Nov. 15, 1932. C. HAVLISH 1,887,808

RHEOSTAT WINDING MACHINE

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Fig. 1.

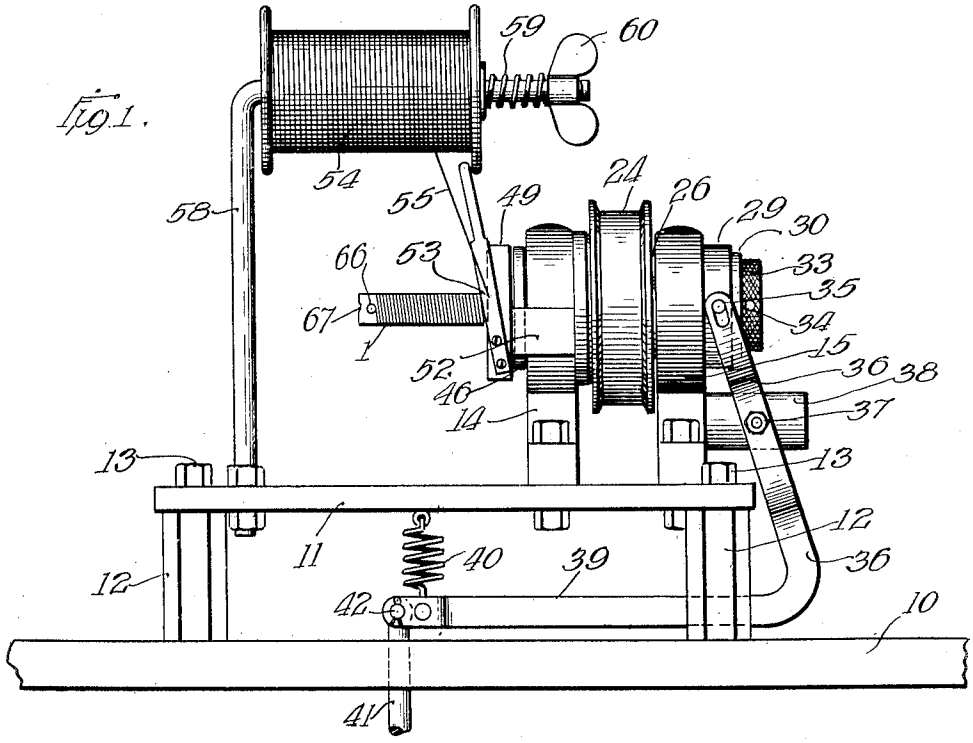
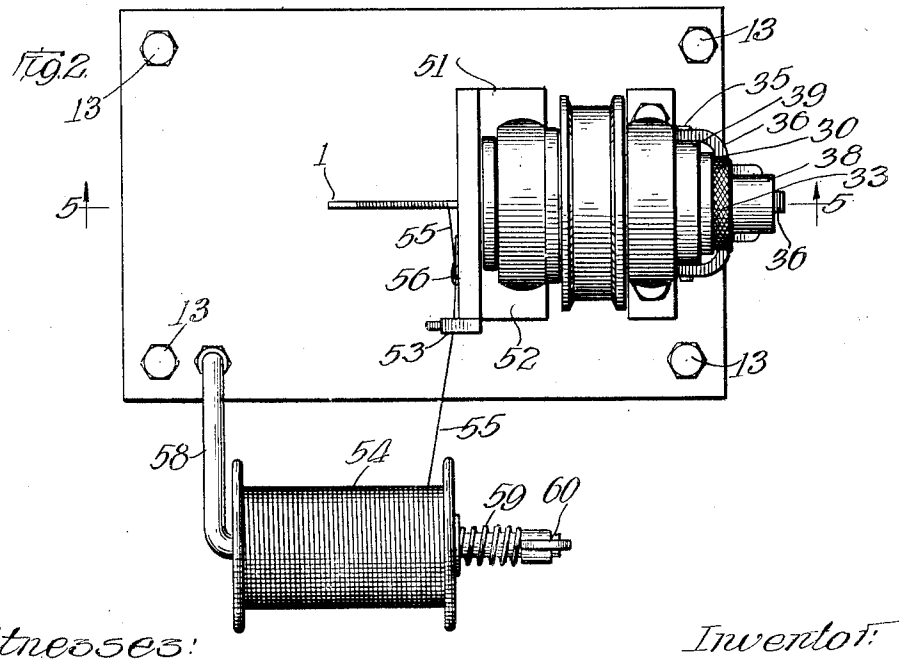


Fig. 2.



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RHEOSTAT WINDING MACHINE

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Fig. 3.

