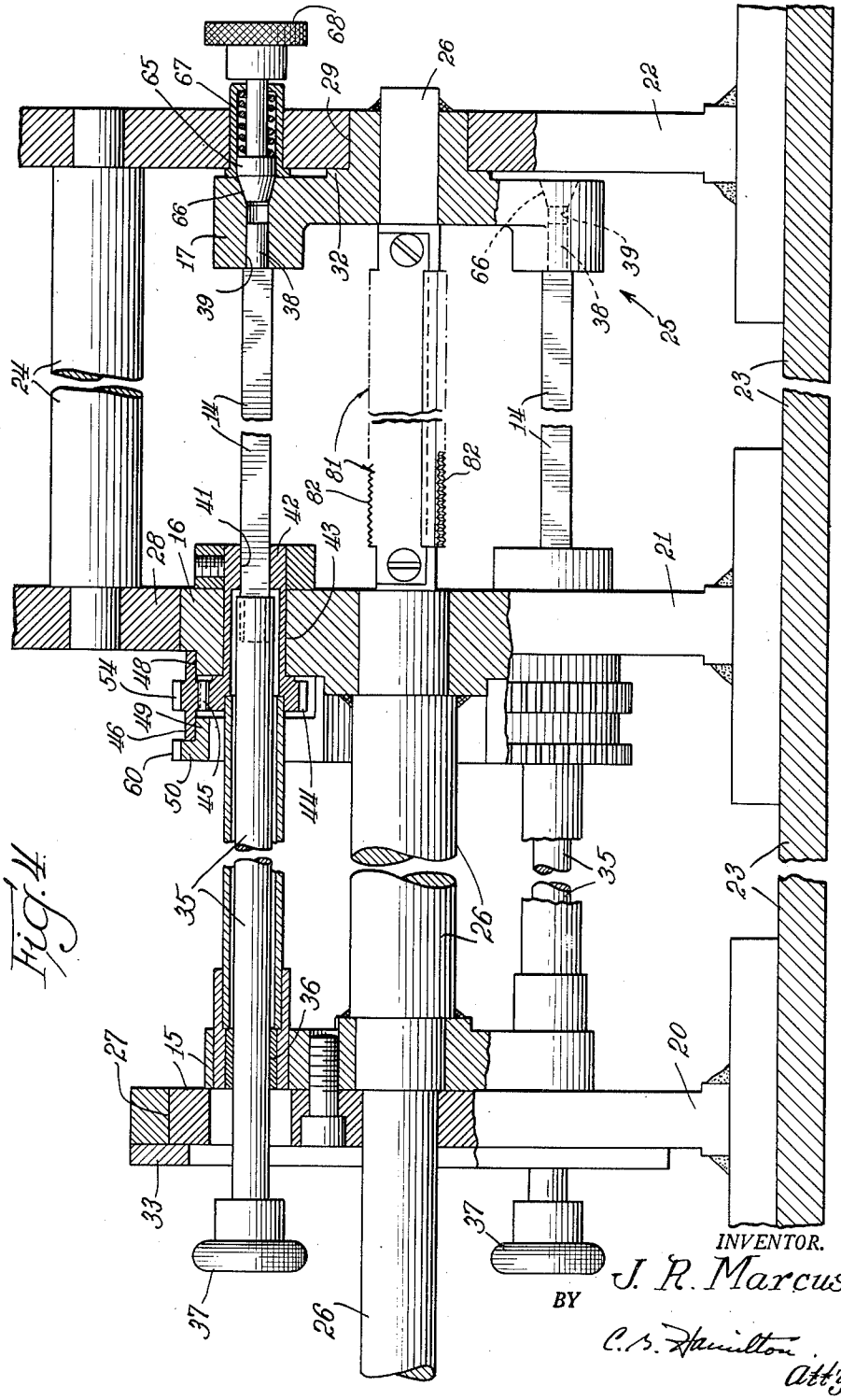


Fig. 4

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CONDENSER