Jan. 16, 1940. T. E. GALLIGAN 2,187,267

HEATING ELEMENT WINDING MACHINE

Filed Feb. 27, 1939 5 Sheets-Sheet 1

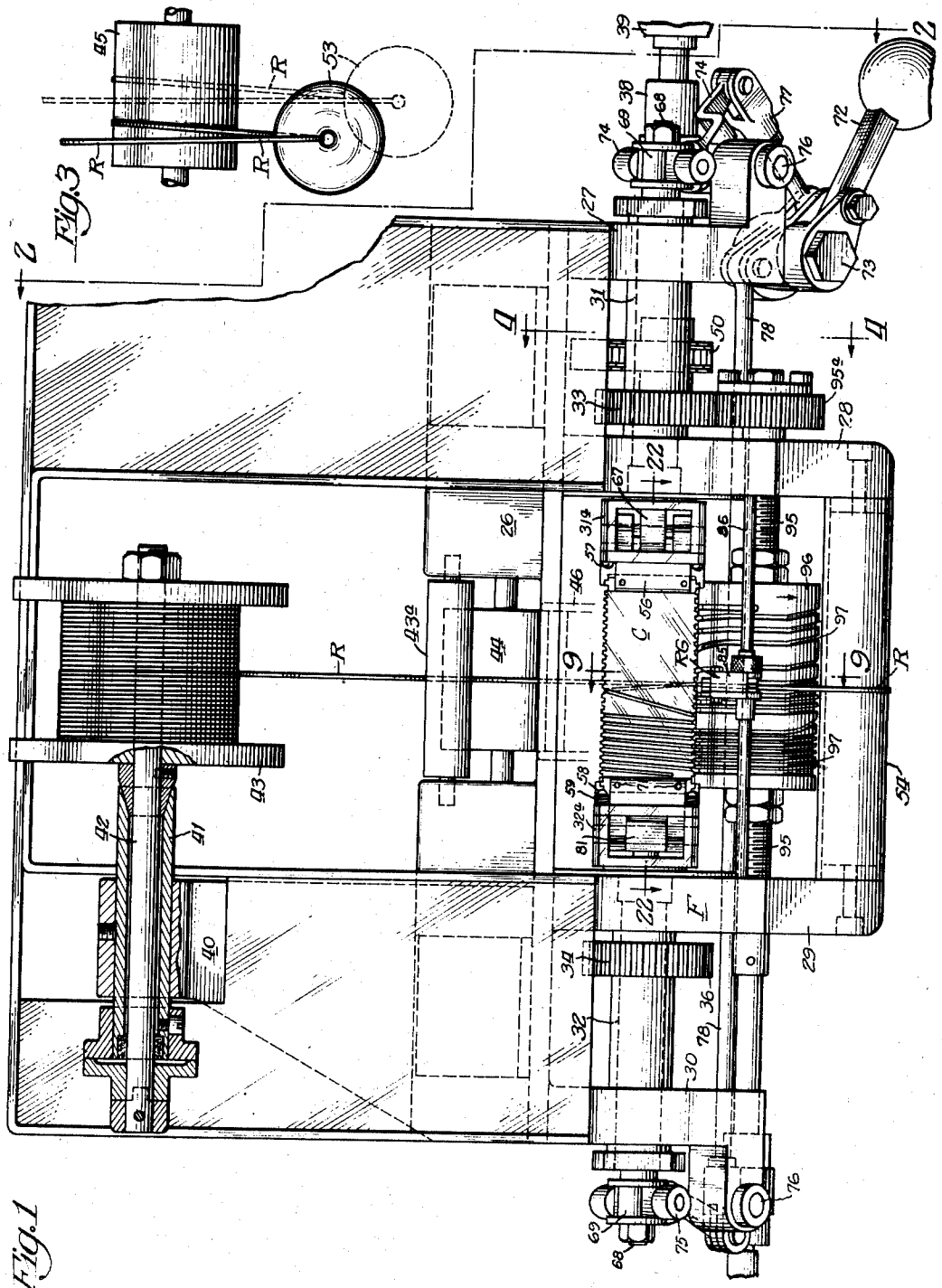


Fig. 1

Fig. 3

Inventor
Thomas E. Galligan
By Bair & Freeman Attys

Jan. 16, 1940. T. E. GALLIGAN 2,187,267

HEATING ELEMENT WINDING MACHINE

Filed Feb. 27, 1939 5 Sheets-Sheet 2

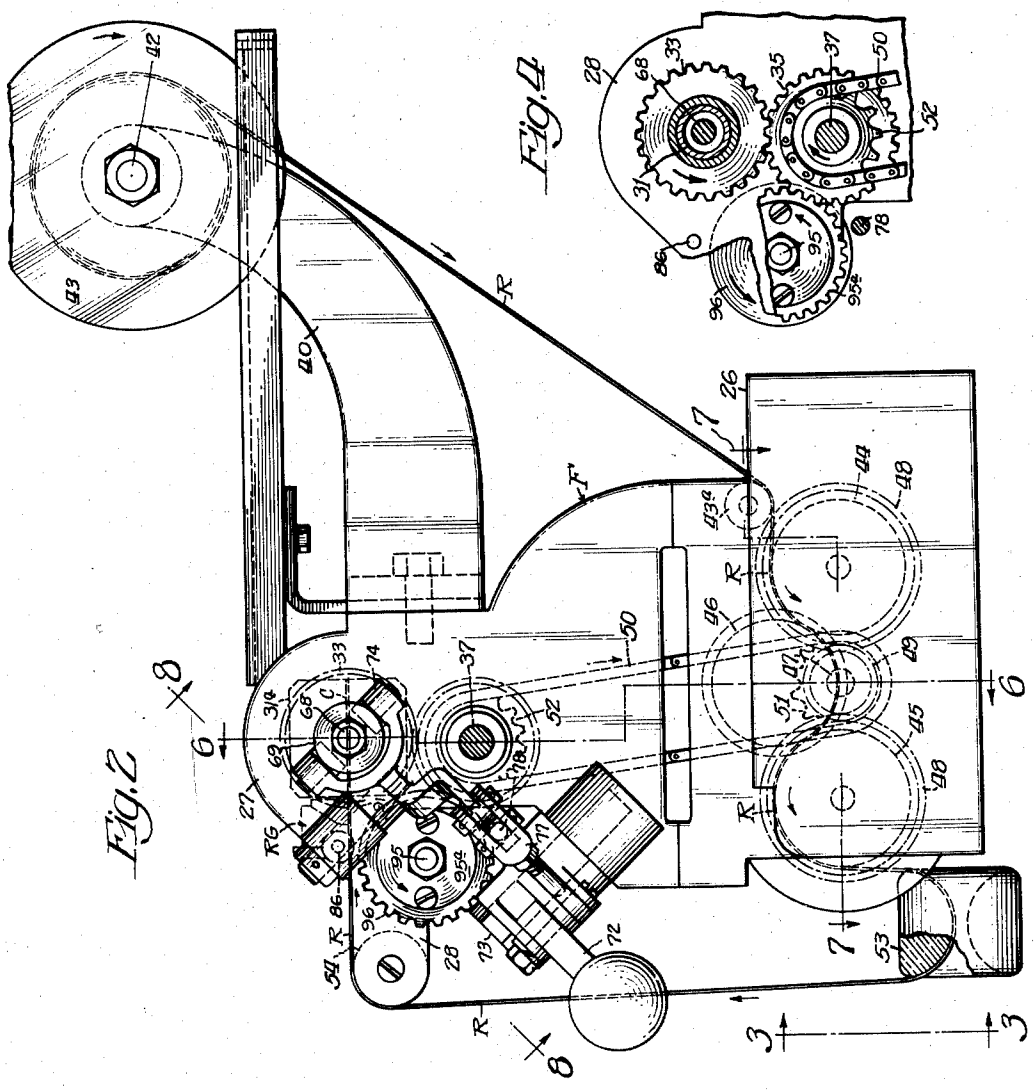


Fig. 2

Fig. 4

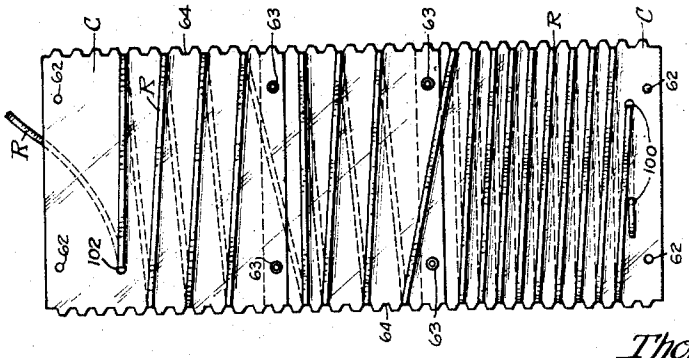


Fig. 5

Inventor:
Thomas E. Galligan
By Bair & Freeman Attys.