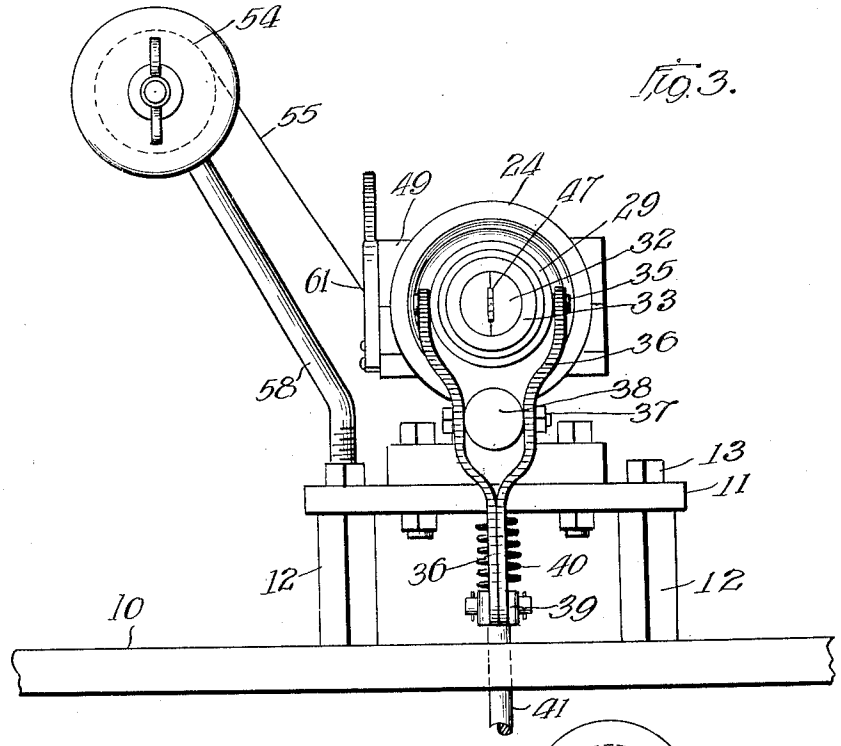
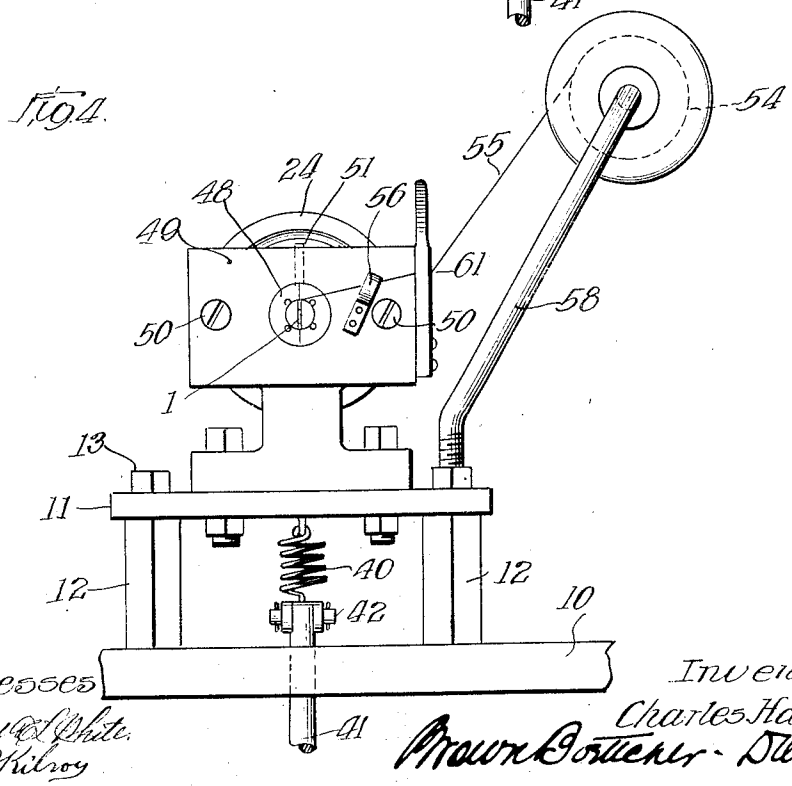


Fig. 4.



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RHEOSTAT WINDING MACHINE

Filed Aug. 1, 1924 4 Sheets-Sheet 3

Fig. 5.