WINDING MACHINE

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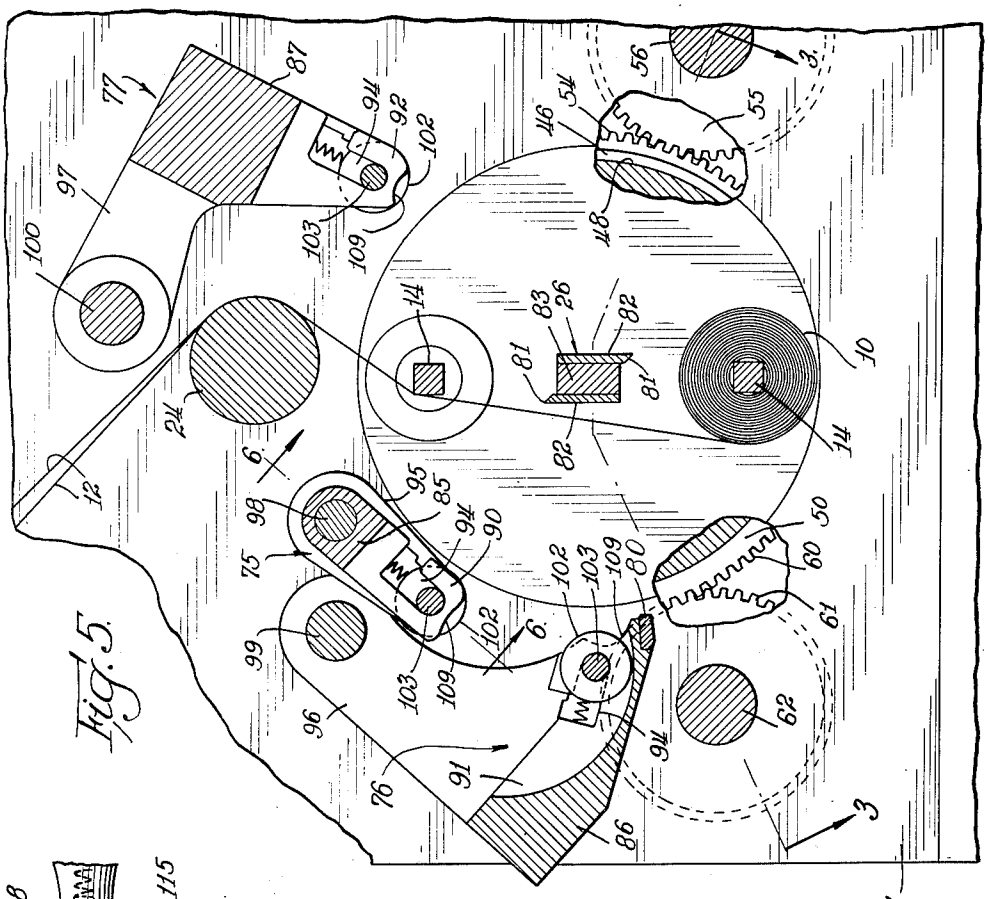


