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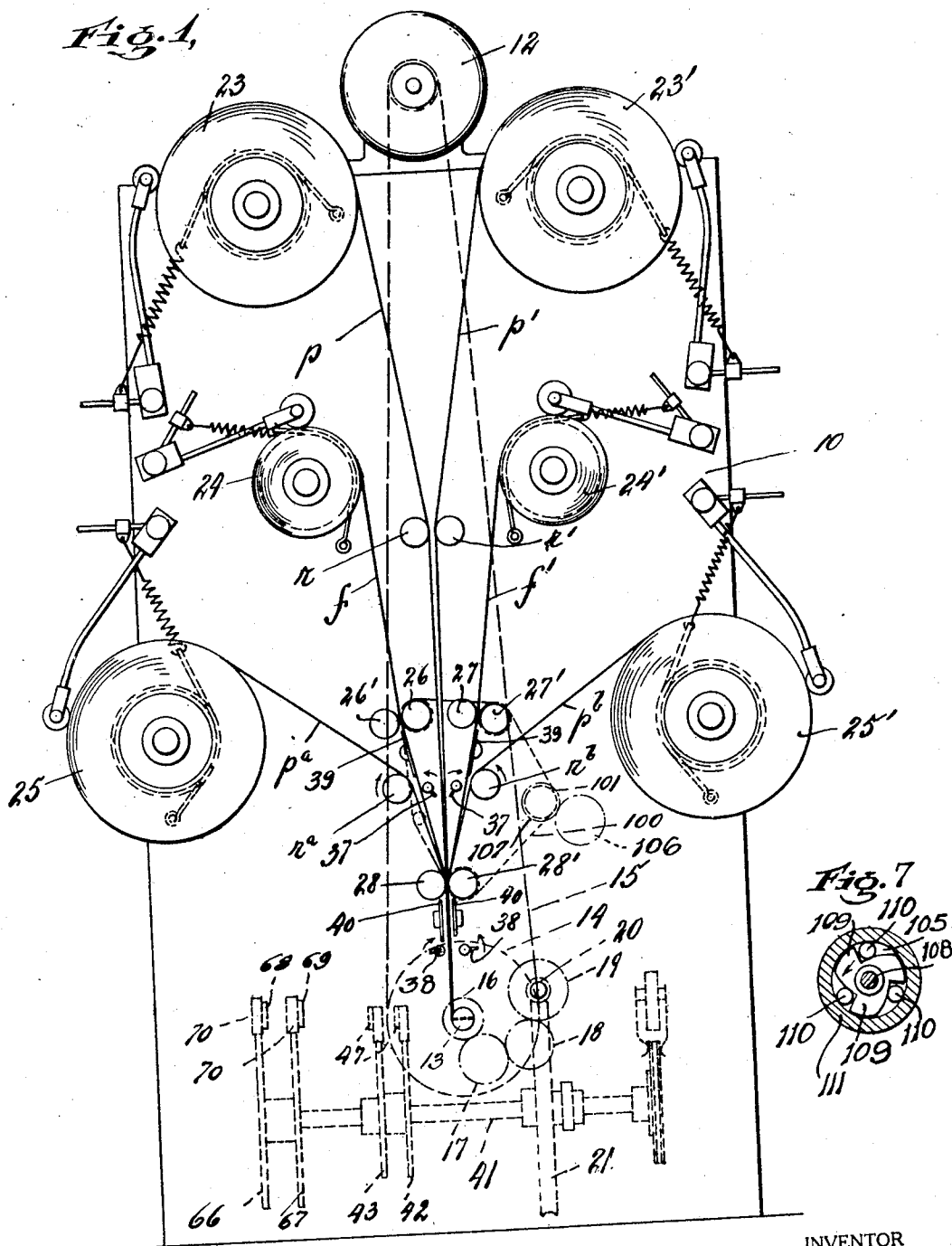
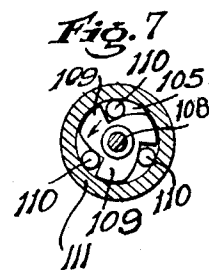
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APPARATUS FOR WINDING COIL CONDENSERS