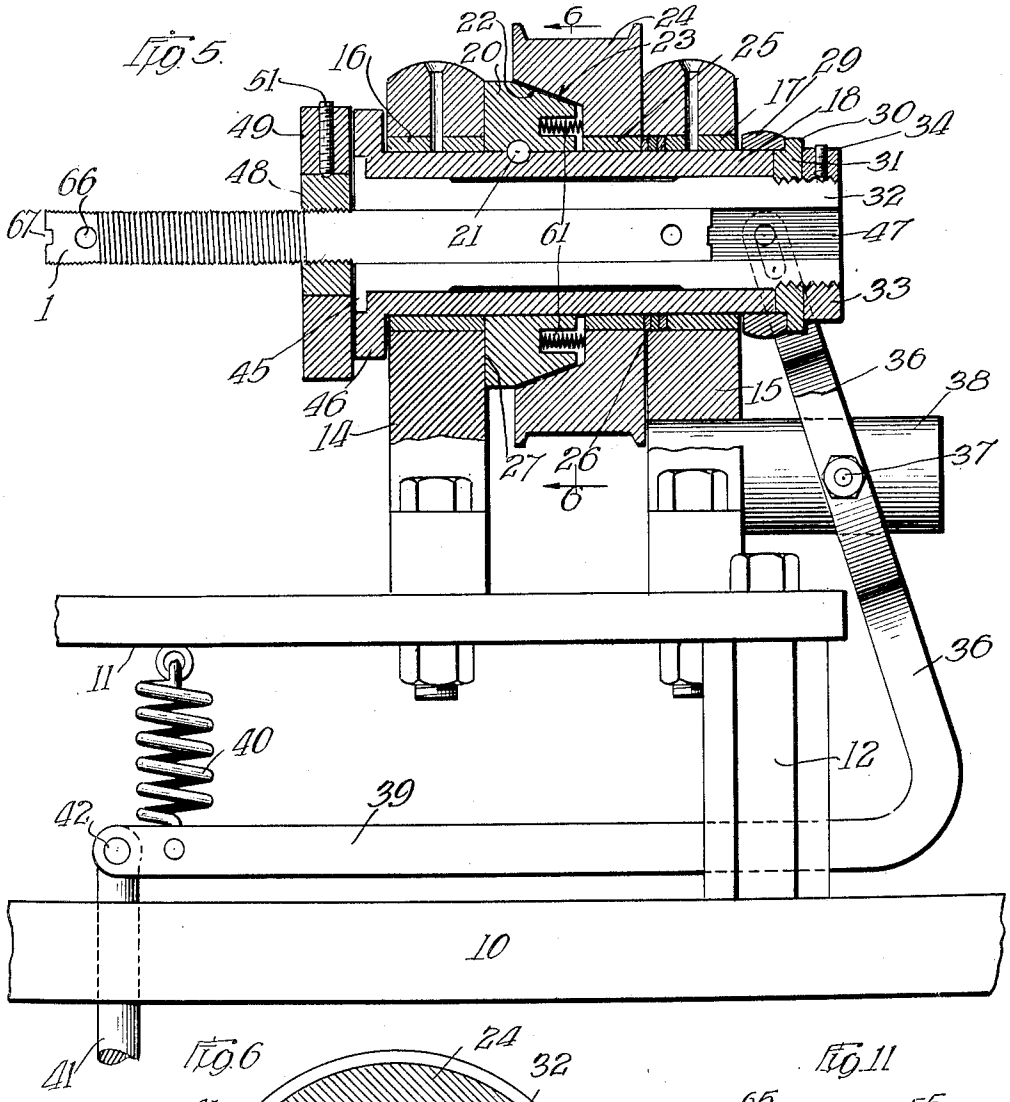


Fig. 6

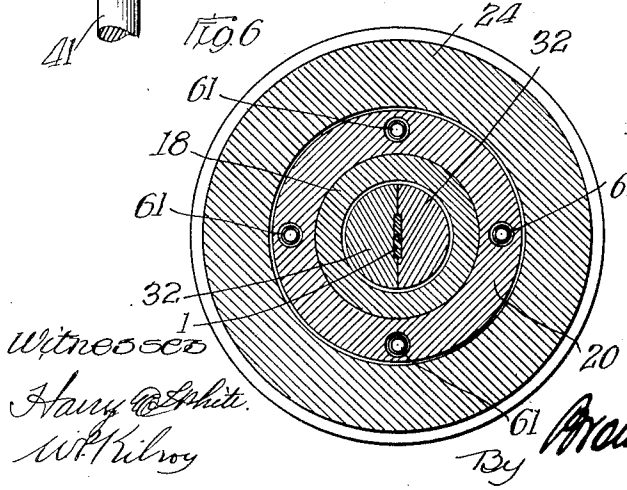


Fig. 11

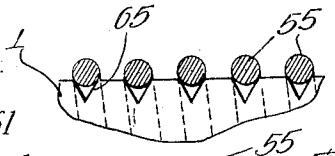
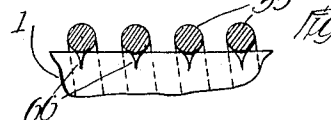


Fig. 12



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Nov. 15, 1932. C. HAVLISH 1,887,808

RHEOSTAT WINDING MACHINE

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Fig. 8

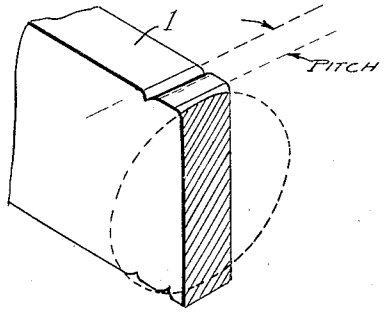


Fig. 7.

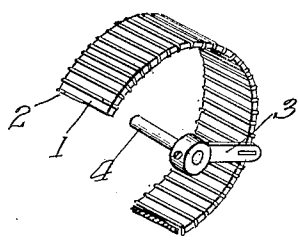


Fig. 9.

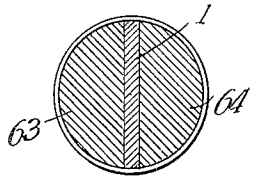


Fig. 10

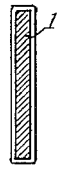


Fig. 13

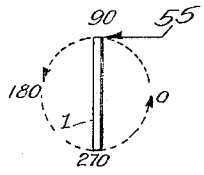


Fig. 14

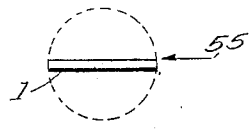


Fig. 15

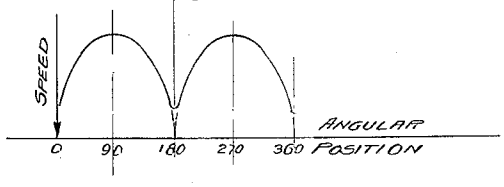


Fig. 16

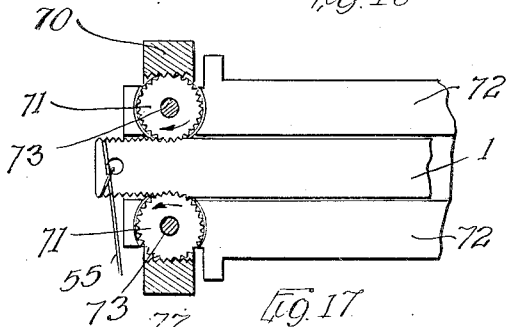


Fig. 17

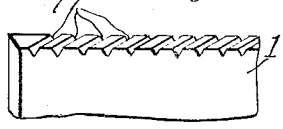
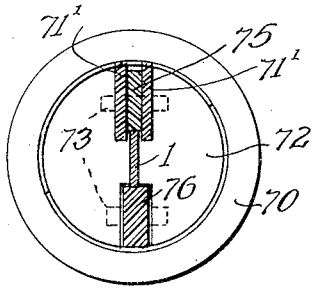


Fig. 18



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Patented Nov. 15, 1932

1,887,808

UNITED STATES PATENT OFFICE

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RHEOSTAT WINDING MACHINE

Application filed August 1, 1924. Serial No. 729,479.