Fig. 5

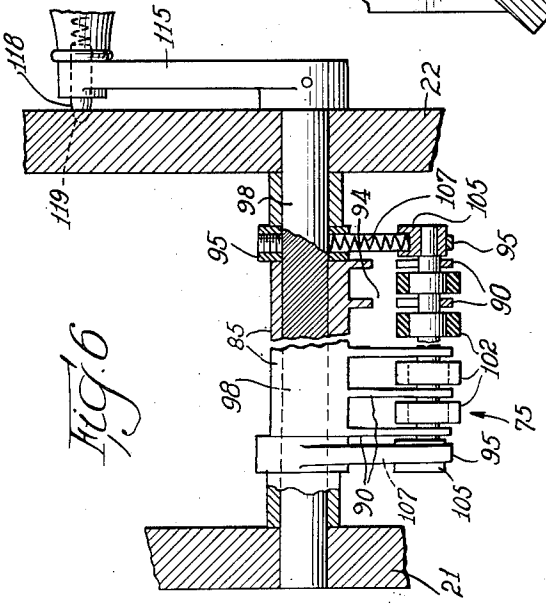


Fig. 6

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CONDENSER WINDING MACHINE

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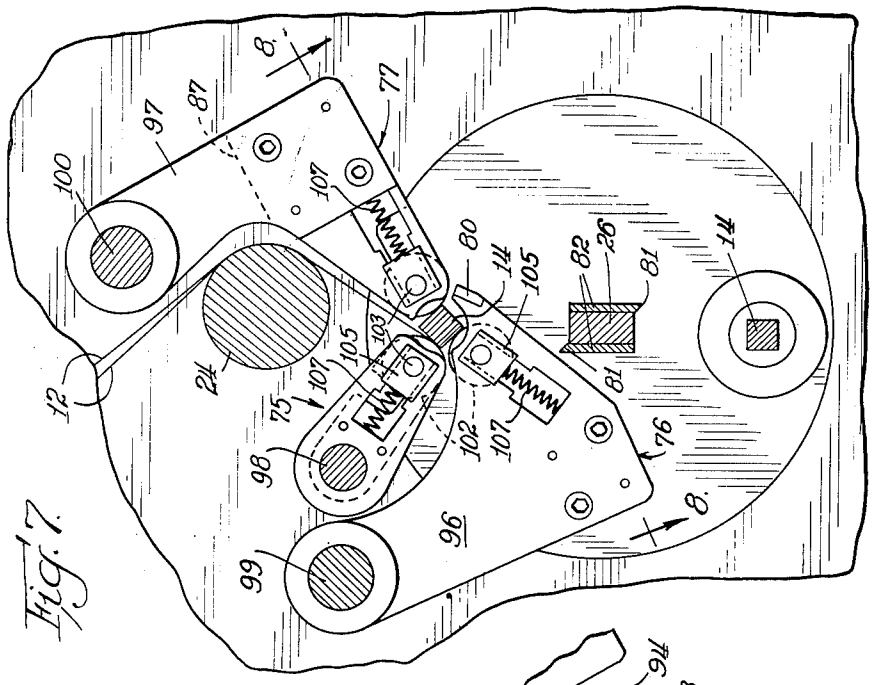


Fig. 7.

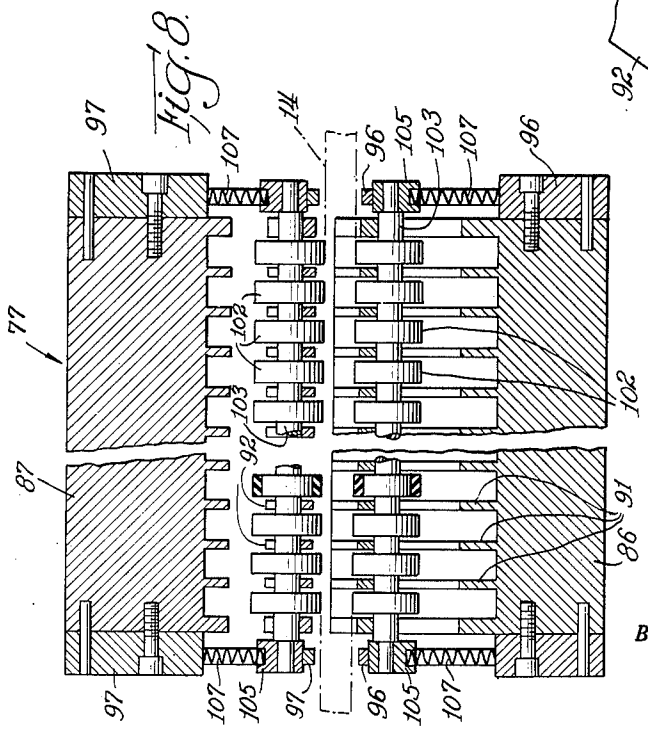


Fig. 8.

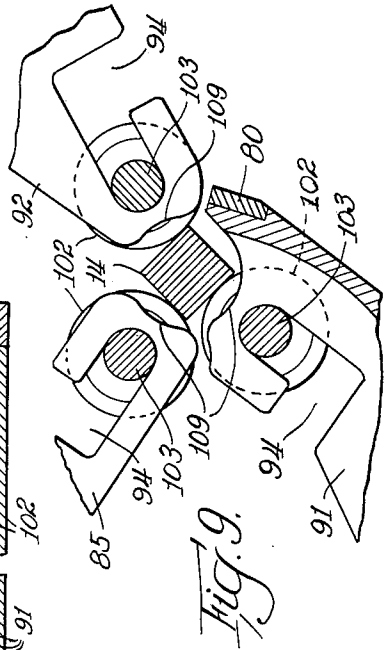


Fig. 9.

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United States Patent Office 2,797,879 Patented July 2, 1957

2,797,879

CONDENSER WINDING MACHINE

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Application July 8, 1953, Serial No. 366,823

8 Claims. (Cl. 242—56.1)

This invention relates to an apparatus for winding strip material and more particularly to a machine for winding capacitors.

It is an object of the present invention to provide an improved apparatus for expediting the winding of strip material and severing the wound material from the supply.

It is a further object of the invention to provide an apparatus for winding strip material having an improved mechanism for wrapping the end portion of the strip around the arbor.