Filed May 10, 1926

3 Sheets-Sheet 1



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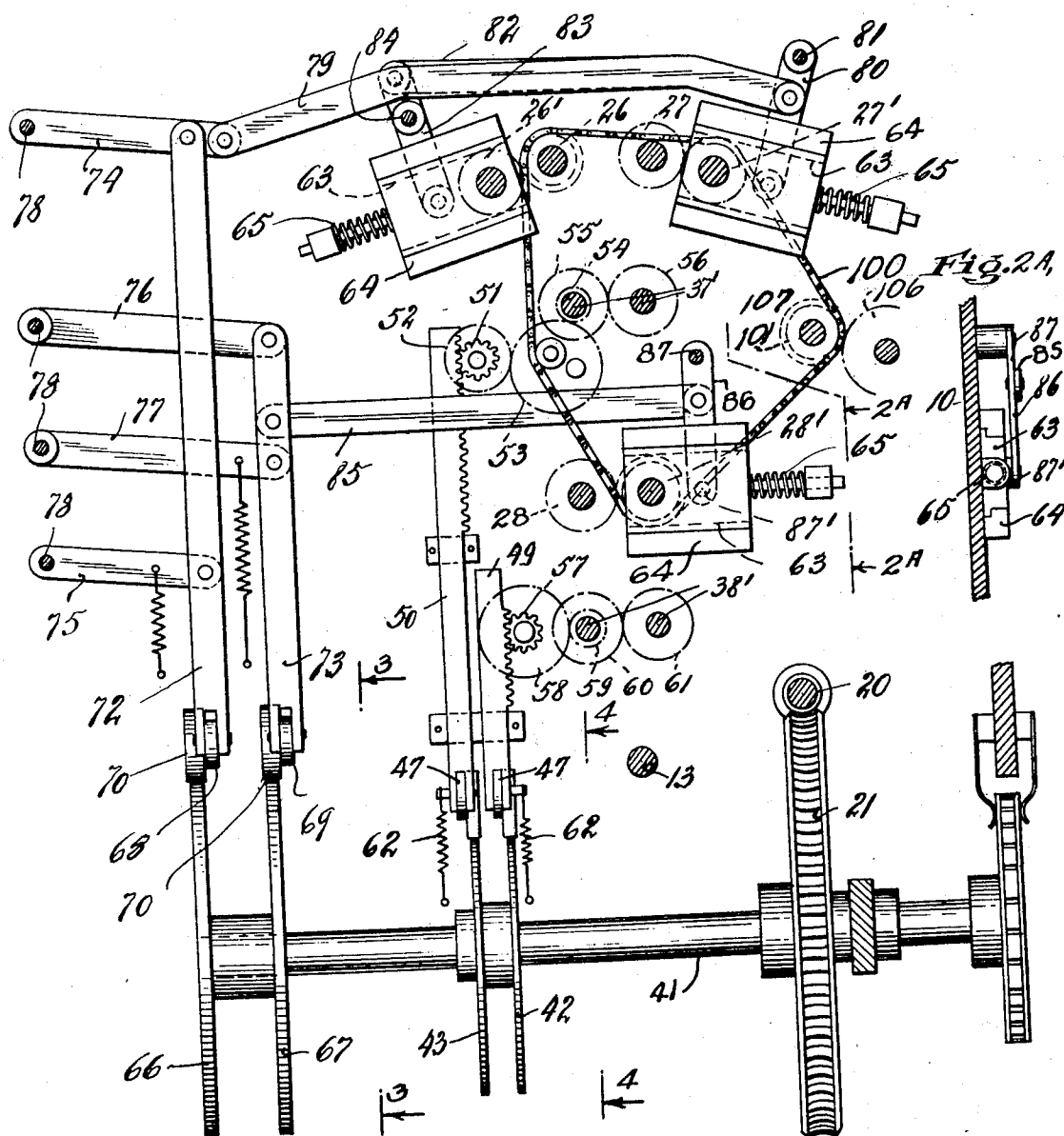
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Fig. 2,



