Dec. 29, 1931. J. FLAWS, JR 1,838,819

GRID MAKING MACHINE

Filed Feb. 10, 1926 2 Sheets-Sheet 1

Fig. 1.

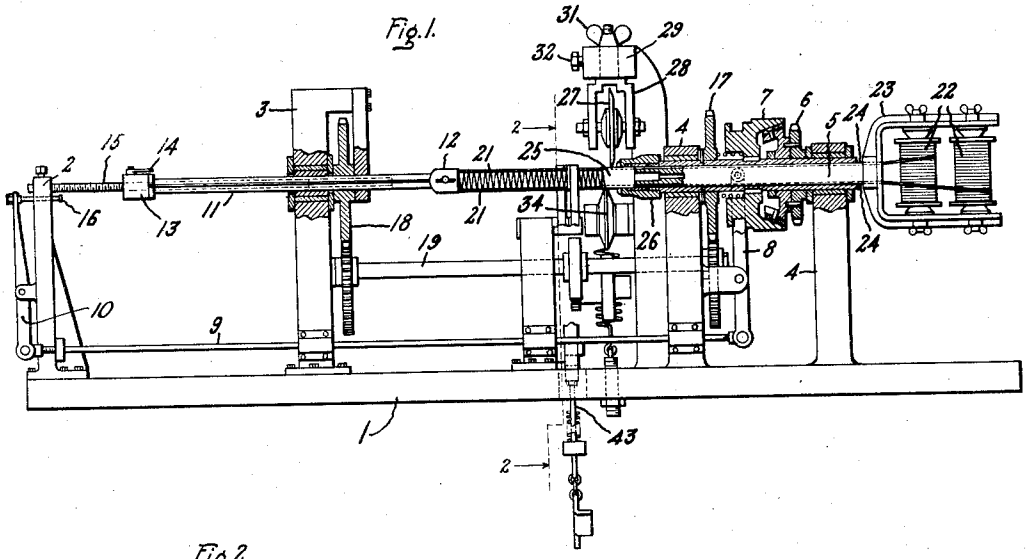


Fig. 2.

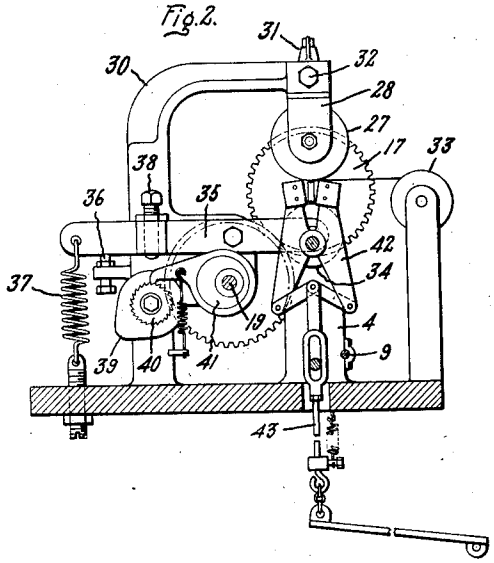


Fig. 3.

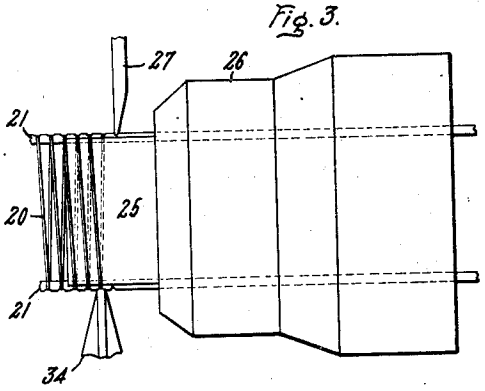


Fig. 5.

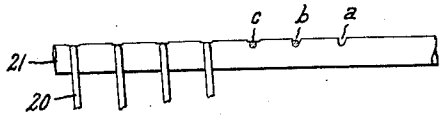
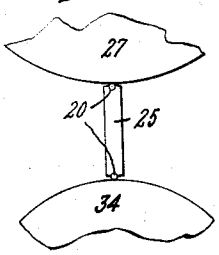


Fig. 4.



