

March 18, 1952

P. J. McCULLOUGH
METHOD AND MACHINE FOR WINDING
ELECTRICAL RESISTANCE UNITS

2,589,503

Filed April 24, 1947

4 Sheets-Sheet 1

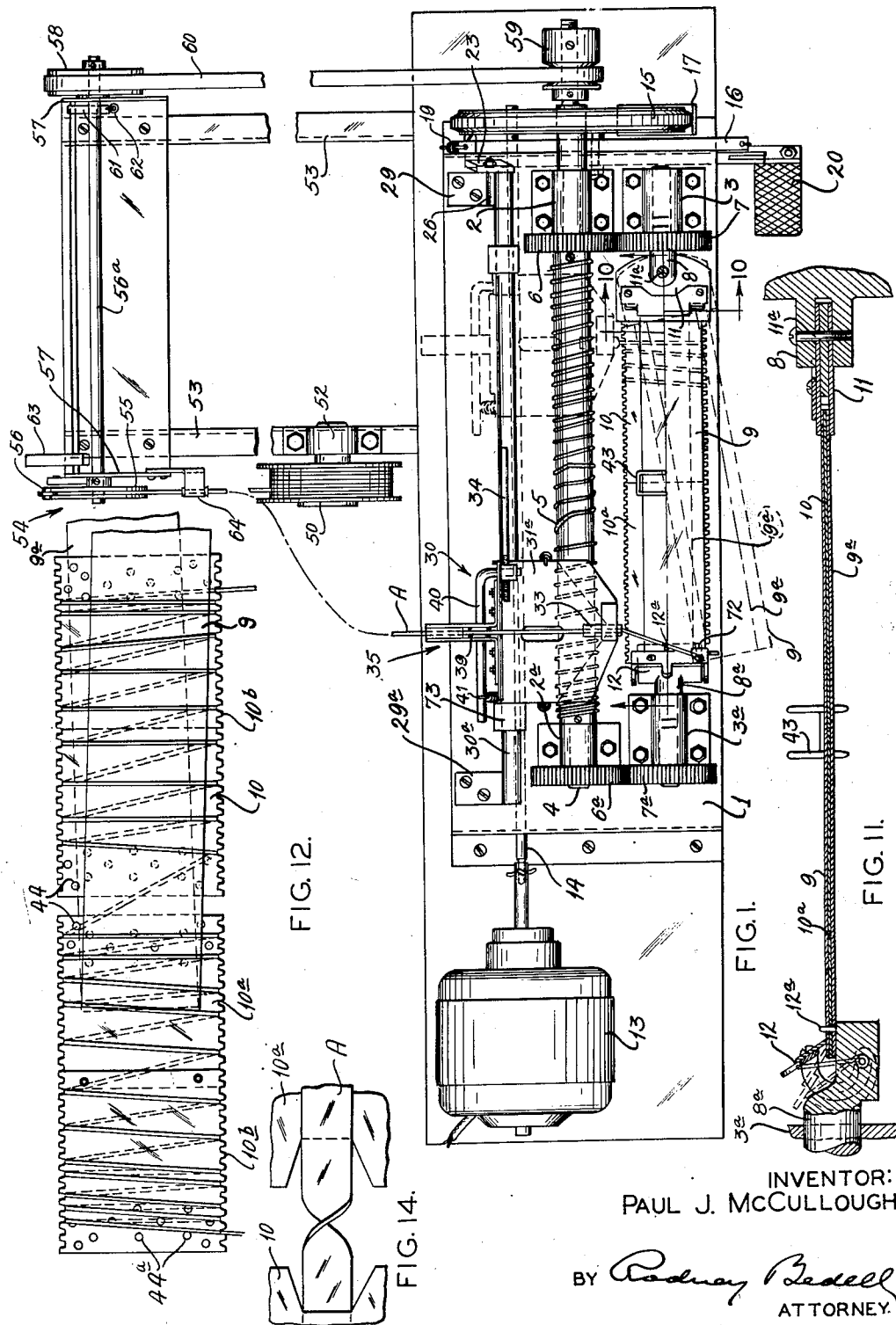


FIG. 12.

FIG. 14.

FIG. 1.

FIG. 11.