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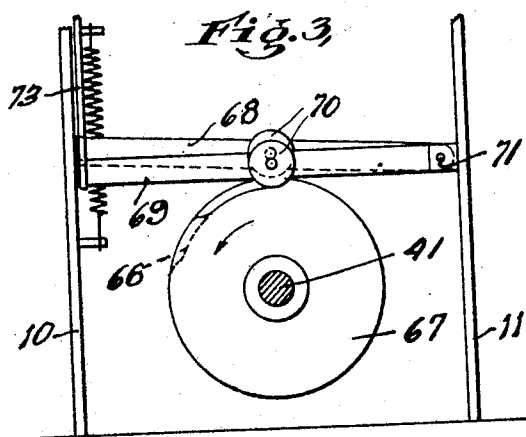
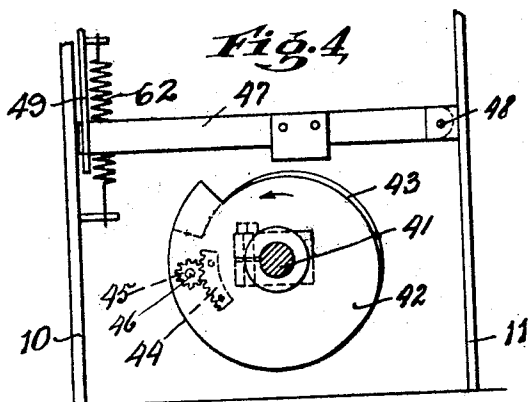
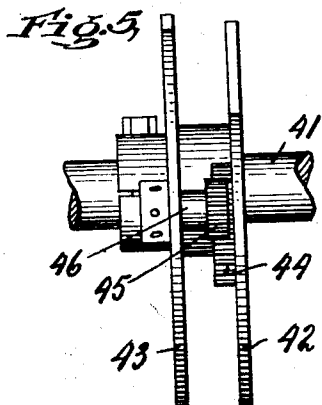
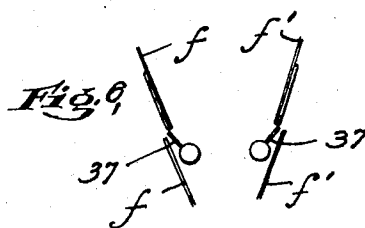
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APPARATUS FOR WINDING COIL CONDENSERS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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APPARATUS FOR WINDING COIL
CONDENSERS

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Application May 10, 1926. Serial No. 107,983

24 Claims. (Cl. 242—56)

This invention relates to automatic machines for winding coil condensers and has for its main object to provide a construction which will be comparatively simple and yet efficient to produce condensers sufficiently compact and solid to withstand considerable mechanical stress and which will have a maximum electrostatic capacity.

Another object of this invention is to provide an apparatus for doing the work of winding the condensers and performing automatically all operations which hitherto have been done by hand, whereby a considerably larger output is insured and the cost of manufacture of the condensers is reduced to a minimum.

To accomplish these objects my apparatus comprises substantially a rotatable split or sectional mandrel, a plurality of rotatable reel supports from which bands of dielectric and foil are adapted to unwind in a downwardly converging manner toward said mandrel, automatically controlled means for retaining the tension of the unwinding bands, means for holding said bands separated during their entire unwound length, automatically controlled rotary cutters, automatically controlled feed rollers, whereby the tension of the bands will be increased during the cutting operation and reduced during the winding operation, means for automatically controlling the length of the bands to be wound around the mandrel, and means for automatically stopping the apparatus in case the dielectric or foil bands break or give out.

My invention also consists in the novel construction, arrangement and combination of parts as will be hereinafter described and defined in the appended claims.