Jan. 16, 1940. T. E. GALLIGAN 2,187,267

HEATING ELEMENT WINDING MACHINE

Filed Feb. 27, 1939 5 Sheets-Sheet 3

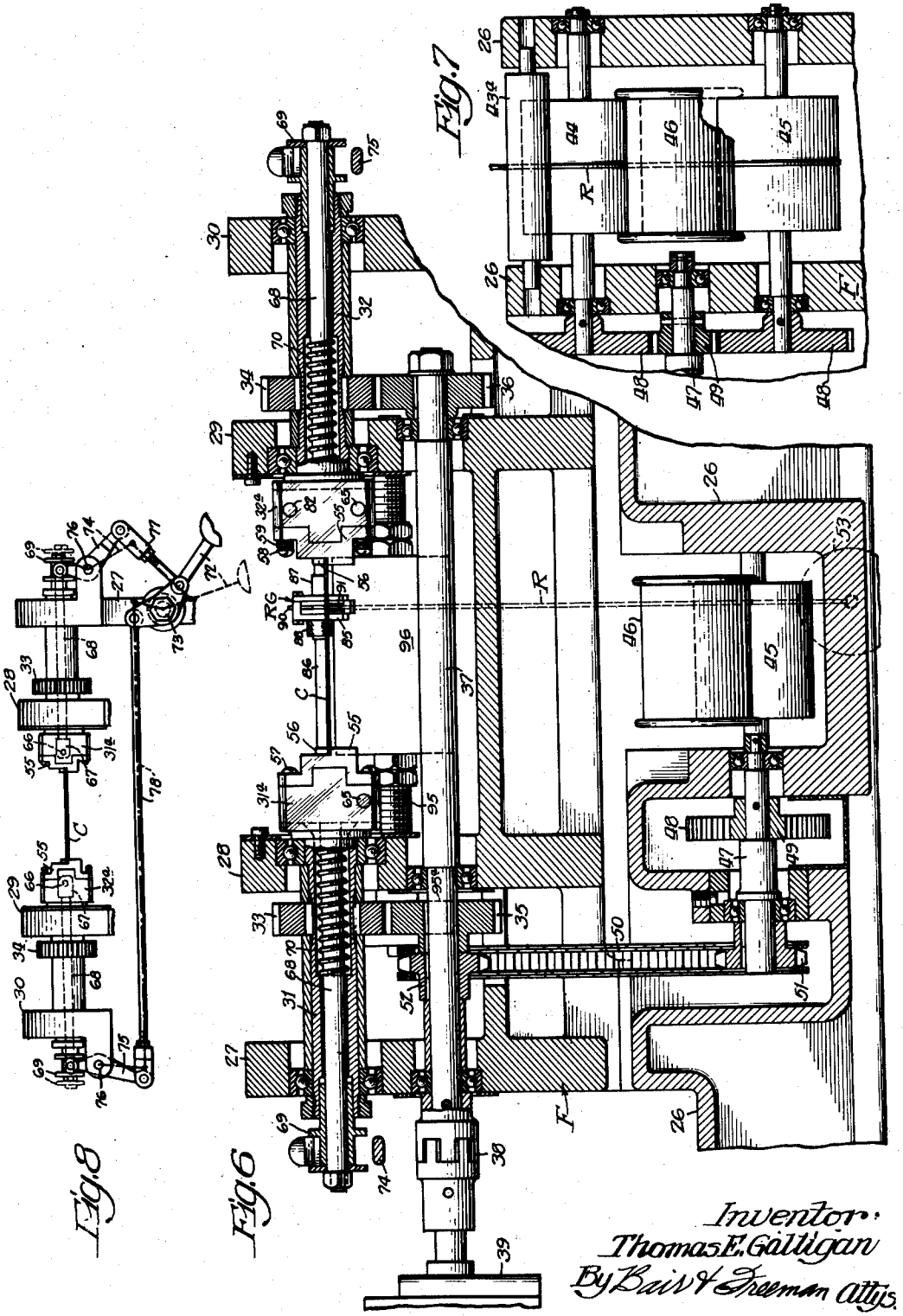


Fig. 7

Fig. 8

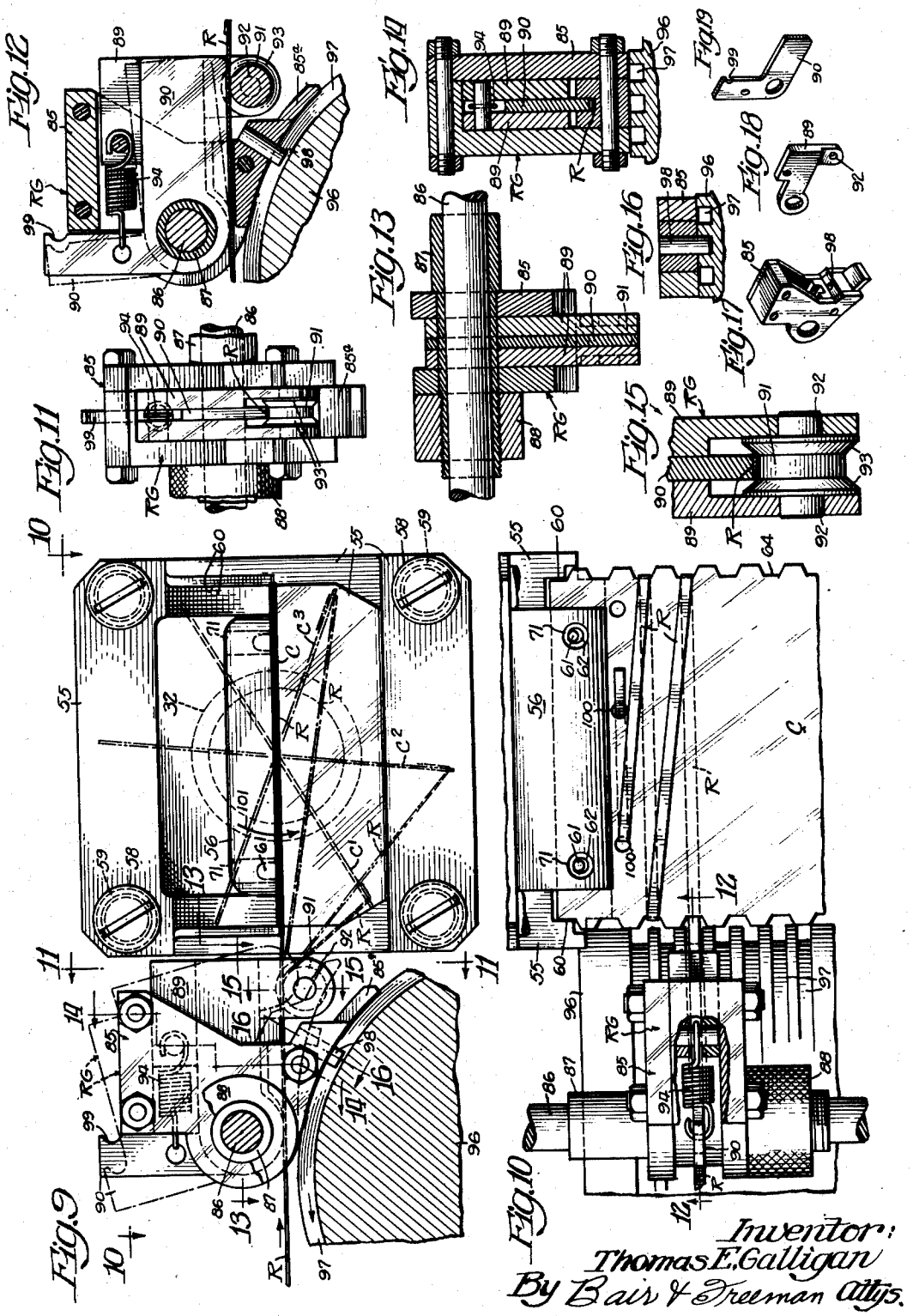
Fig. 6

Inventor:
Thomas E. Galligan
By Bair & Freeman Attys.