In accordance with one embodiment of the invention as applied to an apparatus for winding capacitors from strips of metallized dielectric, the apparatus is provided with a pair of spaced parallel, horizontally disposed arbors arranged in vertically spaced relation to each other, a cutting bar disposed midway therebetween, and mechanism for rotating the arbors about their axes and for revolving the arbors about an axis intermediate the arbors, whereby the strips of dielectric are wound onto the upper arbor and on completion of the winding of the capacitor, the arbors are revolved 180° to position the strip from the wound condenser in engagement with the other arbor and in close proximity to the cutting bar. A plurality of comb-like elements of the apparatus are mounted for movement from a normal outer position to an inner position in close proximity to the upper arbor and arranged about the periphery thereof, each of the comb-like elements having yieldably mounted rollers disposed between the fingers of the elements for engaging and pressing the strips against the arbor, and the elements having curved guide surfaces on the ends of the fingers to form an annular space around the arbor. One of the comb-like elements has a longitudinally disposed portion thereon forming a pusher bar cooperable with the cutter bar during the movement of the element to its inner position for severing the strip, whereby a predetermined one of the comb-like elements may be moved to its inner position to cause the rollers thereon to press and hold the strip against the arbor, the comb element with the pusher bar thereon may then be moved to its inner position to sever the strip and wrap the end portion of the strip partially around the arbor, and a third comb element may be moved to its inner position to wrap the remainder of the end portion of the strip around the arbor to form the initial convolution of the capacitor, after which the arbor is actuated to wind a predetermined length of the strip thereon to form the capacitor. After several revolutions of the arbor the elements are returned to their normal outer positions and the winding continued.

Other objects and advantages of the invention will become apparent by reference to the following detailed description thereof and the accompanying drawings illustrating a preferred embodiment of the invention, in which

Fig. 1 is a front elevational view of the apparatus;

Fig. 2 is an end elevation of the apparatus as viewed from the right of Fig. 1;

Fig. 3 is a reduced plan sectional view of a portion of the apparatus taken on the line 3—3 of Fig. 5;

Fig. 4 is a central vertical longitudinal sectional view through the apparatus;

Fig. 5 is an enlarged vertical transverse sectional view through a portion of the apparatus taken on line 5—5 of Fig. 1 showing the parts thereof in one position;

Fig. 6 is a fragmentary detailed sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a vertical transverse sectional view similar to Fig. 5 showing some of the parts thereof in elevation and in changed position;

Fig. 8 is a fragmentary longitudinal sectional view taken on the line 8—8 of Fig. 7; and

Fig. 9 is a fragmentary view of the comb-like elements of the apparatus in operative position.

The present apparatus is designed to wind capacitor units 10 (Fig. 5) from a pair of metallized strips 12 comprising elongated webs of dielectric having a strip of metal vaporized thereon. The capacitors 10 are adapted to be wound on the upper one of a pair of arbors 14—14, which are mounted for rotation in a plurality of heads 15, 16 and 17 (Fig. 4), which in turn are rotatably supported in plates or supporting members 20, 21, and 22 secured to and extending upwardly from a base plate 23. The strips 12 from supply rolls (not shown) are guided onto the upper arbor around a roller 24 rotatably supported in and between the plates 21 and 22.

The heads 15, 16, and 17, which are centrally apertured, are secured to a shaft 26 extending through the apertures therein to form a unitary arbor supporting structure 25 and the heads 15, 16, and 17 are provided with cylindrical surfaces 27, 28, and 29, respectively, which are rotatably suported in cylindrical bearing surfaces in the plates 20, 21 and 22, respectively. The unitary supporting structure 25 is adapted to be rotated about the axis of the shaft 26 to revolve the arbors 14 therearound and the unitary supporting structure is held against longitudinal movement in one direction by the shoulder 32 of the head 17 bearing against the plate 22 and against movement in the opposite direction by a retaining ring 33 mounted on the plate 20 and engaging the head 15.

Each of the arbors 14, which preferably is of square cross-section but may be of any suitable non-circular cross-section, is secured to one end of a round rod 35 (Fig. 4) rotatably supported in a bearing 36 in the head 15 and has a handle 37 on the end thereof by means of which the arbor 14 may be axially reciprocated to permit its withdrawal from a wound capacitor 10 thereon. At the other end thereof, each of the arbors 14 has a reduced cylindrical end portion 38, which is slidable into a cylindrical aperture 39 in the head 17 and is rotatably supported thereby. Adjacent the rods 35, each of the arbors 14 is slidably supported in an aperture 41 in a bushing 42, which aperture conforms to the cross-section of the arbor 14. The bushing 42 is journalled for rotation in bearing apertures 43 in the head 16.