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Dec. 29, 1931. J. FLAWS, JR 1,838,819

GRID MAKING MACHINE

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Fig. 7.

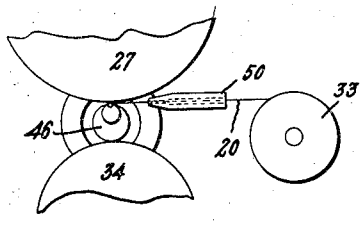


Fig. 6.

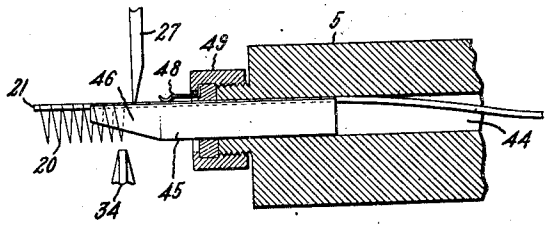


Fig. 8.

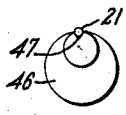


Fig. 9.

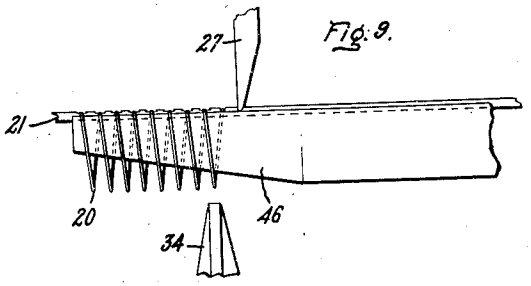


Fig. 10.

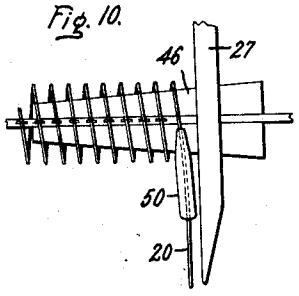


Fig. 11.

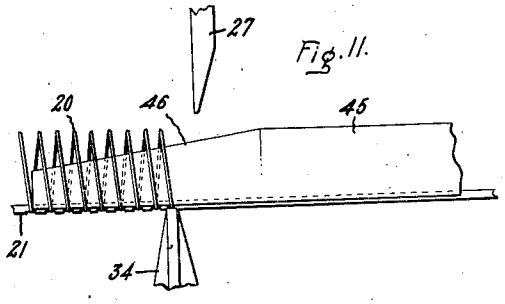
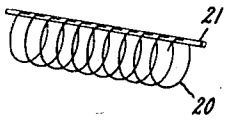


Fig. 12.



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Patented Dec. 29, 1931

1,838,819

UNITED STATES PATENT OFFICE

JOHN FLAWS, JR., OF IRVINGTON, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

GRID MAKING MACHINE

Application filed February 10, 1926. Serial No. 87,468.

This invention relates to grid electrodes which consist of a grid wire helix with its turns secured to one or more longitudinal support wires, and more particularly to machinery for making such grids, which are commonly used in thermionic or electron discharge tubes and similar devices.

The object of my invention is to provide means for making grids rapidly and accurately, with a minimum of skilled labor, and in general to improve the manufacture of grids.