Jan. 16, 1940. T. E. GALLIGAN 2,187,267

HEATING ELEMENT WINDING MACHINE

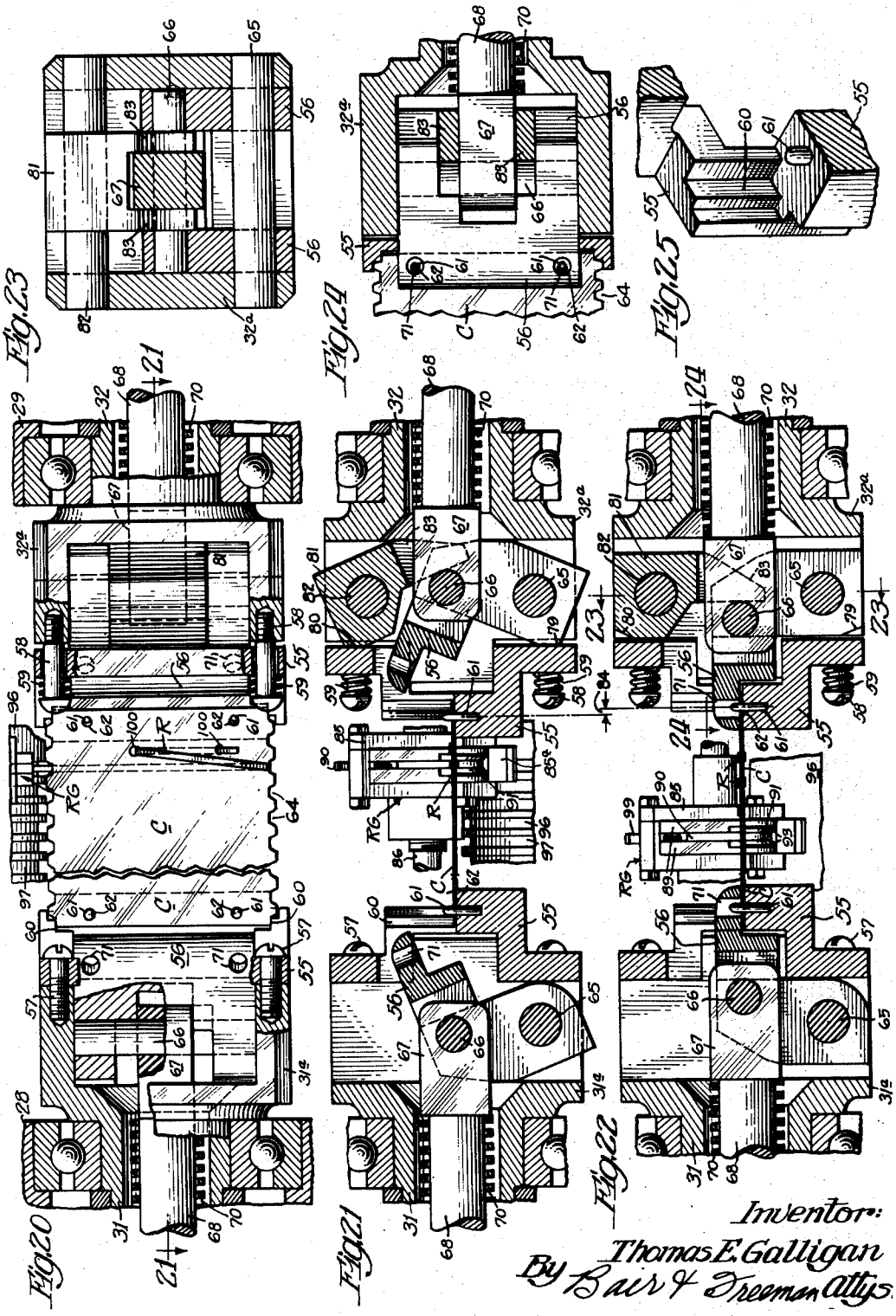
Filed Feb. 27, 1939 5 Sheets-Sheet 4



Jan. 16, 1940. T. E. GALLIGAN 2,187,267

HEATING ELEMENT WINDING MACHINE

Filed Feb. 27, 1939 5 Sheets-Sheet 5



Inventor:
Thomas E. Galligan
By Baer & Freeman Attys.

Patented Jan. 16, 1940 2,187,267

UNITED STATES PATENT OFFICE

2,187,267

HEATING ELEMENT WINDING MACHINE

Thomas E. Galligan, St. Louis, Mo., assignor to Knapp-Monarch Company, St. Louis, Mo., a corporation of Missouri

Application February 27, 1939, Serial No. 258,776

20 Claims. (Cl. 140—92.2)

An object of my invention is to provide a heating element winding machine of relatively simple and inexpensive construction designed particularly to wind heating element ribbons on relatively flat cores such as sheets of mica, such operation heretofore being performed by hand.

A further object is to provide a winding machine in which the mica heating element core may be readily positioned and clamped in such fashion that it is placed under tension so that as it rotates and thereby winds the heating element ribbon upon itself, the fact that the core is under tension gives it the desired rigidity necessary to permit a relatively rapid winding of the ribbon on the core with the ribbon under tension to cause it to tightly engage the core.

A further object is to provide a pair of spaced aligned arbors with jaws to grip the ends of the heating element core, the jaws having pins to be received in perforations of the ends of the core and one of the jaws being under tension to cause the pins to tend to distort the perforations of the core as the core is placed under tension thereby, the jaws (after such tension being imposed on the core) tightly gripping the core so that thereafter, upon simultaneous rotation of the arbors in the same direction, the core will be rotated to effect winding of the heating element ribbon thereon.

Another object is to provide a ribbon guide having a pair of surfaces between which the ribbon passes, these surfaces engaging each other under spring tension to impose upon the heating element ribbon the desired tension for winding it on the heating element core.

Another object is to provide a roller carried by the ribbon guide across which the ribbon whips when the heating element core rotates to a position substantially aligned with the ribbon guide and thereupon sharply strikes the ribbon to cause a sharp bend in it over the edge of the core so that subsequently, when the heating element ribbon is energized and expands, it will not be displaced from notches in the edge of the core designed to receive and position the ribbon relative to the core.

Still another object is to provide a machine in which the jaws may be simultaneously opened for removing a wound heating element and inserting another heating element core to be wound, whereupon the jaws may again be closed and the arbors rotated to effect the winding operation.

Still a further object is to provide means to feed the ribbon to the ribbon guide at substantially the same speed as the ribbon is wound on the heating element core, such means being in the form of rollers having a peripheral speed of timed relation to the rotation of the arbors that support the heating element core.