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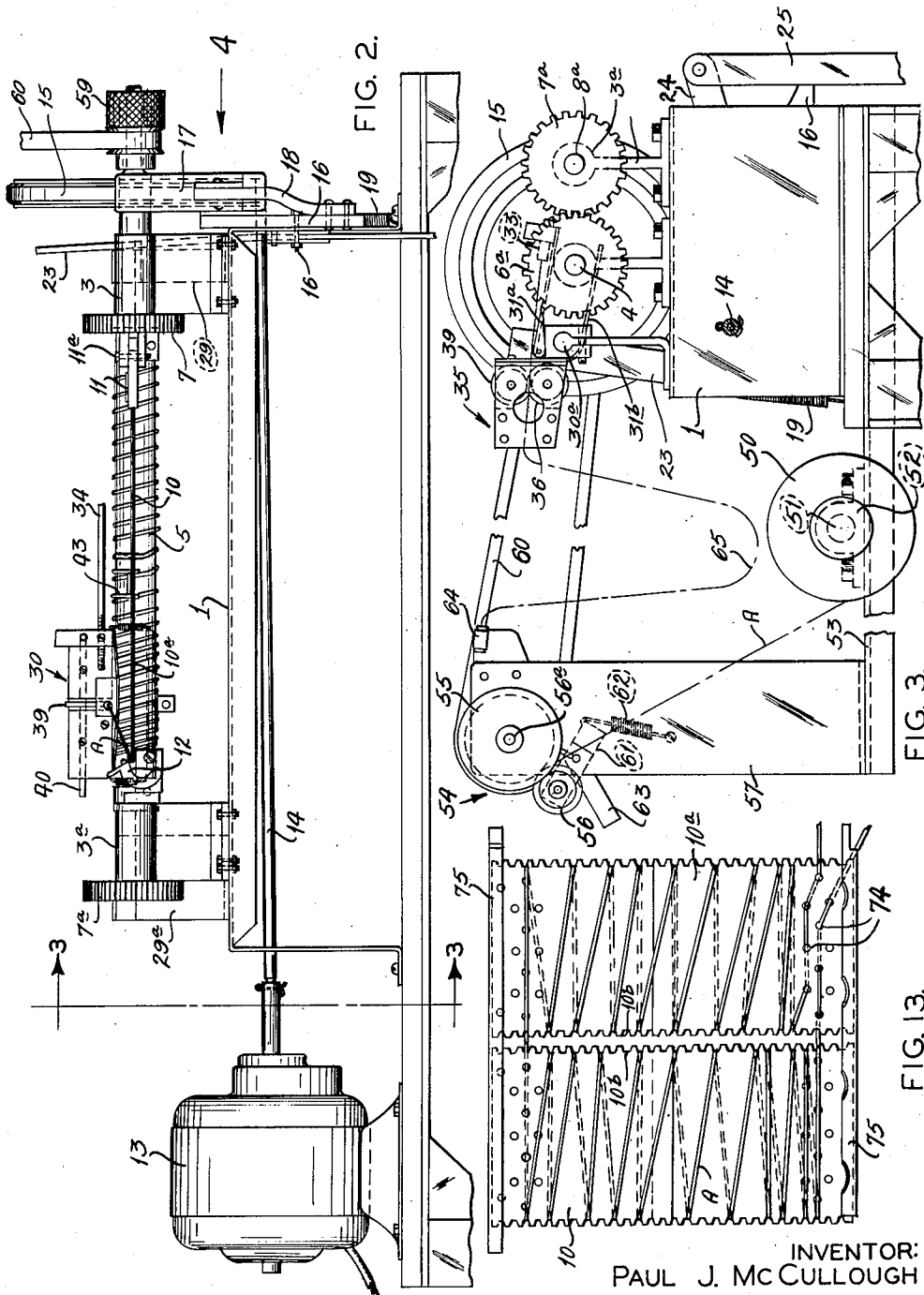
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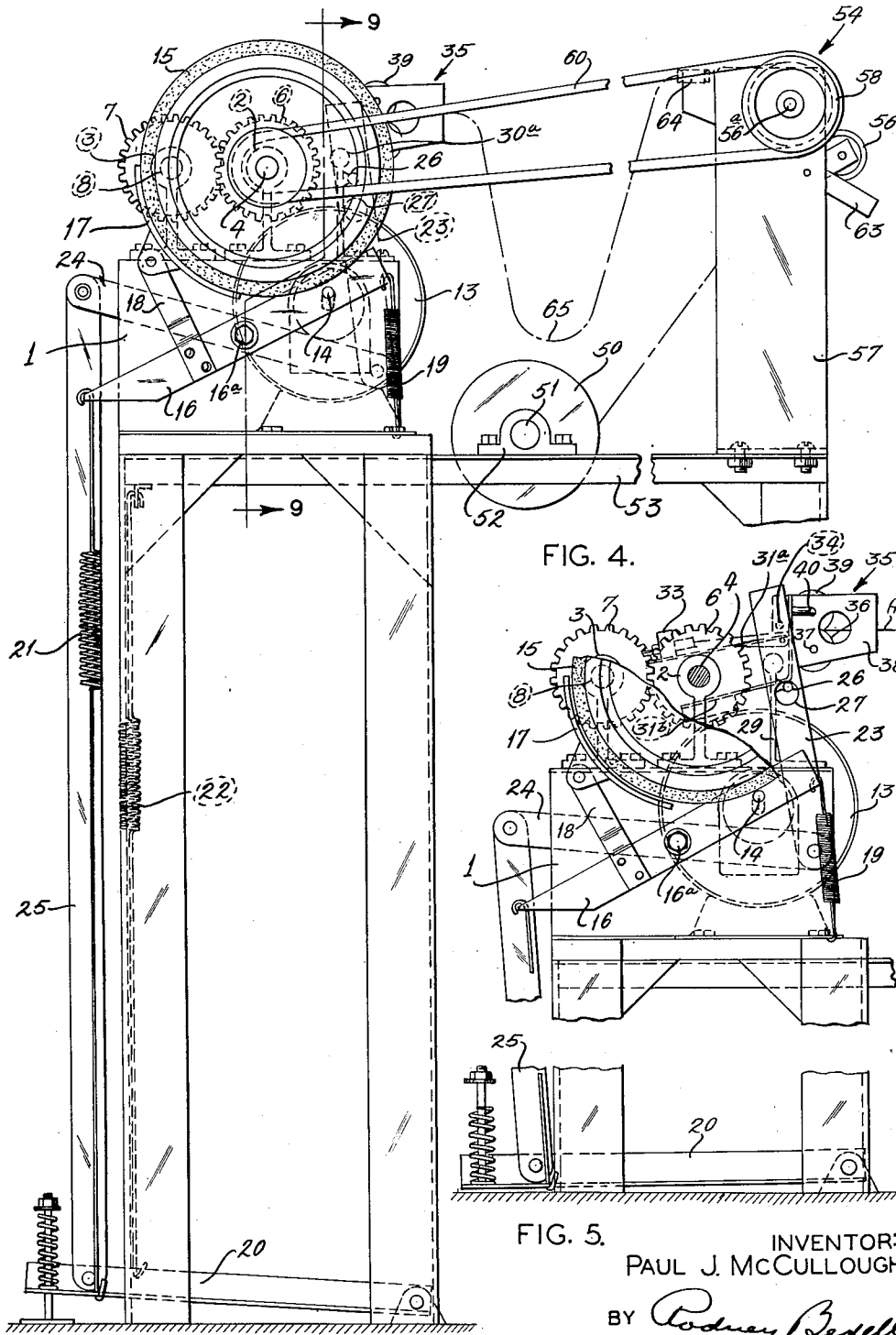