In accordance with my invention the grid is made by forming notches or slots in a support wire in spaced relation and bending or winding the grid wire about the support wire into a helix with its convolutions or turns lying in the notches or slots so that its pitch is determined by the spacing of the notches or slots along the support wire. The turns or convolutions of the grid wire helix are firmly secured to the longitudinal support wire by displacing the edges of the slots or otherwise reducing the dimensions of the slots or even closing them so that the grid wire is clamped to or even embedded in the support wire. In one embodiment of the invention the grid wire is bent or wound into a coil or helix over one or more support wires which lie in longitudinal grooves in a rotatable mandrel or arbor and the grid wire is so guided that each turn of the helically wound grid wire crosses the support wires preferably at substantially a right angle. As the mandrel rotates the grid wire is wound on it into a coil, and each turn of the coil as it is formed is embedded in the support wire at the point where it crosses the support wire, thereby producing a very rigid and sturdy structure. A convenient way of doing this is to make along the support wire notches or slots spaced apart the same distance as the turns of the grid coil, place each turn in a notch and then close the notches down on the grid wire to lock it in place. Preferably the support wire is moved continuously along the mandrel and is notched at each revolution of the mandrel as it is carried under the edge of a notching wheel or similar device set to engage the support wire at one point in the rotation of the mandrel. By the time the mandrel has completed another revolution the support wire has moved a distance equal to the spacing between notches. After a notch is formed it is carried by the movement of the support wire and the rotation of the mandrel into such a position that the grid wire which is being bent around the mandrel to make a turn of the grid coil enters the notch, after which the notch is closed to clamp the turn of the grid when the continued rotation of the mandrel carries the support wire within range of a notch closing device, such as a closing wheel set to press the walls of the notch in on the grid wire as the support wire is carried past the wheel. Preferably the steps of making a notch, placing a turn of the grid in it, and closing it on the grid wire follow each other as closely as possible and are all completed during a few revolutions of the mandrel, so that for practical purposes the making of each turn of the grid and the fastening of that turn to the support wire are simultaneous. The support wires are continuous and are fed from spools, so that the grid structure may be produced in long lengths, which may afterwards be cut up into grids of the desired length.

My invention will best be understood in connection with the accompanying drawings in which I have shown one of the various forms in which it may be embodied and in which Figure 1 is a longitudinal view, partly in section, of a grid making machine embodying my invention; Fig. 2 a cross section along the line 2—2 of Fig. 1; Fig. 3 an enlarged side view of a part of the notching and closing mechanism; Fig. 4 an end view of Fig. 3; Fig. 5 a side view of a portion of a grid during manufacture, showing the support wire with notches, and the placing of the grid wire in them; Fig. 6 a side view, partly in section, of the mandrel used for making single support grids in notching position; Fig. 7 an end view of Fig. 6; Fig. 8 an enlarged end view of the mandrel in Fig. 7; Fig. 9 an enlarged side view of the mandrel and cooperating parts shown in Fig. 8; Fig. 10 a top view of Fig. 9; Fig. 11 a side

view of the mandrel of Fig. 10 in notch closing position; and Fig. 12 a perspective view of a one support grid made on the mandrel illustrated in Figs. 6 to 11.

This particular form of grid making machine is constructed somewhat like a lathe, and comprises a bed plate 1 having at one end an end post 2, and also provided with a tail stock 3 and a head stock 4. A rotary head comprising a head spindle 5 is driven from a sprocket wheel 6 through a friction clutch 7 controlled by a clutch lever 8 actuated by a rod 9 from a stop lever 10 pivoted on the end post 2. A tubular tail spindle 11, provided on its inner end with a clamp 12 and on its outer end with a split nut 13 opened and closed by means of a handle 14, rotates in the tail stock and also retreats from the head spindle 5 as it rotates if the split nut 13 is closed upon a feed screw 15 fixed to the end post 2. At the end of its travel along the feed screw the nut 13 encounters a stop 16 on the handle 10, opens the friction clutch 7, and stops the head spindle 5. The head and tail spindles rotate at the same speed, as they are geared together through a gear 17 on the head spindle and a gear 18 on the tail spindle, both in mesh with gears on the countershaft 19. The gear 18 in the tail stock 3 is splined on the tail spindle to drive it and also permit it to move longitudinally through the gear.

The particular grid which this machine is adapted to make has two supports, and comprises a helix or coil of grid wire 20, with each turn of the grid firmly embedded in two parallel support wires or side rods 21. The grid wire is secured to, and preferably embedded in the support wires by notching or slotting each support wire at intervals corresponding to the spacing of the turns of the grid, placing each turn in the corresponding notch or slot, and then closing the notches or slots or at least reducing their dimensions or displacing their edges to clamp the grid wire in place.