Another object is to provide means for shifting the ribbon guide so that it guides the ribbon irregularly in an axial direction of the core as the ribbon is wound on the core, so that the proper distribution of the ribbon on the core is secured automatically without any attention on the part of the operator of the machine.

Still another object is to provide a heating element winding machine in which it is merely necessary for the operator to operate the jaws that hold the heating element core, remove the finished heating element and replace it with an unwound core and reset the heating element ribbon guide for the beginning of the winding operation.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawings. Although the invention is susceptible of a variety of embodiments, it is unnecessary to fully describe and illustrate more than one in order to give a full understanding of the invention both from its structural and functional standpoints. Accordingly, I have illustrated a preferred and desirable embodiment of the invention in the accompanying drawings, in which:

Figure 1 is a plan view of a heating element winding machine embodying my invention;

Figure 2 is an end elevation of my machine looking from the right hand end of Figure 1;

Figure 3 is a front elevation of a ribbon weight which is shown partially in section in Figure 2;

Figure 4 is a sectional view on the line 4—4 of Figure 1, showing a gearing arrangement for the cam and for an arbor of my machine;

Figure 5 is a full sized plan view of a heating element consisting of a heating element core and a ribbon of the kind to be wound in my machine;

Figure 6 is a vertical sectional view on the line 6—6 of Figure 2;

Figure 7 is a horizontal sectional view on the line 7—7 of Figure 2;

Figure 8 is a diagrammatic view of the jaw releasing mechanism of my machine;

Figure 9 is an enlarged sectional view on the line 9—9 of Figure 1 showing a heating element being wound, and the relation of the ribbon guide thereto;

Figure 10 is a plan view of the mechanism shown in Figure 9;

Figure 11 is a rear elevation of the ribbon guide as viewed from the indicated line 11—11 of Figure 9;

Figure 12 is a vertical sectional view through the ribbon guide on the line 12—12 of Figure 10;

Figure 13 is a sectional view on the line 13—13 of Figure 9, the view being turned a quarter-turn clockwise;

Figure 14 is a vertical sectional view on the line 14—14 of Figure 9, showing the cooperation of a heating element ribbon with a pair of cooperating tension elements;

Figure 15 is an enlarged sectional view on the line 15—15 of Figure 9 showing the coaction of a heating element ribbon with a tension element;

Figure 16 is an enlarged sectional view on the line 16—16 of Figure 9 showing the coaction of the ribbon guide with a cam groove of the cam;

Figure 17 is a perspective view of a body member of the ribbon guide;

Figure 18 is a perspective view of a roller carrying member of the ribbon guide;

Figure 19 is a perspective view of a tension element of the ribbon guide;

Figure 20 is an enlarged plan view partly in section of the jaws for holding the heating element core;

Figure 21 is a vertical sectional view on the line 21—21 of Figure 20 showing the jaws released;

Figure 22 is a similar view showing the jaws in closed position;

Figure 23 is a sectional view on the line 23—23 of Figure 22;

Figure 24 is a sectional view on the line 24—24 of Figure 22, and

Figure 25 is a perspective view of a portion of one of the jaws.