My invention relates to rheostat or the like and more particularly to rheostat strips such as are employed for light current work and the method of and means for winding the same.

A demand for rheostats for controlling current flow of relatively small quantity has recently sprung up in connection with the development of radio apparatus particularly such rheostats as are employed for controlling filament current for hot cathode tubes or for rheostats or potentiometers.

Rheostats and potentiometers of the general character shown in patent to Maclagan No. 870,042 of November 5, 1907 are now in common use. Such construction employs a strip of flexible insulating material such as fibre, impregnated paper and the like.

The resistance conductor is first wound transversely about the strip and then the strip is mounted in circular form upon a suitable mounting or base. A contact finger may travel over the edges of the strip engaging the adjacent convolutions or coils of wire or a contact may be made along the side of the strip if desired.

Considerable difficulty has been encountered heretofore in disposing the conductor suitably and permanently upon the flexible strip. The strip being flexible is difficult to support and it is no simple matter to get the wire wound upon the flexible strip with sufficient tightness and accurate spacing as to secure substantially equal increment of resistance with equal increment of motion of the contacting finger. The friction of the contacting finger furthermore tends to displace the coils of the conductor and the winding of the strips heretofore has presented a problem requiring careful attention and relatively slow operation.

I have conceived the idea of cutting helical threads upon the tangential surfaces or edges of a suitable strip or rod and simultaneously applying the conductor to such strip or rod and letting it wind itself in the helical threads by its own rotation. By maintaining a suitable tension upon the wire and by providing suitable guiding means in combination therewith the conductor may be made to track in the helical groove and thus be securely and permanently mounted in position.

In the preferred manner of performing the method of my invention the threading die is held stationary and the conductor tensioning and supplying means is held relatively stationary and the strip is rotated and passed through the die. It is quite obvious that relative motion of the parts may be reversed without departing from the spirit and scope of my invention.

While the particular machine which I employ is adapted for winding rheostat strips it will be apparent that the invention is not limited to the winding of such specific articles, but may be employed for the manufacture of other articles. Also it will be noted that instead of employing a thin flexible strip any other form of support for the rheostat conductor that is desired may be employed. The particular rod or mounting for the conductor may be circular or non-circular, but a thin flat or other non-circular strip is found to be highly satisfactory.

The irregularity of surface speed of winding of such a strip and the guiding of the conductor in the helical groove is satisfactorily accomplished by a guiding and tensioning means which permits of very rapid variation of linear speed of the conductor as it is wound upon the strip in addition to the main tension which is put upon the conductor.

In order to acquaint those skilled in the art with the manner of constructing a rheostat strip according to my invention, and for constructing and operating a machine embodying the mode of operation which I have indicated, I shall now describe in connection with the accompanying drawings, a rheostat strip embodying the invention and a rheostat strip winding machine embodying my invention.

In the drawings:

Fig. 1 is a right side elevational view of a machine embodying my invention;

Fig. 2 is a plan view of the same;

Fig. 3 is a rear end view; and Fig. 4 is a front end view of the machine;

Fig. 5 is a vertical longitudinal section taken on the line 5—5 of Fig. 2;

Fig. 6 is a vertical transverse section taken on the line 6—6 of Fig. 5;

Fig. 7 is a fragmentary isometric view of a rheostat employing a strip constructed in accordance with my invention;

Fig. 8 is a fragmentary diagrammatic view indicating the manner in which the thread or guiding groove is cut in the edges of the strip;

Figs. 9 and 10 are diagrams indicating in end view the character of the enveloping helix and the enveloping wire;

Fig. 11 is a fragmentary detail view indicating the manner in which the wires are disposed in the grooves;

Fig. 12 is a fragmentary view similar to Fig. 11 showing the disposition of the current convolutions in the grooves which are cut in the edge of the strip;

Figs. 13 and 14 are diagrams illustrating the variation of linear speed of the wire as it is wound upon the flat strip;

Fig. 15 is a graph of the variation of speed due to the radial irregularity of the strip with respect to its axis of rotation as illustrated in Figs. 13 and 14;

Fig. 16 is a fragmentary sectional view of a modification of the winding machine when the cutting is done by separate rollers;

Fig. 17 is a fragmentary view of the notches cut by the machine shown in Fig. 16; and

Fig. 18 is a modification showing the feeding or cutting roller made a separate piece as distinguished from the roller or rollers that track in the threads of the stationary nut or hollow lead screw.

Referring first to Fig. 7 I have here shown the elements of a rheostat or potentiometer embodying the strip of my invention. This strip comprises a thin flexible rod 1 of insulating material such as fibre, impregnated paper or other suitable insulating material upon which strip there is wound in suitable convolutions or turns the conductor 2. The strip 1 is preferably bent in arcuate or circular shape and a spring finger 3 mounted on a coaxial shaft 4 is adapted to sweep over the edges of the coils or turns 2 to make contact therewith. This general form of construction is well known and I lay no claim to the rheostat as such, apart from the novelty in the strip and its method of manufacture.

According to the theory of my invention I take the rod or strip 1 and cut upon the edge thereof, grooves corresponding to screw threads which may be conceived as enveloping or circumscribing the strip as explained in connection with Fig. 9. Now the bar or strip 1 is preferably oblong in cross section as indicated in Fig. 8. I arrange to thread this strip through a regular threading die, supporting the strip by a suitable chuck in the meanwhile and cut helical threads in the narrow face of edge of the strip and in these grooves I lay the turns or convolutions of the conductor 2, meanwhile maintaining a suitable tension upon the conductor to bend and thereby hold the conductor in the strip at the same time. Suitable take-up and guiding means for securing the desired laying of the conductor in said grooves is used in addition to the tensioning means.