Gears 44 formed on the end of the bushings 42 mesh with an internal gear 45 of a ring member 46, which has axially projecting cylindrical flange portions rotatably supported on cylindrical bearing surfaces 48 and 49 formed on an axially extending portion of the head 16 and an annular member 50 secured to the head 16 by screws 51 (Fig. 3) and forming a portion thereof. An external gear 54 on the ring member 46 meshes with a gear 55 fixed to a shaft 56 supported in bearing apertures in the plates 20, 21, and 22. The shaft 56 is connected through a chain and sprocket connection 58 to a motor 60 (Fig. 3) which may be started and stopped by means of suitable controls including a switch 61, to impart rotation through the gear 55, the ring 46, the gears 44, bushings 42, to the arbors 14 for winding the strips 12 on the upper arbor to form a capacitor unit 10.

Mechanism is provided for rotating the supporting mechanism and revolving the arbors **14** through 180°, which comprises a gear **60** formed on the member **50** of the head **16**. The gear **60** meshes with a gear **61** (Figs. 1, 3, and 5) fixed to a shaft **62**, which is suitably journalled in the plates **20**, **21**, and **22** and has a crank **63** (Fig. 2) secured thereto at one end for rotating the shaft and imparting turning movement to the unitary arbor supporting structure **25**.

The arbors **14** and the arbor supporting structure **25** are adapted to be locked in operative position by a locking pin **65** (Fig. 4) having a tapered end engageable in tapered recesses **66** formed in the head **17** in alignment with the apertures **39** therein. The pin **65** is stressed for movement into engagement with the head **17** by a spring **67** and has a knob or handle **68** by means of which the pin **65** may be retracted to permit the indexing of the arbors **14**.

From the description of the apparatus thus far, it will be seen that the pair of arbors are mounted in spaced and parallel relation to each other with the upper arbor positioned in a winding position or station and the lower arbor disposed in an ejecting position or station and that the arbors are rotatable about their axes for winding the metallized strips **12** thereon when in the winding station to form the capacitor **10**, and that on completion of the winding of a capacitor on the arbor, the arbors are indexed through 180° to move the full arbor with the condenser thereon to the ejecting station and to move the empty arbor to the winding station and into engagement with the strips **12** (Fig. 5).

Mechanism is provided for severing the strips **12** intermediate the arbors and for wrapping the free end of the strips **12** from the supply rolls around the upper arbor comprising a plurality of movable guide members or combs **75**, **76**, and **77** movable through a predetermined path from a normal outer position shown in Fig. 5 to an inner or operative position shown in Fig. 7. An elongated pusher member or bar **80** mounted on the guide member **76** and forming an edge portion thereof is adapted to engage the strips **12** intermediate the arbors **14** and move the strips against the serrated edge **81** of a cutter bar **82** for severing the strips intermediate the arbors **14**. The cutters **82**, two of which are provided, are secured to opposite sides of the flattened portion **83** of the shaft **26** extending between the heads **16** and **17** (Figs. 4 and 5).

The guide members **75**, **76**, and **77** comprise comb-like bars **85**, **86**, and **87** having a plurality of fingers or teeth **90**, **91**, and **92** thereon in which are formed L-shaped slots **94**. The bars or combs **85**, **86**, and **87** have levers **95**, **96**, and **97**, respectively, secured to their ends and have rock shafts or trunnions **98**, **99**, and **100** which are journalled for oscillating movement in the plates **21** and **22**. The guide members **75**, **76**, and **77** are substantially co-extensive with the arbors **14** and are of a length substantially equal to the width of the strips **12**. Each of the guide members **75**, **76**, and **77** is provided with a plurality of rollers **102** positioned between the fingers of the several guide members and mounted on roller shafts **103** disposed in the end portions of the L-shaped slots **94** of the fingers. The ends of the shaft **103** are reduced in diameter and are journalled in bearing blocks **105** which are mounted for sliding movement in guide slots formed in the levers **95**, **96**, and **97**. Springs **107** urge the guide blocks **105**, the shafts **103**, and the rollers **102** thereon outwardly into engagement with the strips **12** when the guide members are moved to their inner or operative position, as shown in Fig. 7, to yieldably maintain the strips **12** in engagement with the arbor **14**.

The fingers **90**, **91**, and **92** of the guide members **75**, **76**, and **77** are provided with curved end guide surfaces **109**, which, when the guide members are in their inner operative position, as shown in Fig. 7, are spaced from

the arbor **14** and form a substantially complete annular guide surface surrounding the arbor, except for a space between the fingers **90** and **92**, providing clearance for the strips **12** from the guide roll **24**. The annular guide surface formed by the curved surfaces **109** in cooperation with the rollers **102** serve to guide and wrap the loose end of the webs **12** around the arbor when the guide members are moved to their inner position in a predetermined sequence.