In the accompanying drawings which form part of this specification and in which similar reference characters denote corresponding parts,

Fig. 1 is a front elevation of my improved apparatus;

Fig. 2 is an inner view of the apparatus with the front plate of the frame removed;

Fig. 2A is a fragmentary end view taken substantially along the line 2A—2A of Fig. 2;

Fig. 3 is a section on the line 3—3 of Fig. 2 seen in the direction of the arrows;

Fig. 4 is a section on the line 4—4 of Fig. 2 seen in the direction of the arrows;

Fig. 5 is a side view of the cams shown in Fig. 4;

Fig. 6 is a detail view of one of the cutting mechanisms showing the same in operation; and

Fig. 7 is a detail of a feed roller.

The machine comprises a frame composed of

two upstanding parallel plates, a front plate 10 and a rear plate 11 spaced apart and suitably joined together. Supported on the frame is the main motor 12 from which is suitably driven as by means of pulley 14 and belt 15 a shaft 13 which extends transversely through the frame at the lower part of the latter. One end of said shaft projects forwardly from the front plate 10 and constitutes the mandrel of the condenser. The other end of the shaft 13 carries a gear 16 which through a train of gears 17, 18 and 19 drives a worm 20, which meshes with a worm gear 21 mounted on a shaft 41 extending at a right angle to and below the shaft 13 through the space between the two plates 10 and 11.

Rotatively supported on the outside of the plate 10 of the frame are three pairs of drums or the like 23, 23¹, 24, 24¹ and 25, 25¹, adapted to carry the stock of paper or dielectric and foil. The drums of each pair are arranged equi-distantly from the central vertical line of the frame and the three pairs are arranged in a vertical superposed order. The uppermost drums 23, 23¹ and the lowermost drums 25, 25¹, are adapted to carry the paper stock while the intermediate drums 24, 24¹, are adapted to carry the foil stock. It will be noted that the drums carrying the foil stock are arranged closer to the central vertical line than those carrying the paper stock and between the latter. The strips or bands of papers, *p*, *p*¹, serve as the inner layers and the strips or bands of papers *p*^a, *p*^b, as the outer layers for the strips or bands of foil *f*, *f*¹. All these strips are adapted to pass from the top of their respective drums and to converge downwardly toward the central vertical line and toward the mandrel on which the condenser is to be wound. The paper strips *p*, *p*¹, are guided over guide rollers *r*, *r*¹, and the paper strips *p*^a, *p*^b, are guided over guide rollers *r*^a, *r*^b. The strips of foil *f*, *f*¹, are guided over guide rollers 26, 27, respectively with which cooperate feed rollers 28¹ and 27¹. A pair of main feed rollers 28 and 28¹ serve to feed all strips, brought together at the lower part of the apparatus a short distance from the mandrel, onto the latter.

To cut off the foil and the paper after a certain number of windings thereof around the mandrel 13, I provide suitable rotary cutters 37, one cutter for each strip of foil, and a pair of cutters 38 for the paper strips. Plates 39 and 40, fixed to the frame and extending parallel to the outer faces of the different strips, serve as rests for the latter during the cutting operations. In order that the foil layers may be completely enveloped between the layers of dielectric, so as to prevent contact

between such foil layers, the cutters are so timed that the foil strips will be cut off in advance of the paper or dielectric strips. The cutters or knives are adapted to be driven from the spindle 41 by the following mechanism.