FIG. 4.

FIG. 5.

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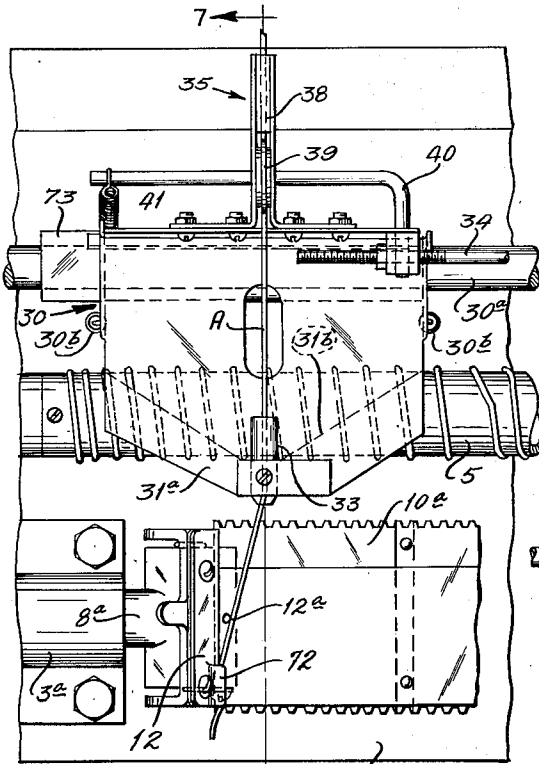


FIG. 6.