Each support wire or rod 21 is automatically fed in a continuous length from a spool 22 in a yoke 23 on the outer end of the spindle 5. The two support wires or rods pass along two parallel channels 24, extending longitudinally through the head spindle 5, to a support for holding them properly positioned and spaced. The support wires preferably lie in grooves in the opposite edges of a flat arbor or mandrel 25 which supports and holds them and which is mounted on the inner end of the head spindle 5, and is preferably held in place by a sleeve or cap 26 threaded on the end of the spindle 5. The means for feeding the support wires along the mandrel is preferably so constructed that the support wires are fed by being drawn along the mandrel. A suitable feed mechanism for doing this is one in which the projecting ends of the support wires are gripped by a member which moves away from the arbor, such as the clamp 12 on the inner end of the tail spindle 11, so that as the tail spindle retreats the two support wires are drawn through the channels 24 and along the opposite edges of the mandrel 25.

In order to form notches or slots in spaced relation along the support wires at the proper intervals some means for forming slots or notches is associated with the head spindle, one such means being a notching device, such as a notching wheel 27, mounted in such position that its edge cuts a notch in the support wire as the support wire is carried bodily under the notching wheel by the rotation of the arbor 25. This notching wheel or slot forming member, as best shown in Fig. 3, has an edge which is rounded, preferably on the same radius as the radius of the grid wire, and has a flat side perpendicular to its axis of rotation, the other side being at an angle of about 10 degrees with the flat side. The notch produced in the support wire is rounded at the bottom to the curvature of the grid wire, with one side perpendicular to the support wire, and the other side inclined away at an angle of 10 degrees, so that the grid wire enters it freely and seats firmly in the bottom of the notch.

The notching or slot forming wheel is preferably carried in a yoke 28 with a cylindrical shank which fits into a boss 29 on a standard 30 secured to the bed plate 1. The yoke, held in the boss by wing nut 31, can be rotated in the boss to set the notching wheel with its plane at the same angle to the axis of the spindle 5 as the threads of the feed screw 15, so that the notches will be parallel to the screw threads, and can be locked in that position by a set screw 32. The edge of the notching wheel is so close to the edge of the mandrel that as the support wire 21 passes under the notching wheel the edge of the wheel makes a notch of a depth somewhat greater than the diameter of the grid wire, as best seen in Fig. 5. The spacing of the notches in the support wire determines the pitch of the grid wire helix, and is dependent upon the pitch of the feed screw 15, as the spacing between the notches depends upon the distance which the support wire moves along the mandrel during one revolution of the mandrel.

The grid wire is wound on the mandrel in a helix or coil, of the same pitch as the feed screw 15 and with its convolutions or turns disposed in and spaced the same as the notches in the support wire or rod, by feeding or guiding the grid wire to the mandrel practically perpendicular to the axis of the mandrel, and parallel to the plane of the notching wheel, so that the grid wire will lie straight in the notch of the support wire. As shown in Fig. 2, the grid wire is carried on a wire carrier, such as a spool 33, and is

drawn off the spool and wound over the two support wires 21 in a helix of the same pitch as the feed screw, by the rotation of the mandrel and the movement of the support wires due to the retreat of the tail spindle, the rotating mandrel and the tail spindle cooperating to form a means for helically winding the grid wire over the support wires.

As appears from Fig. 3, in one position of the mandrel a notch is made in one of the support wires. By the end of the next complete revolution the wire has moved along the mandrel the distance equal to the spacing between turns of the grid, and as a result the notch is in such position that as the mandrel turns the grid wire which is being wound around the two support wires by the rotation of the mandrel enters the notch and is firmly seated in it. The grid wire is firmly secured to the support wire by a securing device or means, such as a notch closing wheel or compression member 34, for deforming or displacing the metal at the edges of the slots or notches in the support wire enough to reduce the dimensions of the slots or preferably to close them and thereby firmly secure the grid wire to the support wire. The next half revolution brings this notch and the grid wire in it under the notch or slot closing wheel 34, which presses in or deforms the edges of the notch and closes the notch so that the grid wire is firmly secured to and practically embedded in the support wire.