On the accompanying drawings I have used the reference character F to indicate generally a frame. The frame F includes a base 26 with supporting arms 27, 28, 29 and 30 extending upwardly therefrom. In Figure 1, the machine is viewed from the operator's position in front of the machine, while the section in Figure 6 is taken so that the parts are viewed from the rear.

Journaled in suitable ball bearings supported by the supporting arms 27 and 28 is an arbor 31. A similar arbor 32 is journaled in bearings supported by the arms 29 and 30. The arbors 31 and 32 are provided with gears 33 and 34, respectively. The gears 33 and 34 mesh with gears 35 and 36 secured to a drive shaft 37.

The drive shaft 37 is journaled in suitable ball bearings supported by the arms 27, 28 and 29, as shown in Figure 6, and is connected by a coupling 38 to a speed reducer 39. Any suitable source of power, such as an electric motor (not shown), may be used to operate the speed reducer 39.

Extending rearwardly from the frame F is a bracket 40 having a sleeve 41 supported thereby. A spindle 42 is rotatably carried by the bracket 41 and is adapted to removably support a spool 43. A ribbon R, such as Nichrome wire or the like, is wound on the spool 43, the spool being a supply spool to be replaced when the ribbon is completely wound therefrom.

The ribbon R passes over a roller 43*a*, then over a pair of rollers 44 and 45 and is held tightly in contact therewith by a floating roller 46. The weight of the roller 46 keeps the ribbon R in sufficiently tight surface contact with the rollers 44 and 45 to cause feed of the ribbon at the peripheral speed of the rollers.

The rollers 44 and 45 are geared to a shaft 47 by a pair of gears 48 and a pinion 49. The pinion 49 is mounted on the shaft 47 and the shaft in turn is mounted in bearings supported by the base 26 of the frame F.

For rotating the shaft 47 at a predetermined speed with relation to the arbors 31 and 32, I provide a chain 50 passing over a sprocket 51 on the shaft 47 and a sprocket 52 on the drive shaft 37.

The ribbon R after leaving the roller 44 passes through a weighted ring 53 (see Figures 2 and 3). This ring may be made of glass or porcelain and of suitable weight to impose enough tension on the ribbon to take up slack between the roller 44 and a tube 54. The tube 54 is supported by portions of the arms 28 and 29 which extend toward the front of the machine. After passing over the tube 54 the ribbon passes through a ribbon guide RG and is then wound on a heating element core C supported by the arbors 31 and 32 in the manner that will now be described.

Each of the arbors 31 and 32 has a relatively stationary jaw member 55 and a movable jaw member 56. The jaw member 55 of the arbor 31 is secured to an enlarged head 31*a* of the arbor by screws 57. The jaw 55 of the arbor 32 is loosely mounted relative to an enlarged head 32*a* thereof by screws 58. Springs 59 are interposed between the heads of the screws 58 and the jaw 55 of the arbor 32 which tend to force the jaw 55 of the arbor 32 axially away from the jaw 55 of of the arbor 31.

Referring to Figure 25, the jaws 55 have shoulders 60 which serve as positioning means for the heating element core C, the ends of the core coacting therewith as shown in Figure 20. Each jaw 55 has a pair of pins 61 extending therefrom and adapted to enter perforations 62 of the heating element core C. These perforations are shown in Figure 5 and the coaction thereof with the pins 61 is shown in Figures 20, 21 and 22.

Turning now to the heating element shown in Figure 5, the core C is made up usually of a plurality of sheets of mica riveted together as by tubular rivets 63. The sheets are notched at their edges as indicated at 64 for the ribbon R to be wound in. Preferably the ribbon is wound in successive notches adjacent the lower end thereof and the spacing between adjacent turns of the heating element is increased adjacent the top because of the heat rising from the lower portion of the heating element supplementing that radiated from the upper portion thereof. This irregular winding is done in order to effect substantially even toasting of a slice of bread adjacent the heating element.

The ribbon R must also miss the rivets 63 so as not to make electrical contact therewith, and for that reason the winding of the ribbon on the core is relatively irregular, as illustrated.

Heretofore it has been customary to wind these heating elements by hand and this is a rather tedious and slow job. It is difficult to maintain an even tension on the ribbon and at the same time wind the ribbon in such manner that it bends tightly over the edges of the core C and remains tight throughout its extent from one

edge of the core to the other. If the ribbon is pulled too tightly it will cut into the notches 64 and damage the core C, while if it is too lose and any attempt is made to pinch the ribbon together over the edge of the core then the stretch of the ribbon between opposite edges is loosened. It is also difficult to wind the heating element in the proper notches 64 which have been equally spaced for convenience in manufacture instead of unequally spaced, which would facilitate proper hand winding. It is therefore my purpose to provide a machine which will make it possible to wind this form of heating element without danger of breaking the core C at the notches 64 and yet will secure the desired tension on the ribbon and the desired formation of the ribbon so that it will stay permanently on the core when the ribbon is energized.

One of the troubles heretofore experienced with winding a resistance ribbon on a sheet mica core has been the fragility of the core and its relatively low resistance to bending. Whenever any attempt is made to stretch the ribbon on the core, the core tends to bend and this introduces a factor which is detrimental to quick, speedy and accurate winding of heating elements without spoiling a considerable number of them. I therefore provide the pins 61 to enter the perforations 62 with the pins a variable distance apart, as determined by the movability of the jaw 55 carried by the arbor 32. The movable jaws 56 carried by the arbors 31 and 32 are pivoted on pins 65 carried by the respective arbor heads 31a and 32a (see Figures 21 and 22). The jaws 56 carry pins 66 which pass through heads 67 of rods 68. The rods 68 extend slidably through the arbors 31 and 32 (the arbors being tubular for this purpose) and terminate in flanged collars 69. Within the arbors 31 and 32 springs 70 engage the heads 67 and tend to close the jaws 56 with relation to the jaws 55. The jaws 56 are provided with perforations 71 adapted to receive the pins 61 when the jaws are in the closed position of Figure 22.

For opening the jaws 56 or permitting them to close, I provide a lever system which is perhaps best shown in Figure 8. It consists of a control lever 72 pivoted to the arm 27 at 73. A pair of forked levers 74 and 75 are pivoted on the pins 76 carried by the arms 27 and 30. The forked levers 74 and 75 coact with the flanged collars 69 of the arbors 31 and 32 to effect sliding movement of the rods 68 away from each other against the tension of the springs 70 upon movement of the lower ends of the levers 74 and 75 in Figure 8 toward each other. Such movement of the levers 74 and 75 is effected by swinging the control lever 72 clockwise, it being connected by links 77 and 78 to the levers 74 and 75. When the lever 72 is released, then the springs 70 will return the jaws 56 to closed position with relation to the jaws 55 under the tension of the springs 70.