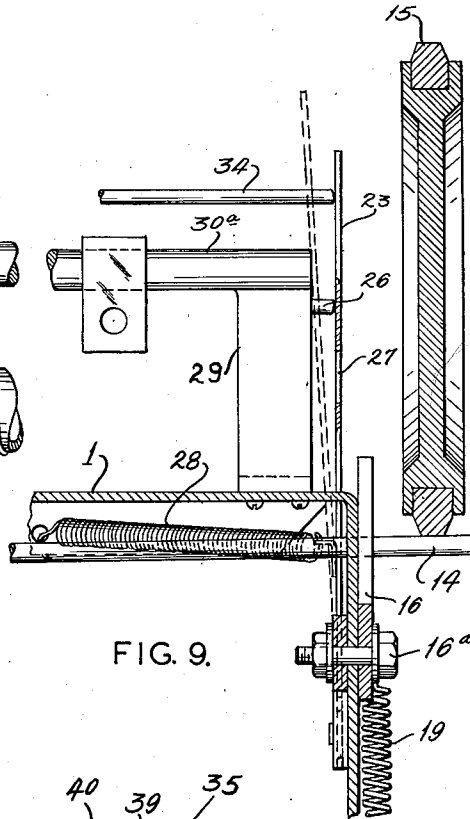


FIG. 9.

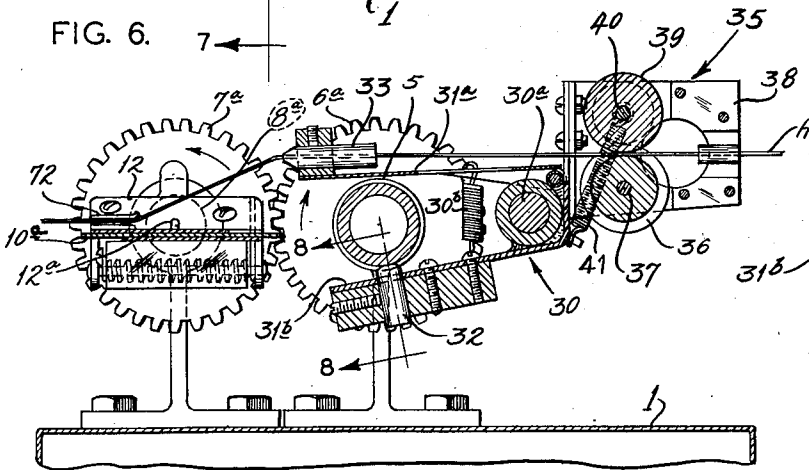


FIG. 7.

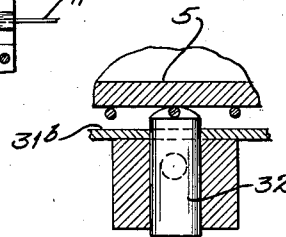


FIG. 8.

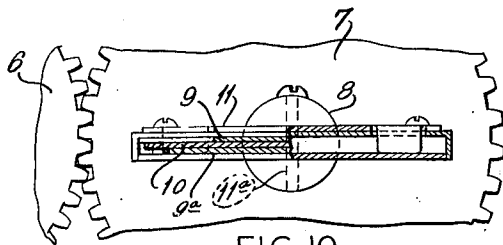


FIG. 10.

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UNITED STATES PATENT OFFICE

2,589,503

METHOD AND MACHINE FOR WINDING ELECTRICAL RESISTANCE UNITS

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Application April 24, 1947, Serial No. 743,539

4 Claims. (Cl. 29—155.5)

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The invention relates generally to wire winding and more particularly to the winding of electric resistance elements commonly used, for example, in electric toasters.

Such a heating element comprises a flat substantially non-rigid insulating sheet having a resistance wire wound thereon. A heating unit may comprise a pair of such elements arranged edge to edge and held in alignment by relatively rigid strips applied to their ends. Preferably the resistance wire is wound separately over successive sheets before the rigid strips are assembled to the sheets.

Heretofore, it has been the practice to wind the heating elements by hand. This operation consumes considerable time and it requires skill to tension the wire on the sheets uniformly by hand so that the wire will not sag when heated.