The sequence of operations is clear from Fig. 5, in which the notch (*a*) is the notch made by the notching wheel, the next notch (*b*) is the notch in which the grid wire has just been placed by the rotation of the mandrel, and the next notch (*c*) was closed upon the grid wire by passing under the notch closing wheel.

The notch closing wheel 34 is mounted on the end of an arm 35 pivoted on the standard 30 and held against an adjustable stop 36 on the standard by a spring 37 strong enough to hold the closing wheel up to its work of closing the notches. The clearance between the edge of the wheel 34 and the edge of the mandrel is less than the distance the support wire projects radially from the mandrel so that the edges of the notch are deformed and the grid wire is pressed home in the notch as the support wire passes under the closing wheel. This clearance may be varied by adjusting the position of the stop 36.

The machine produces a long grid structure sufficient for ten or more grids. It is desirable to leave some of the notches open at intervals corresponding to the approximate length of a finished grid, so as to leave one or more of the turns of the grid wire unfastened at each point where the long grid structure is to be cut, as these loose or unfastened turns at the point of cutting facilitate cutting the long grid structure up into grids of a length suitable for use in the tubes. To this end the notch closing device is so controlled by the winding means that it is temporarily inoperative at pre-determined intervals during the winding of the grid wire. In this particular machine, as best shown in Fig. 2, the control mechanism is driven from the countershaft 19 geared to the head spindle 5, and the notch closing wheel or roller is mounted on the end of a pivoted arm 35 which has an adjustable follower 38 to engage the edge of a cam 39 mounted on the standard 30 and driven step by step by a ratchet wheel 40 and an oscillating pawl actuated by an eccentric 41 on the counter shaft 19. A definite number of revolutions of the countershaft causes the cam to lift the arm against the pull of the spring 37 and render the notch closing device temporarily inoperative by holding the notch closing roller 34 away from the mandrel for a number of revolutions that can be varied by adjusting the cam follower 38.

To facilitate removing the long grid structure produced by the machine a shear 42 operated by a rod 43 from a pedal is mounted on the bed plate 2 in front of the mandrel. When the tail spindle reaches the limit of its travel, and stops the machine, the driving motor (not shown) is stopped, the two support wires are cut by the shear, the grid structure removed, the split nut 13 opened, the tail spindle slid toward the head spindle and the clamp 12 closed on the ends of the support wires still on the mandrel, the split nut tightened on the feed screw, and the machine started again.

Figs. 6 to 11 illustrate the manufacture on this machine of a grid in the form of a cylindrical coil mounted on one support. To produce this type of grid one support wire 21 is fed through an axial channel 44 in the spindle 5 and along a cylindrical mandrel 45 having a tapered end 46. The cylindrical mandrel is preferably mounted in the end of the head spindle 5 slightly eccentric to its axis of rotation.

The tapered portion 46 of the mandrel is in the form of a cone set with its axis at an angle of about 10 degrees with the axis of the cylindrical portion and of such size that one side forms an extension of the side of the cylindrical portion. A straight groove 47 along both the cylindrical and tapered part of the mandrel receives the support wire. This groove is a V with an angle of 60% to hold the single support wire so firmly seated in the groove that it will not be displaced when it is carried under the edge of the notching wheel 27 by the rotation of the head spindle 5. To assist in holding the wire in the groove a spring finger 48 may be mounted on the chuck 49 which holds the mandrel in place. The notching wheel 27 and the closing wheel 34 are set the same as

for the production of the two support grid. The grid wire is guided to the single support wire through a grid wire guide 50, preferably set at the same angle to the axis of the machine as the plane of the notching wheel, so that the grid wire will be laid in the groove parallel to the walls of the groove. The tapered end of the mandrel on which the grid wire is wound into a coil permits each turn of the grid to free itself from the mandrel as that turn is carried along by the longitudinal movement of the support wire. Each turn of the grid is wound on the mandrel simultaneously with the placing of that turn in a notch in the support wire, and each turn of the coil is released from the mandrel almost as soon as it is seated in a notch.