The jaw 56 of the arbor 32 and the arbor head 32a is somewhat different from the jaw 56 for the arbor 31 and the arbor 31a, as is readily apparent in Figures 21 and 22. The differences consist in the jaw 56 having a cam face 79 to engage the jaw 55 and another cam face 80 being provided on a cam 81. The cam 81 is pivoted to a pin 82 carried by the arbor head 32a and the cam has an extension 83 adapted to be engaged by the pin 66 of the rod 68 carried by the arbor 32. When the jaw 56 is opened the cam 81 assumes the position shown in Figure 21 for forcing the jaw 55 of the arbor 32 toward the arbor 31. This moves the pins 61 of the arbor 32 toward the pins of the arbor 31 so that the heating element core C may be readily placed in position with its perforations 62 loosely receiving the pins. Subsequently when the control lever 72 is released, the jaw 56 of the arbor 32 and the cam 81 will return to the position shown in Figure 22, thus permitting the pins 61 to impose tension on the heating element core C, as determined by the strength of the springs 59. The movability of the jaw 55 under the tension of the springs 59 takes care of slight variations in the distances between the perforations 62 at opposite ends of the core C and also tends to distort the perforations as the springs 59 come into action. In the final position of Figure 22, the springs 59 have served their purpose and the jaws 55 and 56 now tightly engage the ends of the core C and the core is under the desired tension to give it rigidity to effect winding of the ribbon R thereon as the core is rotated by the arbors.

In Figure 22, a dimension indicated at 84 shows the distance the pins 61 of the movable jaw 55 move for placing the heating element core under tension. As to the construction of the parts within the arbor head 32a, reference is made to Figures 23 and 24 wherein is illustrated the different relative positions of the parts so that they inter-fit in a workable manner within the head.

The ribbon guide RG includes a body member 85 shown in perspective in Figure 17, while Figures 9 to 19 illustrate its cooperation with other parts of the ribbon guide. The body member 85 is pivoted on a rod 86 supported by the arms 28 and 29. Referring to Figure 13, a sleeve 87 surrounds the rod and extends through the body member 85. A retainer nut 88 is provided on one end of the sleeve for retaining it rigidly assembled relative to the body member.

The body member 85, it will be noted, has a pair of spaced sides between which a pair of roller supports 89 and a tension element 90 are located. The elements 89 and 90 are oscillatable on the sleeve 87.

A roller 91 has spindles which are rotatable in perforations 92 of the roller supports 89. The roller 91 is provided with a pair of beveled flanges 93, as shown in Figure 15, between which the ribbon R travels. The tension element 90 is adapted to engage the ribbon with the roller under a certain degree of friction. For accomplishing this result a spring 94 is provided, as shown in Figure 12, to bias the roller supports 89 in a counterclockwise direction of rotation about the sleeve 87 and to bias the tension element 90 in a clockwise direction thereabout. This obviously will tend to squeeze the ribbon R between the roller 91 and the tension element 90.

Journaled below the ribbon guide RG is a cam shaft 95 having a cam 96 mounted thereon. The cam shaft 95 is driven from the drive shaft 37 by a gear 95a, as shown in Figure 4. The gear 95a meshes with the gear 35. The cam 96 has a cam groove 97 adapted to receive a follower pin 98. The entire ribbon guide may be rotated to the position shown by dot and dash lines in Figure 9 for permitting manual shifting of the ribbon guide relative to the cam, for the purpose of bringing the ribbon guide back to starting position. If the body member 85 is held against such tipping, however, the tension element 90 may be tipped to the dot and dash line position of Figure 12 for the purpose of releasing the tension on the ribbon R when readjusting it relative to the ribbon guide or when threading it into the ribbon guide.

For convenience in this operation the tension element **90** is provided with a finger notch **99**.

The cam groove **97**, it will be noted by referring to Figure 1, is an irregular helix designed to cause the ribbon guide RG to wind the lower portion of the core C (see Figure 5) in successive notches **64** and the upper portion in irregularly spaced notches to spread the heating ribbon on the core and miss the rivets **63**. The cam causes the ribbon guide to align the ribbon accurately with the proper notches of the core C as the core is rotated by the arbors.

Practical operation

In the operation of my heating element winding machine, the control lever **72** is first swung by the right hand of the operator in a clockwise direction from the position shown in Figures 1 and 8. This moves the jaws **56** from the closed position of Figure **22** to the open position of Figure 21. The core C on the pins **61**, which has previously been wound with the ribbon R, may then be removed from the pins since the pins have been brought relatively closer together by the cam surfaces **79** and **80** engaging the right hand jaw **55** and moving it against the tension of the springs **59**. It will be noted that the jaws **56** are back out of the way so that the wound heating element can be readily removed and another empty core substituted in position with the shoulders **60** serving to guide it down to the proper position on the pins **61**. This removing and replacing operation may readily be accomplished by one hand of the operator, after which the control lever **72** is released.

Thereupon the springs **70** act to close the jaws **56** from the position of Figure 21 to the position of Figure 22, which permits the pins **61** to engage the outside edges of the perforations **62** under the tension of the springs **59** and tends to stretch the core C. This places the core under a desirable tension as predetermined by the strength of the springs **59**.

With the end of the ribbon R attached to the core C by lacing it through perforations **100** therein, as shown in Figure 20, and with the ribbon guide RG previously swung to the dot and dash line position of Figure 9 and then shifted to the left hand end of the cam **96** in Figure 1 (the right hand end in Figure 21), the drive shaft **37** may then be rotated from the speed reducer **39** by any suitable clutch mechanism (not shown). This will cause the core C to be rotated counterclockwise, as indicated by the arrow **101** in Figure 9, and to wind upon itself the ribbon R. Several positions are shown for the core in this figure which I will designate as C1, C2 and C3. In the full line position of the core C, it is substantially edgewise relative to the ribbon guide RG. As it rotates to the position C1, the ribbon will be pulled through the ribbon guide and folded over the lower edge of the core in the successive positions C2 and C3. Due to the tension on the ribbon imposed by the spring **94** tending to squeeze the roller **91** and the tension element **90** together, there will be the proper degree of tension for bending the ribbon over the lower edge of the core as it passes through positions C1, C2 and C3. Finally, when the core again reaches the solid line position, the left hand edge of the core will suddenly strike the taut span of ribbon between the ribbon guide and the right hand edge of the core, thus effectively causing a relatively sharp bend in the ribbon over the edge of the core. This will cause the ribbon to tightly hug the surface and edge of the core in an obviously desirable manner.