A machine suitable for performing the operation automatically is shown in Figs. 1 to 6 inclusive. In said machine the frame or base is indicated at 10. From this base I support a sub-frame 11 which comprises a plate mounted upon a plurality of posts 12, these posts having suitable bolts 13 passed therethrough and to the main frame.

Upon the top of the plate 11, I mount a front bearing pedestal 14 and a rear bearing pedestal 15. Suitable bearings of anti-friction metal 16 and 17 are mounted in the pedestals 14 and 15 and a hollow spindle 18 is mounted in said bearings. A conical faced clutch member 20 is keyed to the hollow spindle 18 as by means of a taper pin 21 or the like. The conical face 22 of the cone clutch member 20 is adapted to engage in the conical clutch socket 23 which is formed in the side of the pulley member 24, which pulley member is mounted by means of an anti-friction bearing 25 upon said spindle 18. Anti-friction thrust rings or other suitable anti-friction bearings 26 are arranged to take the axial thrust of the cone clutch member 20 when the clutch parts are in engagement.

The radial face 27 of the clutch member 20 may engage the side of the bearing post or column 14 to act as a brake for stopping the live spindle 18 when it is disengaged from the pulley 24.

The live spindle 18 is normally held in its extreme left position, as viewed in Fig. 5, to maintain the clutch surfaces out of contact and to hold the live spindle 18 stationary, a suitable clutch collar 29 being mounted for this purpose, upon the rear end of the live spindle.

The clutch collar 29 bears at its rear end against a cooperating flange 30, which is formed upon a ring 31, this ring being threaded upon the rear end of the shank of the chuck 32. A locking ring 33 is threaded upon the outer end of the shank of the chuck 32 and it is locked in place by means of the set screw 34.

The clutch collar 29 is connected by pins 35 to the arms of a fork lever 36, this lever being fulcrumed at 37 upon a stationary pin or boss 38 which is secured in the rear bearing pedestal 15. The fork lever 36 is formed of two pieces of flat stock as is clear from Fig. 3. The fork shift lever 36 is bent so that its longer arm 39 passes under the frame

plate 11. A tension spring 40 is connected between the end of the lever 39 and the frame plate 11 so as to tend at all times to turn the lever 36 in a clockwise direction and thereby shift the live spindle 18 to the right as viewed in Fig. 5, engaging the clutch parts 22 and 23 to cause driving of the live spindle.

The outer end of the lever 39 has an operating rod 41 pivoted thereto, as indicated at 42, this operating rod leading down to a pedal lever for throwing the clutch member out of engagement and stopping the operation of the device.

The chuck member 32 has a head portion 45 which is set in a counter-bore in the head 46 of the live spindle 18. The said chuck 32 is formed in two parts as will be apparent from Figs. 3 and 5, each part having a longitudinal gutter formed therein, so that when the two parts are matched together the outer surfaces form a circular cylinder and the inner matching surfaces define a slot of oblong cross section for receiving the strip 1. The strip 1 passes freely through the slot in the chuck for axial motion. If a rod or bar of different contour is to be wound the corresponding slot or opening 47 in the chuck 32 is formed to correspond to the desired cross section.

The thread cutting die 48 which may be of any suitable character such as is now found on the market for cutting standard threads, is mounted in a frame plate 49, secured as by means of the machine screws 50 to a pair of short arms 51 and 52 formed on the sides of the bearing pedestal 14. The die 48 may be made in two parts, or it may be made in one unitary piece and it preferably is a standard commercial die. The die is held in the opening in the frame plate 49 as by means of the set screw 51, which serves also to prevent the die turning in the frame 49. The axis of the die 48 is accurately registered with the axis of the slot 47 to facilitate cutting of the helical thread upon the edge of the strip 1. Absolute accuracy of alignment is not essential, a desired function being that the strip 1 which lies in the slot 47 shall be free to enter the die 48 and engage the thread while the live spindle 18 is turning. The function of the chuck is to turn the strip so that it will automatically be advanced through the die as the threads or notches are cut in the edge of the strip.

The wire or conductor is fed from a suitable spool or reel 54 through an adjustable guide member 55, under a tensioning and guiding spring 56 and from there upon the strip 1 at a point just beyond the die 48. The friction of the strip 1 in the die 48 tends to hold the strip relatively rigidly and the strip is furthermore guided by the slot 47 in the chuck 32. The spool or reel 54 is mounted upon an arm 58 secured at its lower end to the frame plate 11 and having a suitable tensioning spring 59 which is adjustable by the wing nut 60 to apply a suitable braking or tensioning of pressure to the end of said spool or reel 54 for the purpose of maintaining the desired tension upon the conductor or wire 55.

Since the strip 1 is relatively thin and it is desired to wind the conductor 55 upon it as rapidly as possible, it is essential that the irregularities of winding speed be taken up by the spring 56.

As indicated in Figures 13 and 14 it will be seen at once that the strip 1 as it rotates about its axis will take up the conductor 55 at a varying linear speed which should vary in accordance with the sine law assuming the strip 1 to be of no thickness and the wire 55 to be a mere line. When the flat face of the strip 1 and wire 55 are tangent, as indicated in Fig. 14, the speed of winding is at a minimum but increases and rises to a maximum at the position shown in Fig. 13 which is 90° advanced and then the speed dies down again as a position of 180° motion is reached. Thus the linear speed of the conductor 55 approaches the sine law of variation somewhat as indicated by the solid line in the graph of Fig. 15.