Mounted on the spindle 41 in parallelism and adjacent to one another are two cams 42, 43 of which 42 is fixed to the shaft 41 and the cam 43 is clamped to be adjustable thereon relative to the cam 42. The latter cam has secured to its inner face a toothed sector 44 with which is adapted to mesh a pinion 45 carried by a pin 46, projecting from the opposite inner face of the cam 43. By means of sector 44 and pinion 45 the two cams 42, 43, can be adjusted relative to one another so that the cutting operation performed on the foil strips will take place sooner or later relative to the cutting operation performed on the paper strips. Each of these cams operates a horizontally extending bar 47 pivoted to the frame at 48 at one end and at the opposite end engaging a vertically moving spring actuated rack 49, 50, respectively. The rack 50 meshes with a pinion 51 which through a train of gears 52, 53, 54, 55, 56 slowly drives the spindles 37¹ of the rotary knives 37 in opposite directions, the one at the left in Fig. 1 in a clockwise direction, and the one at the right in a counter-clockwise direction. The rack 49 meshes with a pinion 57 which through a train of gears 58, 59, 60 and 61 slowly drives the spindles 38¹ of the rotary knives 38, the one at the left of Figure 1 in a counter-clockwise direction, and the one at the right in a clockwise direction. Upon reference to Figure 4, it will be observed that at predetermined relative times the springs 62 become operable suddenly to return the respective bars 47 to their downward positions, thus drawing the racks 49 and 50 successively and suddenly downward and causing the rotary knives 37 and 38 to rotate suddenly in the directions of the arrows of Figure 1 to cut the respective strips. Upon further rotation of the cams 42 and 43 the racks 49 and 50 are again slowly raised as before, thereby tensioning the springs 62 into readiness for the next cutting operations.

The feed rollers 26¹, 27¹ and 28¹ are made adjustable relative to the rollers 26, 27 and 28 with which they respectively cooperate, so that the tension on the strips may be increased during the cutting operation and reduced during the winding operation. To this end these feed rollers have spindles which extend through slots in the plate 10 and are rotatively journaled in adjustable bearings each of substantially the same construction. Each adjustable bearing consists of a slide 63 borne in a block 64 suitably fixed to the frame. The slide is actuated at predetermined times by a comparatively heavy spring 65 which tends to suddenly move and hold the slide in such position that the roller journaled therein will be in strong frictional contact with the corresponding roller of the pair, and thereby exert the necessary tension on the particular strip conveyed between the same. Each slide 63 is normally retained away from the corresponding one of the rollers 26, 27, 28, the spring being under compression. The adjustment of the slide or bearing 63 is automatically controlled from the shaft 41. To this end I provide on the latter another pair of cams 66, 67, each of which cooperates with a vertically swinging horizontal arm 68, 69, respectively, through the medium of a roller 70. Each of these arms at one end is fulcrumed to the frame at 71 and at the opposite end is connected to a bar 72, 73, respectively, suitably guided in verti-

cal direction, each by a pair of oscillatory arms 74, 75 and 76, 77 respectively pivoted to the frame as at 78. One of the pair of arms 74, 75 is connected by a link 79 to a lever 80, which is pivoted at one end 81 to the frame, and at the other end to one of the slides 63. This lever is also connected by a link 82 to a double armed lever 83 fulcrumed to the frame at 84 and pivoted to the other slide 63. The swinging of the levers 80 and 83 will cause the slides 63 of the feed rollers 26¹, 27¹ to move into frictional contact with, or away from, their adjacent rollers 26 and 27. The bar 73 is connected by a link 85 to a lever 86 which is fulcrumed to the frame at one end 87 and at the opposite end 87¹ to the slide 63 of the feed roller 28¹. The two cams 66, 67 which are uniform in shape are so adjusted that one will operate in advance of the other; that is, the feed rollers 26¹, 27¹ feeding the foil will be operated in advance of the feed roller 28¹ to correspond with the timing of the cutting operations of the foil and of the paper strips.

The rollers 26, 27¹ and 28¹ are all driven from the worm operated spindle 41 by means of a set of gears (not shown) through the medium of gears 106 and 107, a sprocket chain 100, and sprocket wheels such as that shown at 101. Each of said rollers is mounted on its driven shaft by suitable coupling such as that shown at 105 in Fig. 7, whereby the rotary motion of said roller is enabled to adapt itself to the speed of travel of the corresponding strips fed by it. That is, the shaft 108 has the cam teeth 109 mounted thereon. The shaft rotates in the direction of the arrow of Figure 7, and as long as it moves faster than the roller 111 mounted thereon, the loose balls or rollers 110 are jammed against the inner surface of said roller to drive the latter. The roller 111 is free, however, to move faster than the shaft 108 at any time, for in such an event, the balls 110 are freely rotatable without jamming.