As the core proceeds to the position C1, the ribbon R is whipped across the roller **91** and the roller maintains the desired tension thereon, yet due to the surface of the roller moving with the ribbon the tendency for the whipping action to be more than the mica can stand is minimized. Also, as the ribbon bends across the roller, the roller has a tendency to impart curvature to the ribbon in a direction which places the convex side of such curvature next to the core C. This tends to cause the ribbon throughout its extent laterally across the core to tightly engage the core and thus resist subsequent bulging away from the core under the influence of electric energization of the heating element.

Since the mica core C is under tension as initially produced by the springs **59** and maintained by the jaws **56** closing on the jaws **55**, each time the mica assumes the full line position of Figure 9 as it is rotated by the arbors the rigidity of the mica is greatly increased by such tension and its resistance to the ribbon cutting into the edge of the mica at the bottom of the notches **64** is correspondingly reduced. It is therefore evident that the placing of the mica under tension is an important feature of the invention.

When the ribbon guide RG has completely traversed the cam **96**, the drive shaft **37** will be stopped automatically by mechanism which forms no part of my present invention and accordingly is not illustrated. The ribbon R can then be cut by the operator between the ribbon guide and the core C and the loose end laced through an opening **102** to retain the ribbon for subsequent connection to a terminal when the heating element is placed in a toaster or the like.

My machine obviously facilitates the winding of heating element ribbons on mica cores and at the same time insures a uniform winding of the ribbon and a minimized possibility for damaging the core during the winding operation. A completed heating element may be readily and quickly replaced by an empty core and the parts adjusted for winding it. The machine may be adjusted for any desired pattern of winding by changing the cam **96** to correspond to the desired pattern. The core is so placed under tension during operation that its rigidity is greatly increased, thus making it possible to employ considerably more tension on the ribbon during the winding operation than when attempting to wind a core by hand while holding it in the hand. The arbors **31** and **32** of course rotate simultaneously at the same speed and in the same direction, while the cam **96** is timed to shift the ribbon guide RG at the proper times as the core C assumes its positions C1, C2 and C3, so that the ribbon will be accurately guided into the desired notches **64** of the core C.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

I claim as my invention:

1. In a heating element winding machine, a frame, a pair of spaced axially aligned arbors journaled thereon, means for rotating said arbors

simultaneously at the same speed and in the same direction, a jaw carried by each arbor to grip the ends of a heating element core having perforations in its ends, said jaws having pins to be received in said perforations, means for moving one of said jaws axially to move its pins axially and thereby place said core under tension, a ribbon guide for a heating element ribbon to be found on said core, cam means for shifting said ribbon guide axially relative to said core as the core is rotated by said arbors and thereby spacing the turns of said winding as desired on said core and means for rotating said cam means in timed relation to the rotation of said arbors.

2. In a heating element winding machine, a frame, a pair of spaced axially aligned arbors journaled thereon, means for rotating said arbors simultaneously at the same speed and in the same direction, a jaw carried by each arbor to grip the ends of a heating element having perforations therein, said jaws having pins to enter said perforations, means including springs for moving said jaws and pins axially relative to each other to thereby place the edges of the perforations in said core under tension of said springs, a ribbon guide for a heating element ribbon to be wound on said core, means for shifting said ribbon guide axially relative to said core as the core is rotated and means for operating said last means in timed relation to the rotation of said arbors.

3. A heating element winding machine comprising a frame, a pair of spaced aligned arbors journaled thereon, means for simultaneously rotating said arbors, a jaw carried by each arbor to grip the ends of a heating element core, means for relatively moving said jaws to thereby place said core under tension, a ribbon guide for a heating element ribbon to be wound on said core, cam means for shifting said ribbon guide axially relative to said core as the core is rotated by said arbors and thereby spacing the turns of said winding as desired on said core, means for rotating said cam means in timed relation to the rotation of said arbors, said ribbon guide comprising a body member, a roller carried thereby for the ribbon to bend across in one direction, a tensioned element engaging said ribbon with said roller to predetermine the tension on said ribbon as it is wound onto said core from said ribbon guide and said ribbon guide being disengageable from said cam means and movable axially thereof to starting position thereon.

4. In a heating element winding machine, a frame, a pair of spaced axially aligned arbors journaled thereon, means for rotating said arbors simultaneously at the same speed and in the same direction, means carried by said arbors to support and rotate a heating element core, a ribbon guide for a heating element ribbon to be wound on said core, means for shifting said ribbon guide axially relative to said core as the core is rotated by said arbors, said ribbon guide comprising a body member and a pair of tensioned elements engaging opposite sides of said ribbon to predetermine the tension on said ribbon as it is wound on said core.

5. In a heating element winding machine, a frame, a pair of spaced rotatable arbors thereon, means for rotating said arbors, a jaw carried by each arbor to grip the ends of a relatively flat heating element core having perforations in its ends, said jaws having pins to be received in said perforations, means for moving the pins of one jaw away from the pins of the other jaw to thereby place said core under tension, a ribbon guide for a heating element ribbon to be wound on said core, means operated in synchronism with said arbors for shifting said ribbon guide axially relative to said core as the core is rotated by said arbors and thereby spacing the turns of said winding on said core, said ribbon guide comprising a body member, a roller carried thereby for the ribbon to bend across as said core rotates and its edges successively engage said ribbon, and a tension element engaging said ribbon with said roller to maintain a predetermined tension on the ribbon.

6. In a heating element winding machine, a frame, a pair of arbors journaled thereon, means carried by said arbors to coact with a relatively flat heating element core and place said core under tension, a ribbon guide for a heating element ribbon, said guide being supported for axial movement relative to the heating element core, cam means for causing such axial movement in timed relation to the rotation of said arbors, said ribbon guide having means to place the ribbon passing therethrough under the desired tension for winding it on said heating element core and bending the ribbon sharply over the edges thereof.

7. In a heating element winding machine, a frame, a pair of spaced rotary members supported thereon and having pins to coact with perforations in the ends of a relatively flat heating element core and place said core under tension by spreading said pins relative to each other, a ribbon guide for a heating element ribbon and means for advancing said ribbon guide in timed relation to the rotation of said core and in a direction substantially parallel to the axis of rotation thereof, said ribbon guide having means to place the ribbon passing therethrough under tension.

8. In a heating element winding machine, means for supporting and rotating a relatively flat heating element core, a ribbon guide for guiding a heating element ribbon axially along said core as it is wound thereon by rotation of the core, said ribbon guide comprising a body member, a roller floatingly journaled therein, a tension element engaging the ribbon therewith, said heating element core being substantially in alignment with said ribbon guide when the core is rotated to a position edgewise relative to the ribbon guide, said roller and tension element being so positioned relative to said means for supporting and rotating said core and arranged to cause the heating element core to strike the ribbon sharply, substantially immediately after reaching such edgewise position and thereby bend the ribbon over the edge of the core and pull the ribbon over the roller as the core rotates further from such edgewise position.