Since the notches which are cut in the surface of the strip 1 are separated by the regular pitch distance as indicated in Fig. 8, and since there is no guiding function of that part of the cylinder which is indicated by the dotted ellipse in Fig. 8 it will be seen at once that the problem of taking up the irregularities of surface speed due to winding on a flat strip and also the problem of guiding the wire into the next adjacent slot is relatively complex. I find, however, that the guiding spring 56, when supplemented by suitable tension on the drum or reel 54 and by suitable positioning of the guide 61 performs this function by taking up slack during the period of relatively low surface speed and at the same time throwing the wire over to the right, as viewed in Fig. 2, to bring the wire or conductor into the next adjacent notch or part of the helical groove.

Attention is here called to Figs. 9 and 10 which illustrate the difference between the strip 1 with the wire wound tight thereupon, and the strip 1 with a round helix wire surrounding the same. Assume that the strip 1 were supplemented as indicated by the shaded portion 63 and 64 in Fig. 9, and that the helical groove were formed upon the cylindrical surface thereof, it will be seen at once that the wire conductor 55 would be self guiding upon the surface thereof, and the speed would be uniform.

Since the semi-cylindrical parts 63 and 64 are missing as is obvious from Fig. 10, the wire has no guide during the major part of its travel upon the strip 1 and depends solely upon the notches in the edges for accurate spacing. The spring finger 56 performs the com-

pound function of taking up the individual irregularities caused by the deviation of the cross section of strip 1 from the cross section of a true circle to the circular cylinder and throws the wire over into the next notch during such period of taking up slack so that the wire is carefully guided and suitably tensioned into its slot with the result that the strip when completed has the conductor 55 firmly imbedded in the edges so that the contact arm, such as the arm 3 as indicated in Fig. 7 or any other contacting arm whether engaging along the edge or along the sides, is able to press firmly against the turns or convolutions 2 without displacing them.

In Figures 11 and 12 I have indicated the strip 1 with the conductor 55 mounted thereupon. The strip 1 as indicated in Fig. 11 is of a material which permits a sharp V-shaped notch to be cut therein, as is the case in material which is of a crystalline character, such for instance as hard rubber or bakelite. In Fig. 12 I have indicated the character of the notch which is the result of cutting fibrous material with the usual thread cutting die, a notch 66 tending to close up but forming a suitable seat for the conductor 55.

The operation of the machine shown in Figs. 1 to 6 inclusive is as follows: The bare strips 1 which are of the length substantially in excess of the length of the chuck 32 are inserted in the opening 47 while the chuck and live spindle are stationary. At this time the live spindle 18 is thrown as far as possible to the left as viewed in Fig. 5, bringing the clutch member 20 to the left and engaging the surface of the same against the side of the bearing pedestal 14. The springs 61 which are placed between the two chuck parts tend to maintain the two parts out of contact when the pedal rod 41 is pulled down. When pressure is now released on the pedal and the spring 40 permitted to act, the collar 29 throws the live spindle 18 to the right, engaging the clutch surfaces 22 and 23 and driving the live spindle with its contained chuck. The chuck 32 in turn turns the strip 1 and by pressure upon the rear end of the strip the strip is advanced into the teeth of the die 48 whereupon the strip automatically advances until the end thereof protrudes from the die 48. As soon as the hole 66 sufficiently clears the die 48 the conductor 55 is thrust therethrough and given sufficient of a hitch to start the winding of the conductor upon the strip. The conductor is then looped under the guiding and tensioning spring 56, the clutch pedal is released and the winding proceeds automatically. As soon as the rear end of the strip 1 clears the chuck 32, winding automatically stops. The conductor is then cut and looped through the corresponding opening 66 in the opposite end of the strip, or if desired, the attendant may feed the next strip through and merely transfer the wire without cutting from one strip to the advancing end of the next.

In order to facilitate the continuous feeding of the strip I form notches such as shown at 67 in the ends of the strip and then it is possible by the engagement of these notches with each other, for the next succeeding strip, to turn the strip which is issuing from the die to clear it of the die.

The operation is therefore almost wholly automatic and a single attendant with one of these machines can do as much work as was heretofore accomplished by three or four machines of the prior art each with an attendant.

While the machine shown in Figs. 1 to 6 inclusive is the preferred device for winding the strips I do not intend to be limited to the specific embodiment there shown except in such claims as are limited thereto. The broad aspect of the invention comprises utilizing the rotation of the strip which is essential to winding upon it the wire 55, to perform at the same time an automatic advance of the strip may be embodied in other machines. For example I have shown in Fig. 16 how I may employ a stationary nut or hollow lead screw 70 and worm wheels 71 for converting the rotation of the chuck 72 and strip 1 into a longitudinal feeding motion of strip 1.

In this construction chuck 72 is formed of two halves just as chuck 32 above shown. This chuck has however the two feeding rollers 71 journaled on pins 73 in the chuck. The feeding rollers are provided with teeth which mesh with the threads of the nut 70 and which on their inner sides engage the strip 1 between them. This strip is guided and turned by the axial channel or slot in the chuck 72.

Relatively deep notches may be cut into the edge of the strip 1 as indicated in Fig. 17 and these cross sections may have a lay or inclination greater than the normal lay of a helix by employing a cutter 75 on the same shaft or secured to the driving wheels 71 which mesh with the threads of the nut 70. This cutter 75 which acts as a feeding roller may cut any form of notches desired. The strip may be notched on one edge only if desired or an idler as shown at 76 may be employed for engaging the other edge.

If the grooves 77 have a greater overlap as shown in Fig. 17 the passage of a contactor over them is smoother and less abrupt.

The machines shown in Figs. 16 and 18 provide support of the strip beyond the point where the notches or grooves are formed.

I do not intend to be limited to the precise details shown or described.

I claim:

1. In combination a strip feeding chuck, a revolvable member, a clutch for clutching the chuck to the member, a thread cutting die at the end of the chuck, and means for supply-

ing a wire to be wound automatically upon said strip issuing from the cutting die.