As is shown by Figs. 9 and 11 the path of the mandrel is such that the edge of the notching wheel is close to the mandrel only while the groove 47 is passing under the notching wheel, and is a safe distance away from the mandrel while the grid wire is being wound into a coil and while the notch containing the grid wire is being closed by the closing wheel.

While the notching wheel above described is the preferred device for making the notches, I may use other means, such as a reciprocating chisel, also a reciprocating hammer in place of the closing wheel to close the notches on the grid wire. The machine is put in operation by threading the support wires 21 through the head spindle, gripping their projecting ends by the clamp 12 on the tail spindle, and closing the split nut 13 on the feed screw 15. The head spindle is turned by hand to carry one of these supports 21 under the notching wheel 27 to make a notch, a grid wire from the spool 33 placed in this notch, and the head spindle further turned by hand until this particular notch is closed upon the grid wire by the closing wheel 34, thereby fastening the end of the grid wire to the support. The machine is then run at full speed, the two spindles rotating at the same speed, and the tail spindle retreating and pulling through the head spindle and over the mandrel 25 at such a rate that the grid wire is wound over the two supports and on the mandrel in a helix of the same pitch as the feed screw 15. As above explained, a notch is made each time a support passes under the notching wheel; one revolution later the grid wire is laid in the notch; and a half revolution after that the notch is closed on the grid wire. The operation continues until the nut 13 on the tail spindle encounters the stop 16 and the machine is automatically stopped. There is produced in continuous length a grid structure long enough to be cut up into ten or more grids.

To facilitate cutting the long grid structure up into grids some of the notches are left open by so adjusting the follower 38 that after the mandrel has made as many revolutions as there are turns on the grid the closing wheel 34 is held away from the mandrel for two or three revolutions, then returns to operative position for as many revolutions as necessary for the next grid, and so on.

When the machine stops the clamp 12 is opened, and the grid structure is cut by the shear 42, leaving the support wires 21 projecting far enough from the mandrel so that the clamp 12 can grip them when the tail spindle is brought forward by opening the split nut 13 and sliding the tail spindle toward the head spindle. This operation can be repeated time after time until the supply of support wire and of grid wire on the spools 22 and 33 has been used up.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In a machine of the character described, the combination of a notching device for making spaced notches along a support, a wire coiling device mounted adjacent said notching device for winding a wire around said support to form a helix larger than said support and with its turns in said notches, and a notch closing device mounted adjacent said notching device and operative in synchronism therewith for closing said notches upon the wire.

2. In a machine of the character described, a mandrel having a groove for carrying a support which projects above the edges of the groove, a wire carrier for delivering a wire transversely of said support, a notching device and a notch closing device mounted in parallel planes adjacent said mandrel to engage the support in said mandrel, and means for producing relative movement of said mandrel and said devices to wind said wire around said mandrel in notches in said support to form a helix and for actuating said devices to close said notches successively on successive turns of said helix.

3. In a machine of the character described, means for revolving a support about an axis parallel to it and also moving it in the direction of said axis, a notching device mounted to notch said support during one revolution, a notch closer mounted to close said notch during a subsequent revolution, and means for winding a wire around said support into a coil with a turn of wire in each of said notches.

4. In a machine of the character described, a rotatable mandrel having in its periphery a longitudinal groove for a support greater in diameter than the depth of the groove, a notching wheel and a notch closing wheel mounted in parallel planes transverse to the mandrel and with their edges close to the path of the edges of said groove, means for moving a support in and along said groove

during rotation of said mandrel, and a wire feed for delivering a wire along a line transverse to and at a point in the travel of said support such that the wire enters the notch produced by said notching wheel, whereby the wire is coiled on said mandrel and over said support into a helix with each turn embedded in said support.