Levers **115**, **116**, and **117** (Fig. 2) are fixed to the shafts **98**, **99**, and **100**, respectively, and serve as means by which the guide members **75**, **76**, and **77** may be moved to and from their inner and outer positions. Spring-pressed detents **118** (Figs. 2 and 6) in the handle portions of each of the levers **115**, **116**, and **117** are engageable with a pair of recesses **119** for each lever formed in the plate **22** in a position to yieldably retain the guide members in either their inner or their outer positions.

In the operation of the apparatus, after the capacitor has been completely wound on the upper arbor **14** and the arbors **14** have been indexed to move the completely wound capacitor **10** to the position shown in Fig. 5, the lever **115** may be moved from the dotted line position to the full line position shown in Fig. 2 to move the guide member **75** from its outer position to its inner position with the rollers **102** thereof in engagement with the strips **12** and yieldably pressing the strips **12** against the arbor **14**. The lever **116** may then be moved from the dotted line position to the full line position, as shown in Fig. 2, to move the guide member **96** from its outer to its inner position, during the movement of which the edge portion **80** engages the strips **12** and moves them against the serrated edge **81** of the cutter **82** and effects the severance of the strips **12** and as the guide member **76** continues its movement into its inner position, the loose ends of the strips **12** are moved laterally and upwardly and partially wrapped around the arbor **14** by the rollers **102** and the guide surfaces **109** on the guide member **76**.

The lever **117** may then be moved from the dotted line position to the full line position shown in Fig. 2 to move the guide member **77** from its outer position to its inner position to cause the rollers **102** to engage the free upwardly directed end portions of the strips **12** and move them laterally to complete the wrapping of the loose ends of the strips around the arbor **14** to form the initial convolution of the capacitor preparatory to imparting rotation to the arbor.

After the three guide members **75**, **76**, and **77** have thus been moved to their operative position in the above-described sequence, the motor drive may be started to impart rotation to the arbor **14** to wind the strips **12** thereon. The guide members **75**, **76**, and **77** may be maintained in their inner position for several revolutions of the arbor to insure a good connection between the strips **12** and the arbor after which they are returned to their normal outer positions. The yieldable mounting of the rollers **102** in the guide members **75**, **76**, and **77** and the clearance provided by the curved guide surfaces **109** permit the winding of a plurality of convolutions of the capacitor with the guide members **75**, **76**, and **77** in their inner positions. As the capacitor is being wound on the upper arbor **14**, the handle **37** of the lower arbor **14** may be engaged to withdraw the arbor from the wound capacitor **10** to effect the ejection of the capacitor from the apparatus. After a predetermined length of the strips **12** has been wound onto the arbor, the motor drive is stopped, the arbors are indexed through 180°, and the cycle of operation is repeated.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. In a machine for winding strip material, the combination of a rotatable arbor, means for supporting said strip material with the end portion thereof extending on one side of said arbor in close proximity thereto, a plurality of guide elements mounted for individual movement through predetermined paths from inoperative positions in spaced relation to said arbor to operative positions in close proximity to said arbor for engaging successive portions of the said end portion of the strip material and wrapping it around the arbor while the strip material is stationary, said guide elements in said operative position having portions disposed in close proximity one to another around the arbor to form a guiding surface encircling the major portion of said arbor and disposed in close proximity thereto and predetermined ones of said guide elements being effective when moved to operative position to support portions of the unwound strip in the path of movement of another guide element, means yieldably mounted in some of said guide elements for engagement with said arbor for yieldably pressing the strip material against the arbor, and manually operable means for moving said guide elements individually into said operative positions so that said guide elements are capable of being moved to their operative positions in a predetermined sequence to engage the strip in spaced relation to the end thereof and then successive portions thereof progressively closer to said end to wrap the end portion of the strip around the arbor to initiate the winding of the strip.

2. In a condenser winding machine, the combination of a rotatable arbor, means for supporting condenser forming strip material with the end portion thereof directed from said arbor and on one side thereof, a plurality of guide elements, means mounting said elements for movement through predetermined paths from inoperative positions in spaced relation to said arbor to operative positions in close proximity to said arbor for engaging successive portions of the said end portion of the strip material and wrapping it around the arbor while the arbor and the strip material are stationary, said guide elements in said operative positions having portions disposed in close proximity one to another around the arbor to form a cylindrical guide surface encircling the major portion of said arbor and disposed in close proximity thereto and predetermined ones of said guide elements being effective when moved to operative position to support portions of the unwound stationary strip material in the path of movement of another guide element, roller means yieldably mounted in said guide elements for engagement with said arbor to yieldably press the strip material against the arbor, manually operable means for moving said guide elements individually into said operative positions whereby said guide elements may be moved to their operative positions in a predetermined sequence to engage the strip material in spaced relation to the end thereof and then successive portions thereof progressively closer to said end to wrap the end portion of the strip material around the arbor to initiate the winding of the strip material, and means for rotating said arbor.