One object of the invention is to provide a method and a machine for winding the wire on a sheet with uniform tension.

Another object is to provide a method and a machine for winding a resistance wire continuously and successively and with uniform tension on a pair of sheets arranged end to end so that they may be turned to side to side position to form a finished unit as described above.

Another object is to wind heating elements of the kind described more rapidly than heretofore and particularly to effect rapid and accurate winding by inexperienced operators.

Another object is to produce a heating element having a substantially uniformly tensioned resistance wire wound about a sheet of insulating material and more particularly to produce a heating unit comprising a pair of such elements with continuous, successive windings.

Other objects will be apparent to those skilled in the art from the following description and accompanying drawings.

The method comprises clamping two sheets of insulating material end to end between a pair of rotatably mounted relatively rigid plates and securing an end of the wire so that the wire winds on the sheets and plates when the sheets and plates are rotated. The wire is guided lengthwise of the sheets and plates as it winds thereon. The sheets are slid endwise from between the plates and then are rotated relative to one another in the plane of the sheets until their side edges are adjacent one another. The sheets are held in this position by assembling a rigid member to the ends of the sheets. The ends of the wire are laced through apertures in one of the sheets provided for that purpose.

The machine for winding the elements com-

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prises a pair of relatively stiff plates adapted to clamp between them end to end the sheets to be wound with the side edges of the sheets projecting beyond the side edges of the plates. The plates are rotated to wind the wire on the sheets and plates. A table moves lengthwise of the plates and tensions and guides the wire as it winds on the plates and sheets. A screw-type cam determines movement of the table lengthwise of the sheets and plates to effect desired lateral spacing of the wire on the sheets. One end of the plates is separable and collapsible to effect separation of the wound sheets from the plates.

15 In the drawings:

Figure 1 is a plan view of a winding machine constructed according to the invention.

Figure 2 is a front view thereof.

20 Figure 3 is a transverse vertical section taken approximately on the line 3—3 of Figure 2.

Figure 4 is an end view of the machine taken in the direction of the arrow 4 in Figure 2 and shows the positions of the various parts when the machine is stopped.

25 Figure 5 is a detail view similar to Figure 4 with portions broken away and showing the positions of various parts when the machine is being operated.

30 Figure 6 is a detail plan view of a wire feed table and plate clamping structure as shown in Figure 1, drawn to enlarged scale.

Figure 7 is a detail transverse vertical section taken approximately on the line 7—7 of Figure 6.

35 Figure 8 is a detail longitudinal section taken approximately on the line 8—8 of Figure 7 and shows the manner in which the feed table engages the guiding cam.

40 Figure 9 is a detail longitudinal section of the right hand end of the machine taken approximately on line 9—9 of Figure 4 and drawn to enlarged scale and shows a device for automatically stopping the machine when the winding operation is completed.

45 Figure 10 is a detail transverse vertical section across the clamping plates taken approximately on the line 10—10 of Figure 1 and drawn to enlarged scale.

50 Figure 11 is a detail longitudinal vertical section lengthwise of the clamping plates taken approximately on the line 11—11 of Figure 1 and drawn to enlarged scale.

Figure 12 shows the wound sheets as they appear when being removed from the machine.

55 Figure 13 shows an assembled heater element, and

Figure 14 shows a detail of the wire between the sheets of the finished product.

The machine comprises a frame 1 mounting pairs of aligned spaced bearings 2, 2a, 3, 3a. A main shaft 4 journalled in the bearings 2, 2a 5 mounts an elongated screw-type cam 5 and gears 6, 6a which mesh with associated gears 7, 7a keyed to stub shafts 8, 8a journalled in bearings 3, 3a, respectively.

A pair of elongated plates 9, 9a offset relative to each other transversely of their length, are supported between stub shafts 8, 8a for rotation therewith. A plate holder 11 is pivoted at 11a to a forked end of stub shaft 8. Plate 9 is attached rigidly at one end to plate holder 11 15 and plate 9a is pivoted at one end to plate holder 11 to swing edgewise relative to plate 9. The opposite ends of plates 9, 9a are received in a spring clamp 12 mounted on stub shaft 8a.

Plates 9, 9a are adapted to receive between 20 them a pair of mica sheets 10, 10a positioned end to end and on which a resistance wire A is to be wound. The sheets are secured between plates 9, 9a by an end of sheet 10 abutting member 11, by a spring clip 43 through 25 aligned apertures in the sheets and plates, and by a pin 12a on spring clamp 12 through aligned apertures in sheet 10a and the plates. The overall width of the plates is narrower than the width of the sheets so that wire A winds on the edges of the sheets.