2. In combination a strip feeding chuck, a revolvable member, a clutch for clutching the chuck to the member, a thread cutting die at the end of the chuck, means for supplying a wire to be wound automatically upon the strip issuing from the cutting die and tensioning means for taking up the irregularities of winding speed of the wire due to variations of tangential surface speed of the rotating strip.

3. In a device of the class described the combination of a chuck for holding a strip of insulation, means for rotating the chuck, means operated by rotation of the chuck for simultaneously advancing the strip axially and cutting transverse grooves across the edge thereof.

4. In combination a hollow spindle, a split chuck adapted to be mounted in said spindle, said chuck having means for holding a strip of insulation, driving means for the spindle, a clutch for clutching the driving means to the spindle, means operated by rotation of the spindle for simultaneously advancing the strip through the chuck axially and for cutting transverse grooves across the edge thereof.

5. In combination a hollow spindle, a split chuck adapted to be mounted in said spindle, said chuck having means for holding a strip of insulation, driving means for the spindle, a clutch for clutching the driving means to the spindle, means operated by rotation of the spindle for simultaneously advancing the strip through the chuck axially and for cutting transverse grooves across the edge thereof, and means for guiding a conductor upon the strip.

6. In a device of the class described, a chuck for holding a strip of insulation, means for rotating the chuck, means for cutting notches in an edge of the strip and for simultaneously advancing the strip and means for winding a conductor in said notches as the strip is advanced.

7. In combination, a chuck for holding a strip of insulation, means for rotating the chuck, notch forming means for advancing the strip as the chuck rotates, means for supplying a conductor to be wound upon the strip and means for guiding the conductor into said notches.

8. In combination, a frame comprising a pair of bearings, a live spindle mounted in the bearings, a driving pulley mounted on said spindle between the bearings, a clutch for connecting the pulley with the spindle, said clutch having throwout means, a relatively stationary die mounted on the frame and a split chuck mounted in the spindle for rotating a strip in cooperation with the die.

9. In combination, a frame comprising a pair of bearings, a live spindle mounted in the bearings, a driving pulley mounted on said spindle between the bearings, a clutch for connecting the pulley with the spindle, said clutch having throwout means, a relatively stationary die mounted on the frame and a split chuck mounted in the spindle for rotating a strip in cooperation with the die, and wire supplying and guiding means for guiding the wire upon the strip as it emerges from the die.

10. In combination, a frame having bearings, a live spindle having a chuck for rotating a strip of insulation, means for driving the live spindle at will and stationary means cooperating with the chuck to form notches or grooves across the edges of the strip and to advance the strip through the chuck.

11. In combination, a frame having bearings, a live spindle having a chuck for rotating a strip of insulation, means for driving the live spindle at will and stationary means cooperating with the chuck to form notches or grooves across the edges of the strip and to advance the strip through the chuck and means for supplying and guiding a conductor upon the strip as it advances axially.

12. In combination, a frame having two bearings, a hollow spindle in the bearings, a loose pulley having a cone clutch socket and a keyed cone clutch mounted on said spindle, means for shifting said spindle axially to bring cone into the clutch socket of the pulley, a chuck mounted in the hollow spindle for rotation therewith, and a threading die in front of the chuck mounted upon the frame.

13. In combination, a rotatable chuck for feeding a strip of insulation, a stationary threaded member and a wheel carried by the chuck and engaging the threaded member for advancing the strip out of the chuck as the chuck is rotated.

14. In combination, a rotatable chuck for feeding a strip of insulation, a stationary threaded member and a wheel carried by the chuck and engaging the threaded member for advancing the strip out of the chuck as the chuck is rotated, and relatively stationary wire feeding means for feding wire to be wound upon the strip as it emerges from the chuck.

15. In an apparatus for mounting a conductor on a supporting element, a cutting tool, means for rotating the element and simultaneously advancing it axially in engagement with the cutting tool, the said tool defining a groove therein, and means for causing the conductor to be wound upon the element by the rotation of the same, the said conductor being guided in the groove defined by the cutting tool.

16. In an apparatus for mounting a conductor on a supporting element, a cutting tool, means for rotating the element on its longitudinal axis in contact with the said

tool and for simultaneously advancing the same to cause the said tool to cut a transverse groove on its surface tangent with the said tool, means for causing the conductor to be wound upon the element by the rotation of the said element, and means maintaining a tension upon the said conductor for aligning the conductor with the groove formed on the said element.

17. In an apparatus for mounting a conductor upon a supporting strip, a cutting tool, means for rotating the strip upon its longitudinal axis, means for moving the strip in contact with the said tool, the said tool gripping the edges of the strip to form transverse grooves thereon, and means for causing the conductor to be wound in the grooves formed thereon by the rotation of the said strip.

18. In an apparatus for mounting a conductor on a supporting element, means for supporting the element for rotation upon its longitudinal axis, means for rotating the element, a grooving tool, means for advancing the element axially in contact with the said grooving tool to form tangential grooves therein, and means for causing the conductor to be wound in the tangential grooves by the rotation of the said element.

19. In an apparatus for mounting a conductor on a supporting element of insulation, a cutting member, means for advancing the element in contact with the said member to form a thread on the element, and means for winding the conductor in the thread so formed by the rotation of the element with respect to the conductor.

20. In an apparatus for mounting a strand on a supporting element, a forming member, means for rotating the supporting element on its longitudinal axis in tangential contact with the forming member and for simultaneously advancing the element to cut a helical groove on a tangent surface thereof, means for causing the strand to be wound upon the element by the rotation of the said element, and means for maintaining a tension upon the strand for causing it to align with the helical groove.

21. In an apparatus for mounting a strand upon a supporting element, a forming member, means for rotating and advancing axially the element in tangential contact with the said member to form diagonal notches across a longitudinal surface of the element, and means for laying the strand in said notches as the element advances.