The apparatus hereinbefore described has been found to be very effective producing condensers of a high degree of solidity in minimum time.

It is, of course, understood that my apparatus may be modified in various ways without departing from the principle of my invention. I, therefore, do not wish to restrict myself to the details described and shown herein. For example, it will be understood that the terms "foil" and "paper", as the same are used herein and in the appended claims, are intended to signify any conventional types of conductive and non-conductive materials, used in the winding of coiled condenser bodies.

What I claim is:—

1. In a condenser winding machine, a supply of paper, a supply of metallic foil, a rotatable arbor on which the paper and foil are adapted to be wound, means for severing the foil and paper, means driven in timed relationship with the arbor, and means controlled by the last-mentioned means for causing the operation of said severing means to sever the foil prior to the severance of the paper.

2. In a condenser winding machine, a supply of paper, a supply of metallic foil, a rotatable arbor on which the paper and foil are adapted to be wound, means for severing the foil and paper, adjustable means driven in timed relation with the arbor, and means controlled by the last-mentioned means for causing the operation of said severing means to sever the foil prior to the severance of the paper.

3. In a condenser winding machine, a supply

of paper, a supply of foil, a rotatable arbor on which the paper and foil are adapted to be wound, cutters for the foil and paper, mechanism driven in timed relation with the arbor for controlling the operation of said cutters to sever the foil prior to the severance of the paper, and means for adjusting said mechanism so as to vary the amount of such priority of severance.

4. In apparatus for winding coil condensers of alternate layers of foil and dielectric, cutters in the path of said layers adapted to cut the latter after predetermined lengths thereof have been wound, means for transmitting motion to said cutters, a pair of driven cams controlling the operation of said cutters and means for adjusting said cams relative to one another to vary the relative lengths of the strips to be wound.

5. In apparatus for winding coil condensers of alternate strips of foil and dielectric, cutters in the path of said strips adapted to cut the latter after predetermined lengths thereof have been wound, a driven spindle, means for transmitting motion to said cutters including cams of which one is fixed on said driven spindle and the other adjustable thereon, a toothed sector in one of said cams and a pinion in the other cam meshing with said sector and serving for the adjustment of said cams relative to one another to vary the length of the strips to be wound.

6. In a winding machine for a coiled condenser body, a rotatable arbor, reels for a supply of conductive and non-conductive strips, means for winding said strips in alternate superposition onto said arbor, means automatically operative before the completion of the winding operation to sever the strips after differing lengths thereof have been wound, and means for automatically advancing the new ends resulting from said severance, at a retarded rate, from said reels toward said arbor so as to position them in readiness for the subsequent winding of another condenser body.

7. An apparatus for winding coil condensers of alternate strips of dielectric and foil, comprising a rotary condenser support upon which said strips are adapted to be wound, cutters adapted to cut said strips after predetermined lengths have been wound and so timed that the strips of foil will be cut off in advance of the dielectric strips, and means operable in timed relation to said cutters for momentarily varying the tensions on said strips during respective cutting operations.

8. An apparatus for winding coil condensers of alternate strips of dielectric and foil, comprising a rotary condenser support upon which said strips are adapted to be wound, cutters so timed as to cut off the strips of foil in advance of the dielectric strips and after predetermined lengths thereof have been wound, and means operable in timed relation to said cutters for increasing the tension on said strips during the cutting operation and decreasing the same during the normal winding operation.

9. In apparatus for winding a continuous strip upon a mandrel, means for exerting a continuous pull upon the strip in the direction of the mandrel, means for cutting said strip during the winding thereof after a predetermined length thereof has been wound, and means operable in timed relation to the cutting means for momentarily increasing the tension of the strip.