Plates 9, 9a and cam 5 are rotated by a motor 13 provided with an elongated shaft 14 in frictional engagement with a drive wheel 15 pinned laterally into and out of engagement with drive wheel 15 by an arm 16 journalled the end of shaft 14 and pivoted to the side of frame 1 by a screw 16a. A brake shoe 17, movable into and out of engagement with drive wheel 15, is pivoted to a bracket 18 mounted on arm 16 and extending substantially at right angles thereto. A tension spring 19, attached to arm 16 and to frame 1, normally urges shaft 14 out of engagement with drive wheel 15 and urges brake shoe 17 into engagement with drive wheel 15. A foot pedal 20, pivoted to frame 1, is connected by an elongated spring 21 to arm 16. When the pedal is depressed manually, arm 16 pivots against the tension of spring 19 and moves shaft 14 into engagement with drive wheel 15 and moves brake shoe 17 out of engagement with drive wheel 15. Foot pedal 20 is urged upwardly by a spring 22 attached pedal 20 and to frame 1.

An upright 23 extends through a slot in frame 1 and is attached to an arm 24 pivoted to the frame by screw 16a. Arm 24 is connected through a link 25 to foot pedal 20. When foot pedal 20 is depressed manually against the tension of springs 22 and 19, an aperture 27 in lever 23 receives a pin 26 on an upstanding bracket 29 on frame 1 and holds the pedal in depressed position. A spring 28 urges lever 23 against pin 26.

A wire table 30 is mounted on a shaft 30a rigid with brackets 29, 29a on frame 1. Table 30 has a pair of forwardly extending jaws 31a, 31b mounted for pivotal movement relative to one another and urged toward one another and into engagement with cam 5 by a spring 30b. A notched element 32 on lower jaw 31b engages the raised screw-like portions of cam 5 and table 30 is moved lengthwise of plates 9, 9a towards drive wheel 15 as the cam and plates rotate. A 75

wire guide 33 is attached to upper jaw 31b and guides the wire as it is wound on the plates.

When table 30 moves to the end of plates 9, 9a adjacent drive wheel 15 at the end of a winding operation, the machine is stopped automatically by an arm 34 on table 30 which engages upright 23 and moves it laterally out of engagement with pin 26 against the tension of spring 28, whereupon spring 19 pivots lever 16 and moves drive shaft 14 out of engagement with drive wheel 15 and brake shoe 17 into engagement therewith. Foot pedal 20 is moved to its uppermost position by spring 22 and lever 23 is moved downwardly so notch 27 is out of registry with pin 26.

As the wire is wound on the sheets and plates, it is tensioned uniformly by a friction device 35 (Figures 6 and 7) on table 30. The device comprises a roller 36 grooved to receive the wire and journalled on a pin 37 on a rearwardly extending bracket 38 on table 30. A flanged roller 39 engages the wire received in grooved roller 36 and is journalled on a rod 40 threaded at one end into the rear of table 30 and extending through bracket 38. A spring 41 attached to rod 40 and to table 30 urges the rollers together into tight engagement with the wire.

The wire is fed to the machine from a reel 50 (Figures 1 and 3) mounted on a shaft 51 journalled in a bearing 52 on rearwardly extending brackets 53 of frame 1. The wire is unwound from the reel by a friction device 54 similar to device 35 described above and comprising a pair of rollers 55, 56 receiving the wire between them. Roller 55 is pinned to a shaft 56a journalled in uprights 57 on brackets 53. A pulley 58 is pinned to shaft 56a and is driven by shaft 4 through an adjustable variable speed pulley 59 and a belt 60. Roller 56 rotates on an arm 61 pivoted to upright 57 and is urged into engagement with the wire by a spring 62. Roller 56 may be moved manually out of engagement with roller 55 to thread the wire between the rollers by a handle 63 rigid with arm 61. The wire is threaded through a guide 64 and hangs loosely in a loop 65 before entering friction device 35.

To start a winding operation, the plates preferably are swung about pivot 11a to the dotted line position of Figure 1 and are flexed apart. A pair of mica sheets 10, 10a are inserted end to end between the plates, and the plates and sheets are swung to the solid line position of Figure 1 and are secured as described above.