3. In a condenser winding machine, the combination of a rotatable arbor, means for supporting a condenser forming strip of material with the end portion thereof directed downwardly on one side of said arbor and to a position therebelow, a plurality of elements having curved guide surfaces for guiding the strip around the arbor, means pivotally mounting said elements for movement of said guide surfaces through predetermined paths from inoperative positions in spaced relation to said arbor to operative positions in close proximity to said arbor for wrapping successive portions of the said downwardly directed end portion of the strip and wrapping it around the arbor while the strip is stationary, the guide surfaces of said elements in said operative positions being disposed in close proximity one to another around the arbor and cooperating to form a cylindrical guide surface encircling the major portion of said arbor and predetermined ones of said guide surfaces being effective when moved to operative position to support portions of the unwound strip in the path of movement of another guide surface, said elements having recesses therein intersecting said curved guide surfaces, a plurality of rollers, means mounting said rollers in said recesses for rotation in said elements and for limited movement toward and away from said arbor, resilient means stressing said rollers toward said arbor, manually operable means for moving said elements individually into said operative positions so that said guide elements are capable of being moved to their operative positions in a predetermined sequence to engage the strip in spaced relation to the end thereof and then successive portions thereof progressively closer to said end to wrap the end portion of the strip of material around the arbor to form the initial convolution of said condenser, and means for rotating said arbor.

4. A machine for winding strip material comprising a pair of parallel arbors, means including a plurality of rotatable heads for supporting the arbors for rotary movement about their axes and for revolving movement about an axis intermediate said arbors whereby said arbors may be moved successively to a winding station and an ejecting station, said winding station being disposed above the ejecting station, means for guiding said strip material from a supply onto the arbor at said winding station, means for rotating said arbors at said winding station, means for rotating said heads to move a full arbor from said winding station to said ejecting station and an empty arbor to said winding station and into engagement with the strip extending from said full arbor at said ejecting station, means for severing the strip intermediate said arbors to form an end portion of the strip material suspended from the arbor at the winding station, a plurality of guide elements, means mounting said elements for movement through predetermined paths from inoperative positions in spaced relation to said arbor at said winding station to operative positions in close proximity to said arbor for engaging successive portions of the said suspended end portion of the strip material and wrapping it around the arbor while the strip is stationary, said guide elements in said operative positions having portions disposed in close proximity one to another around the arbor to form a guide surface encircling the major portion of said arbor and in close proximity thereto and predetermined ones of said guide elements being effective when moved to operative position to support portions of the unwound strip in the path of movement of another guide element, resilient means mounted in said guide elements for engagement with said arbor to yieldably press the strip against the arbor, manually operable means for individually actuating said guide elements into said operative positions whereby said elements may be moved to their operative positions in a predetermined sequence to engage the strip in spaced relation to the end thereof and then successive portions thereof progressively closer to said end to wrap the end portion of the strip around the arbor to initiate the winding of the strip, and means for ejecting said wound strip from said arbor at said ejecting station.

5. A machine for winding strip material comprising a pair of parallel arbors, means for supporting the arbors for rotary movement about their axes and for revolving movement about an axis intermediate said arbors whereby said arbors may be moved successively to a winding station, means for guiding a strip of material from a supply onto the arbor at said winding station, means for rotating said arbor at said station, means for revolving said arbors to move a full arbor from said winding station and an empty arbor to said winding station and into engagement with said strip extending from said full arbor to the supply, a cut-off member mounted between said arbors for revolving movement therewith, a plurality of guide

elements mounted for individual movement to and from inoperative positions in spaced relation to said arbor at said winding station and operative positions in close proximity to said arbor, said guide elements in said operative positions having portions disposed in close proximity one to another around the arbor to form a guide surface encircling the major portion of said arbor and in close proximity thereto, roller means yieldably mounted in some of said guide elements for engagement with said arbor for yieldably pressing the strip against the arbor, means for moving said guide elements into said operative positions in a predetermined sequence to engage and wrap successive portions of the end of the strip around the arbor, and a pusher member on one of said elements movable transversely of the strip extending between the arbors for moving the strip across the cut-off member to sever the strip.