10. In apparatus for winding a continuous strip upon a mandrel, means for exerting a continuous pull upon the strip in the direction of the mandrel, means for cutting said strip during the

winding thereof after a predetermined length thereof has been wound, and means operable in timed relation to the cutting means for momentarily increasing the tension of the strip, said last named means comprising a gripping device adapted to frictionally engage the strip and thereby retard it at a point behind the cutting point.

11. In apparatus for winding a continuous strip upon a mandrel, means for exerting a continuous pull upon the strip in the direction of the mandrel, means for cutting said strip during the winding thereof after a predetermined length thereof has been wound, and means operable in timed relation to the cutting means for momentarily increasing the tension of the strip, said last named means comprising a pair of relatively movable and normally spaced friction rollers positioned behind the cutting point and on opposite sides of the strip, whereby movement of the rollers to engage the strip therebetween will counteract the pulling means and thereby create said tension.

12. In apparatus for winding a continuous strip upon a mandrel, means for rotating the mandrel to exert a continuous pull upon the strip being wound, a normally inoperative cutting device positioned to operate upon the strip during the winding thereof so as to sever the strip after a predetermined length thereof has been wound, means for rendering said cutting device operative at a predetermined time, and means operable in timed relation to the cutting device's operation for momentarily increasing the tension of the strip portion which includes the cutting point during the cutting operation, said last named means comprising a device adapted to engage and retard the strip at a point behind the cutting device.

13. In apparatus for winding coil condensers of alternate foil and dielectric strips, a set of rollers for said strips, adjustable bearings carrying said rollers, a second set of rollers cooperating respectively with said first named rollers, driving means, and cam controlled means impelled from said driving means for adjusting said bearings to either increase the pressure between respective rollers or decrease the same.

14. In a winding device for a plurality of superposed strips comprising alternate foil and dielectric material, a receiving mandrel, means for rotating the mandrel to wind the strips thereon, a pair of normally inoperative rollers between which all strips pass in approaching the mandrel, a cutting device in advance of said rollers, pairs of normally inoperative rollers between which only the foil strips pass in approaching the first mentioned pair, a cutting device in advance of each of said foil rollers, means for rendering said rollers operative at predetermined relative times for engaging the strips between them and thus increasing the tension of the engaged strips in advance of the operative rollers, and means for rendering the cutting devices operative in timed relation to the tensioning.

15. In a winding device for a plurality of superposed strips comprising alternate strips of foil and dielectric material, a receiving mandrel, means for rotating the mandrel to wind the strips thereon, a pair of normally inoperative rollers between which all strips pass in approaching the mandrel, a cutting device in advance of said rollers, pairs of normally inoperative rollers between which only the foil strips pass in approaching the first mentioned pair, a cutting de-

vice in advance of each of said foil rollers, means for rendering said rollers operative at predetermined relative times for engaging the strips between them thus increasing the tension of the engaged strips in advance of the operative rollers, and means for rendering the cutting device operative in timed relation to the tensioning, said means being operative to tension and cut the strips in such a manner that the foil strips wound upon the mandrel will be of shorter length than the dielectric strips.

16. In apparatus for winding a plurality of continuous strips in superposed relationship upon a mandrel, means for exerting a continuous pull upon the strips in the direction of the mandrel, means for cutting certain of said strips after predetermined lengths thereof have been wound, and means for cutting certain other of said strips after different predetermined lengths of other strips have been wound, said cutting means comprising a series of cutting devices positioned respectively so as to be operable upon respective strips, means for rendering said cutting devices operative at predetermined relative times, and means operable in timed relation to the cutting devices for momentarily increasing the tension of the respective strips adjacent to the respective cutting devices during the cutting operations.