The end of wire A is secured to a clip 72 on spring clamp 12. Foot pedal 20 is depressed sufficiently to move upright 23 upwardly until aperture 27 receives pin 26 and brake shoe 17 moves out of engagement with drive wheel 15 and drive shaft 14 moves into engagement with drive wheel 15, whereupon plates 9, 9a and sheets 10, 10a rotate. The wire is unwound from reel 50 by friction device 54 and is pulled through guide 33 and friction device 35 as it winds on the sheets and plates. Cam 5 moves table 30 lengthwise of the sheets and plates to guide the wire as it winds on the sheets and plates. When the last turn is being wound, arm 34 engages upright 23 and moves it laterally out of engagement with pin 26, whereupon the machine is stopped automatically as described above. After the machine stops, the operator cuts the wire between the edge of sheet 9a and guide 33. The table 30 may be returned to its original starting position into engagement with a stop 73 on shaft 30a by pulling arm 34 forwardly to tilt lower jaw 31b and move element

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32 out of engagement with cam 5. Plates 9, 9a are removed from spring clamp 12 and may be swung on pivot 11a to the broken line position of Figure 1 and plate 9a may be moved on its pivot to the angular relation with plate 9 indicated in Figure 12 so their overall width tapers toward the free end of the plates to facilitate sliding the sheet and windings lengthwise from the plates. The wound sheets appear substantially as shown in Figure 12. After the sheets are removed, they are rotated relative to one another in the plane of the sheets until their side edges 10b are adjacent one another. This results in 180° twist in the portion of the wire A intermediate sheets 10 and 10a (Figure 14). The free ends of the wire are laced through apertures 74 on sheet 10a and a pair of rigid members 75 are installed over the edges of the sheets to hold the sheets in assembled relation.

The details of the construction may be varied substantially without departing from the spirit of the invention and the exclusive use of those modifications coming within the scope of the claims is contemplated.

What is claimed is:

1. In a machine for winding an electrical resistance unit including a pair of thin flat sheets of insulating material and a wire wound thereon, an elongated flat carrier including a pair of relatively rigid plates adapted to mount the sheets of insulating material end to end therebetween, a member extending through apertures in said plates and in the adjacent ends of said sheets, to secure said sheets on said carrier, a wire feeder at one side of the carrier, means to rotate said carrier about its ends to wind the wire over the side of the carrier and opposite edges of the sheets, and means to move said feeder lengthwise of said carrier automatically as said carrier rotates.

2. In a machine for winding an electrical resistance unit, a pair of rotating stub shafts axially aligned and spaced from each other, an elongated flat carrier extending between said shafts and rotatable therewith and adapted to mount a pair of thin flat sheets of insulating material arranged end to end lengthwise of the carrier, a readily detachable member holding the sheets against movement relative to the carrier, a wire feeder at one side of the carrier, means to move said feeder from end to end of the carrier as the carrier is rotated to wind wire from the feeder in a flat helix about the carrier and about the edges of the sheets thereon, said means being constructed and arranged to cause the winding to skip said member, said carrier being readily detached from one of said stub shafts and movable out of alignment therewith to permit removal of said sheets and windings as a unit from the carrier over the detached end of the carrier.

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3. The method of producing an electric heater unit including a pair of flat sheets having a continuous resistance wire wound thereon, comprising placing the sheets end to end between a pair of relatively rigid plates, securing an end of the wire relative to one end of one of said sheets, rotating the plates and sheets to wind the wire on the plates and sheets, guiding the wire lengthwise of the plates and sheets as it winds thereon from the end of one sheet to the remote end of the other sheet, severing the wire near the terminus of its winding, removing the wound sheets from the plates, and rotating the sheets relative to one another in the plane of the sheets until two of their side edges are adjacent one another and the two ends of the wire are adjacent each other.

4. The method of producing an electric heater unit including a pair of flat sheets having a continuous resistance wire wound thereon, comprising placing the sheets end to end between a pair of relatively rigid plates, rotating the plates and sheets to wind the wire on the plates and sheets, guiding the wire lengthwise of the plates and sheets as it winds thereon from the end of one sheet to the remote end of the other sheet, severing the wire near the terminus of its winding, removing the wound sheets from the plates, rotating the sheets relative to one another in the plane of the sheets until two of their side edges are adjacent one another and the two ends of the wire are adjacent each other, and lacing both ends of the wire through apertures in one of the sheets, and securing a substantially rigid member to the edges of the plates to hold them in side edge to side edge position.

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