6. A condenser winding machine comprising a pair of parallel arbors, means for supporting the arbors for rotary movement about their axes and for revolving movement about an axis intermediate said arbors whereby said arbors may be moved successively to a winding station, means for guiding a strip of material for a supply onto the arbor at said winding station, means for rotating said arbors at said station, means for revolving said arbors to move a full arbor from said winding station and an empty arbor to said winding station and into engagement with said strip of material, means for severing the strip intermediate said arbors to provide an end portion of the strip suspended from the arbor at the winding station, a plurality of guide elements mounted for individual movement through predetermined paths from inoperative positions in spaced relation to said arbor at said winding station operative positions in close proximity to said arbor for engaging successive portions of the suspended end portion of the strip and wrapping it around the arbor while the strip is stationary, said guide elements in said operative positions having portions disposed in close proximity one to another around the arbor to form a guide surface encircling the major portion of said arbor and in close proximity thereto and predetermined ones of said guide elements being effective when moved to operative position to support portions of the unwound stationary strip in the path of movement of another guide element, roller means yieldably mounted in some of said guide elements for engagement with said arbor for yieldably pressing the strip against the arbor, and manually operable means for moving said guide elements into said operative positions so that said guide elements are capable of being moved to their operative positions in a predetermined sequence to engage the strip in spaced relation to the end thereof and then successive portions thereof progressively closer to said end to wrap the end portion of the strip around the arbor to initiate the winding of the strip.

7. A machine for winding strip material comprising a pair of parallel arbors, means including a pair of rotatable heads for supporting the arbors for rotary movement about their axes and for revolving movement about an axis intermediate said arbors whereby said arbors may be moved successively to a winding station and an ejecting station, said winding station being disposed above the ejecting station, means for guiding a strip from a supply onto the arbor at said winding station, means for rotating said arbors at said winding station, means for rotating said heads to move a full arbor from said winding station to said ejecting station and an empty arbor to said winding station and into engagement with the portion of the strip extending from the full arbor at said ejecting station, a cut-off member mounted on said heads parallel to and between said arbors for revolving movement therewith, a plurality of guide elements, means

mounting said elements for movement through predetermined paths to and from operative positions in close proximity to said arbor at said winding station, the path of one of said elements intersecting the portion of the strip extending between the arbors, said guide elements in said operative positions having portions disposed in close proximity one to another around the arbor to form a guide surface encircling the major portion of said arbor and in close proximity thereto, means yieldably mounted in said guide elements for engagement with said arbor for yieldably pressing the strip against the arbor, means for actuating said guide elements whereby said elements may be moved into said operative positions in a predetermined sequence to engage and wrap successive portions of the end of the strip around the arbor, a pusher bar, means mounting said bar on said one element for movement therewith to move the strip across the cut-off member for severing the wound strip from the supply, and means for axially reciprocating the arbor in said ejecting station to eject the wound strip therefrom.

8. A machine for winding condensers from strip material comprising a pair of parallel arbors, means including a pair of rotatable heads for supporting the arbors for rotary movement about their axes and for revolving movement about an axis intermediate said arbors whereby said arbors may be moved successively to a winding station and an ejecting station in which the winding station is disposed above the ejecting station, means for guiding said strip material from a supply onto the arbor at said winding station, means for rotating said arbors at said winding station, means for rotating said heads to move a full arbor from said winding station to said ejecting station and an empty arbor to said winding station and into engagement with the portion of the strip extending from the full arbor at said ejecting station, a cut-off member mounted on said heads parallel to and between said arbors for revolving movement therewith, a plurality of elements having curved guide surfaces for guiding the strip around an arbor in said winding station, means pivotally mounting said elements for movement of said guide surfaces from inoperative positions remote from an arbor in the winding station to operative positions in close proximity to said arbor, the guide surfaces of said elements in said operative positions being disposed in close proximity one to another around the arbor and cooperating to form a cylindrical guide surface encircling the major portion of said arbor, said elements having recesses therein intersecting said curved guide surfaces, a plurality of rollers, means mounting said rollers in said recesses for rotation in said elements and for limited movement toward and away from said arbor, resilient means stressing said rollers toward said arbor, means for moving said elements into said operative positions in a predetermined sequence to engage and wrap successive portions of the end of the strip material around the arbor to form the initial convolution of said condenser, means on one of said elements for pushing the strip material across said cutoff member to sever said strip, means for rotating said arbor, means for releasably holding said arbors in said stations, and means for ejecting the wound condenser at said ejecting station.

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