17. In apparatus for winding coil condensers of continuous strips of alternately superposed strips of dielectric and foil, a rotatable mandrel for receiving the strips, means for rotating the mandrel to exert a continuous pull upon the strips, cutting devices operatively positioned with respect to the foil strips, cutting devices operatively positioned with respect to the dielectric strips, and means for rendering said cutting devices operable at predetermined relative times so that the foil strips will be cut after predetermined lengths thereof have been wound, and so that the dielectric strips will be cut after predetermined greater lengths thereof have been wound, and means operable in timed relation to the cutting devices for momentarily tensioning the foil strips and the dielectric strips respectively during the respective cutting operations.

18. In a winding device for a plurality of superposed strips, a driven receiving mandrel for the strips, a plurality of normally inoperative roller pairs between which selected strips or groups of strips may be made to pass in approaching the mandrel, and means for rendering said pairs operative at predetermined relative times for engaging the strip or strips between them and thus increasing the tension of the engaged strip or strips in advance of the operative pairs.

19. In a winding device for a plurality of superposed strips, a driven receiving mandrel for the strips, a plurality of normally inoperative roller pairs between which selected strips or groups of strips may be made to pass in approaching the mandrel, and means for rendering said pairs operative at predetermined relative times for engaging the strip or strips between them and thus increasing the tension of the engaged strip or strips in advance of the operative pairs, and means for cutting said strips in timed relation to the tensioning thereof.

20. In a winding device for a plurality of superposed strips, a driving receiving mandrel for the strips, a plurality of normally inoperative roller pairs between which selected strips or groups of strips may be made to pass in approaching the mandrel, and means for rendering said pairs operative at predetermined relative times for engaging the strip or strips between them and thus increasing the tension of the engaged strip or strips in advance of the operative pairs, a normally inoperative cutting device in advance of each roller pair, and means for operating said cutting devices in timed relation to the tension for cutting the tensioned strips.

21. In a winding device for a plurality of superposed strips, a driving receiving mandrel for the strips, a plurality of roller pairs between which selected strips or groups of strips may be made to pass in approaching the mandrel, each pair comprising relatively movable rollers which are normally spaced to permit free passage therebetween, and means for moving the rollers of said pairs at predetermined relative times to engage the strip or strips between them and thus increase the tension, at predetermined times, of the engaged strip or strips in advance of each pair.

22. In a winding device for a plurality of superposed strips, a mandrel for receiving the strips thereon, means for driving the mandrel, a pair of normally inoperative rollers between which all strips pass in approaching the mandrel, pairs of normally inoperative rollers between which only certain strips pass in approaching the first mentioned pair, and means for rendering said rollers operative at predetermined relative times for engaging the strips between them and thus increasing the tension of the engaged strips in advance of the operative rollers.

23. In apparatus for winding coil condensers, a rotary condenser support, a plurality of reels for foil and dielectric reel stock, means for guiding and feeding the foil and dielectric strips, rotary cutters, a worm driven spindle, cams operated from said spindle and controlling the operation of said cutters so that the foil strips will be cut in advance of the dielectric strips.

24. In apparatus for winding coil condensers, a plurality of pairs of reels for foil and dielectric stock, said pairs being arranged in vertically superposed position and the pair of reels carrying the foil stock being arranged intermediate the two pairs of reels carrying the dielectric stock, a rotary mandrel for the coil condenser, means for guiding and feeding strips of foil and dielectric from said reels in a converging manner toward and onto said mandrel, cutters, automatically controlled means for causing said cutters to cut off the foil strips in advance of the dielectric strips and automatically controlled means for increasing the tension on the strips during the cutting operation and reducing the same at the instant that winding operation begins.

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DISCLAIMER

1,940,847.—Harold I. Danziger, New York, N. Y. APPARATUS FOR WINDING COIL CONDENSERS. Patent dated Dec. 26, 1933. Disclaimer filed May 8, 1945, by the assignee, Condenser Corporation of America. Hereby enters this disclaimer to claims 1, 2, and 3 in said specification. [Official Gazette June 5, 1945.]