9. In a heating element winding machine, arbors for tensioning, supporting and rotating a relatively flat heating element core, a ribbon guide for distributing a heating element ribbon along said core as it is wound thereon by rotation of the core by said arbors, said ribbon guide comprising a body member, tension elements therein frictionally engaging the ribbon as it passes therethrough, said tension elements being so positioned and arranged as to cause the heating element core to strike the ribbon sharply, substantially immediately after reaching an edgewise position relative thereto and thereby bend the ribbon over the edge of the core and thereafter pull the ribbon through the ribbon guide

as the core rotates further from such edgewise position.

10. In a heating element winding machine, means for supporting and rotating a relatively flat heating element core, a ribbon guide for distributing a heating element ribbon on said core as it is wound thereon by rotation of the core by said first means, said ribbon guide comprising a body member, a roller journaled relative thereto and having a pair of beveled flanges to guide the ribbon into the groove of the roller between said flanges and a tension element frictionally engaging the ribbon with said roller.

11. A heating element winding machine including a pair of spaced, axially aligned, rotatable arbors, means for rotating said arbors simultaneously at the same speed and in the same direction, means for supporting a relatively flat heating element core on said arbors, a ribbon guide for guiding a heating element ribbon to said core during rotation of the core by said arbors, means for feeding the ribbon to said guide comprising a pair of spaced rollers over which the ribbon passes, a third roller engaging said ribbon and supported by said pair of rollers, means for rotating said pair of rollers at substantially the same peripheral speed as the ribbon is wound on said heating element core and a weight member having an opening receiving a loop of the ribbon between said pair of rollers and said ribbon guide.

12. A heating element winding machine comprising a frame, a pair of axially aligned arbors journaled thereon, a jaw carried by each arbor, said jaws having means for positioning the ends of a heating element core therein, means for simultaneously opening and closing said jaws, one of said jaws being tensioned to place the heating element core under predetermined tension when the jaws grip the ends of the heating element core therein, said means for closing said jaws also effecting tensioning of said one jaw and a ribbon guide effective to guide a heating element ribbon axially of said heating element core as the core is rotated by said arbors.

13. In a heating element winding machine, a pair of axially aligned, rotatable arbors, a jaw carried by each arbor, means for simultaneously opening and closing said jaws, one of said jaws being tensioned to place the heating element core under predetermined tension when the jaws grip the ends of the heating element core therein, said means for closing said jaws also effecting tensioning of said one jaw and a ribbon guide effective to distribute a heating element ribbon on said heating element core as the core is rotated by said arbors.

14. In a heating element winding machine, a frame, a pair of arbors journaled thereon, a jaw carried by each arbor, said jaws having pins to receive perforations in the ends of a heating element core, means for simultaneously opening or closing said jaws, said jaws being relatively movable to spread said pins and thereby place the heating element core under tension, said means for closing said jaws also effecting such relative movement of said jaws and a ribbon guide effective to guide a heating element ribbon on said heating element core as it is wound thereon by rotation of the core by said arbors.

15. A heating element winding machine comprising a pair of axially aligned arbors arranged end to end and spaced from each other, means carried by one end of each of said arbors to support a relatively flat heating element core under tension between the arbors, a rod substantially parallel to said arbors, a ribbon element guide slidable thereon, a cam effective to slide said ribbon element guide along said rod and operative connections between said arbors and cam to rotate the arbors at the same speed and the cam at a timed speed with relation thereto, said ribbon element guide including means to place the ribbon passing therethrough under tension.

16. In a heating element winding machine, a pair of arbors arranged end to end and spaced from each other, means carried by one end of each of said arbors to support a relatively flat heating element core under tension between the arbors, a rod supported in a position substantially parallel to said arbors, a ribbon element guide slidable longitudinally, means to effect such sliding of said ribbon element guide and an operative connection between said arbors and said last means to rotate the arbors at the same speed and operate the means at a timed speed with relation thereto.

17. A heating element winding machine comprising a pair of clamps spaced from each other and adapted to support a relatively flat heating element core under tension between them, means for rotating said clamps, a rod substantially parallel to the axis of rotation of said clamps, a heating element ribbon guide slidable thereon, a cam cooperating with said guide to slide it along said rod and operative connections between the means for rotating said clamps and said cam to rotate the clamps at the same speed and the cam at a timed speed with relation thereto, said ribbon guide including means to place the ribbon passing therethrough under frictional tension.

18. A heating element winding machine comprising a pair of axially aligned arbors arranged end to end and spaced from each other, jaws carried by one end of each of said arbors to support a relatively flat heating element core under tension between the arbors, said jaws including pins to enter perforations of the heating element and tending to distort said perforations under the influence of the tension applied thereto by said one of said jaws, a rod substantially parallel to said arbors, a ribbon element guide slidable thereon, a cam effective to slide said ribbon element guide along said rod, said ribbon guide being pivoted on said rod to disengage said cam, operative connections between said arbors and cam to rotate the arbors at the same speed and the cam at a timed speed with relation thereto, said ribbon guide including means to place the ribbon passing therethrough under tension, a roller carried by said ribbon guide, for the heating element core as it rotates, to whip the ribbon across as the core passes a position of rotation aligned edgewise with the ribbon guide.

19. A heating element winding machine comprising a pair of arbors, means carried thereby to support and rotate a relatively flat heating element core, said means including pins to enter perforations of the heating element and jaws to grip the ends of the core, a ribbon guide movable in a path substantially parallel to the axis of rotation of said arbors, a cam effective to so move said ribbon guide, operative connections between said arbors and cam to rotate the arbors and the cam at a timed speed with relation to each other, a roller carried by said ribbon guide for the ribbon to bend across as the core is ro-

tated by said arbors and means carried by said ribbon guide to tension said ribbon.

20. A heating element winding machine comprising a pair of axially aligned arbors arranged end to end and spaced from each other, means carried by one end of each of said arbors to support a relatively flat heating element core between the arbors, a ribbon guide effective to guide a ribbon along said core as it is rotated by rotation of said arbors, said ribbon guide including a body member, a roller support pivoted therein, a roller carried by said roller support and having a groove to receive the ribbon, a tension element pivoted in said body member and operable to engage the ribbon with said roller and a common spring connected to said roller support and tension element to effect movement of said roller and tension element, each toward the other.

THOMAS E. GALLIGAN.