22. In an apparatus for mounting a strand upon a supporting element, a helical thread cutting member, means for rotating the element in contact with the member to cause axial motion thereof and to simultaneously cause the member to form a helical groove on the said element, and means for guiding the strand into the said groove to cause it to be wound on the element.

23. In an apparatus for winding a conductor upon a core of non-circular cross-section, a thread cutting die, means for threading the core through the said die by rotation, the said die forming a groove in the said core, means for causing the conductor to be wound upon the core by the rotation thereof, and means for maintaining a predetermined tension upon the conductor to cause it to seek the groove and to be spaced thereby.

24. The method of mounting a strand on a supporting element which consists in rotating the element on its longitudinal axis, advancing the element axially to cut a plurality of grooves therein, and simultaneously guiding the strand into the said grooves as the element is advanced.

25. The method of mounting a strand on a supporting element which consists in forming a circumscribing thread upon the element and simultaneously winding the strand in the groove of said thread.

26. The method of mounting a conductor on a supporting element of insulation which consists in rotating the element to wind the conductor on the element and simultaneously forming grooves on a surface of the element in advance of the application of the conductor thereto for receiving the said conductor.

27. The method of mounting a conductor on a supporting element which consists in rotating the element on its longitudinal axis, cutting a groove therein and simultaneously advancing the element axially and winding the conductor in the groove by the rotation of the element.

28. The method of mounting a strand upon a core of non-circular cross-section which comprises threading the core longitudinally, applying tension to the said strand to guide it into the grooves of the thread so formed, and simultaneously winding the strand around the core in the said grooves.

29. The method of mounting a conductor on a core of non-circular cross section which consists in forming a plurality of grooves on the edges of the said core and contemporaneously causing a relative movement between the core and the conductor to cause the conductor to be wound around the said core, the said grooves receiving the conductor and causing the convolutions thereof to be uniformly disposed around the core.

30. The method of mounting a conductor on a core of insulation of non-circular cross-section which consists in threading the core to cause its edges to have formed thereon a plurality of grooves, contemporaneously causing the conductor to be wound about the core, and applying tension to the said conductor to guide it into the grooves formed on the said core, the said grooves receiving

the conductor and causing the convolutions thereof to be uniformly disposed around the core.

31. The method of mounting a strand on a supporting element which consists in threading the element, contemporaneously advancing the element axially by said threading action and guiding the strand in the grooves of said thread.

32. The method of mounting a strand on a supporting element which consists in rotating the element to cause it to be threaded, contemporaneously advancing the element axially by said threading action and guiding the strand in the grooves of said thread.

33. In an apparatus for mounting a strand on a supporting element, a cutting member for forming grooves in the element and simultaneously advancing it axially, and means for guiding the strand in the said grooves as the element is advanced to cause it to be wound on the said element.

34. In an apparatus for mounting a strand on a supporting element, means for rotating the said element, a cutting member for contemporaneously advancing the element axially and for forming channels therein, and means for guiding the strand in the said channels of the rotating element to cause it to be wound on the said element.

35. A winding device having, in combination, means to rotate a member to be wound, a body having a plurality of spaced cutting edges adapted to be pressed onto the rotating member at an angle thereto, and guiding means on said body for the material being wound on the member.

36. A winding device having, in combination, means to rotate a member to be wound, a body having a plurality of spaced cutting edges adapted to be pressed onto the rotating member at an angle thereto, means to maintain said body on the member with the cutting edges in fixed angular relation to the rotating member, and guiding means on said body for the material being wound on the member.

37. A winding device having, in combination, means to rotate a member to be wound helically with a fine strand, and a guiding body with a portion thereof in the form of a half nut having its semi-cylindrical groove adapted to fit over said member, the threads of the nut entering into the material of the member to cause relative axial movement between the body and the member to be wound during the rotation of said member.

38. A winding device having, in combination, means to rotate a member to be wound, and a guiding body in the form of a half nut having its semi-cylindrical groove adapted to fit over the member, the threads of the nut cutting into the material of the member to cause relative advancement between the body and the member during the rotation of said member, said body having a guideway to receive and feed the material to be helically wound on the member.

39. A winding device having, in combination, means to rotate a member to be wound, and an independent body in the form of a nut section having its arcuate groove adapted to fit over said member, there being a guideway on said body for the material being wound, the threads of the nut being adapted to cut into the material of the member during the rotation thereof whereby relative axial advancement between the body and said member is produced to feed the material being wound to said member to produce a helical winding thereon.

40. A winding device having, in combination, means to rotate a member to be wound, a body having an arcuate cylindrical groove therein adapted to fit over the member being wound, said groove having portions of helical threads therein adapted to cut into the material of the member being wound to cause relative advancement between the member and said body during the rotation of the member, and guiding means on said body to receive the material being wound on the member.

41. A winding device having, in combination, means to rotate a member to be wound, a body having a groove therein to fit over said member for guiding the member axially with respect to the body, spaced cutting edges within said groove at an angle to the rotating member, and guiding means on said body for the material being wound on the member.

42. In a winding machine, a chuck rotatable about an axis and having a slot of a section to receive a member upon which a winding is to be placed, said slot extending through said chuck rectilinearly along the axis of the chuck and having an inlet at one end and an outlet at the opposite end and in axial alignment with said inlet, means for delivering a winding to the member for winding thereon by rotation of the chuck, and means having positive pushing engagement with said member and including a threaded element having an axis generally parallel with the axis of rotation of said chuck for positively pushing said member in a straight path along the axis of rotation of the member to distribute the winding along the member.

In witness whereof, I hereunto subscribe my name this 28th day of July, 1924.

CHARLES HAVLISH.