5. In a machine of the character described, the combination of a notching wheel and a notch closing wheel mounted in parallel planes, a mandrel rotatable about an axis perpendicular to said planes and projecting between the edges of said wheels and having a longitudinal V-shaped groove for holding a support greater in diameter than the depth of said groove, means for moving a support in said groove longitudinally of said mandrel during its rotation, means for rotating said mandrel to carry said support in said groove into operative relation to said notching wheel and to said closing wheel in succession and a wire feed for causing said wire to be wound around said mandrel and over said support and simultaneously placed in said notches, whereby it is embedded in said support.

6. In a machine of the character described, the combination of a rotatable mandrel having on the end a cone with its axis set at an angle to the axis of rotation of said mandrel and having a longitudinal groove parallel to the axis of rotation, means for moving a support along said groove during rotation of the mandrel, a notching wheel and a notch closing wheel mounted adjacent the path of said mandrel to make a notch in a support in said groove and subsequently close said notch, and a wire guide for guiding a wire transversely of said support and into said notch during the winding of said wire into a coil on said mandrel.

7. In a machine of the character described, the combination of a rotatable mandrel having a groove in the edge for carrying a support, means for moving a support along said groove during the rotation of the mandrel, a notching wheel mounted adjacent the path of said groove to form a notch in the support in said groove as said support passes under the notching wheel, means for supplying wire to said mandrel to be coiled on it into a helix with each turn in one of said notches, and a notch closing device comprising a wheel having an edge wider than the notch and set to press the sides of the notch down over the wire as said support passes under said notch closing wheel, and means controlled by said mandrel for at intervals moving said notch closing wheel out of operative position to permit one or more of said notches to remain unclosed.

8. In a machine of the character described, the combination of a head spindle and a tail spindle in alignment and rotatable about a common axis, said head spindle having on the inner end a rotatable mandrel with a groove in the edge eccentric to its axis of rotation, means on said tail spindle for gripping a support in the groove in the edge of said mandrel, a feed screw for causing said tail spindle to retreat from said mandrel during its rotation, notch making and notch closing devices mounted to cooperate with the support in said groove at different points in its path, and a wire feeding mechanism for delivering wire to said mandrel at a point such that the wire is wound around said mandrel into a helix with each turn placed in a groove of said support and subsequently locked by closing of the notch on said wire.

9. In a machine of the character described, the combination of a rotatable mandrel having a groove in the edge eccentric to the axis of rotation of said mandrel, notching and notch closing wheels mounted parallel in planes transverse to the axis of rotation in said mandrel and in position to make a notch in a support in said groove and subsequently close said notch, said notch closing means comprising a wheel having a flat edge wider than the notch in said support, a resilient carrier for yieldingly holding said wheel in operative position, a stop for said carrier for positioning the wheel with relation to the mandrel, and means controlled by said mandrel for intermittently moving sid carrier to move said wheel away from said mandrel.

10. In a machine of the character described, the combination of a rotatable mandrel having a groove on the edge, means for moving a support longitudinally in said groove, a notching wheel mounted to make a notch in said support at each revolution of said mandrel, a wire feeding device for delivering wire to be wound on said mandrel into a helix with each of its coils in a notch in said support, and a notch closing device comprising a wheel wider than the notch, a pivoted lever for carrying said wheel, an adjustable stop for said lever to position said wheel with reference to said mandrel to close each notch upon said wire, a cam cooperating with said lever to move said closing wheel away from the mandrel, and means actuated by said mandrel to rotate said cam and thereby intermittently render said notch closing wheel inoperative.

11. In a machine of the character described, the combination of a mandrel for carrying a support, a wire carrier mounted adjacent said mandrel, a compression member mounted adjacent said mandrel to have between said member and said mandrel a clearance less than the distance to which a wire from said carrier laid across a support on said mandrel projects from the mandrel, and actuating means for producing relative movement of said mandrel, said wire carrier

and said compression member to wind the wire on said carrier around said mandrel and over said support to form a helix and bring each turn of said wire at the point where it crosses said support into registry with said compression member and thereby mechanically press said wire at that point into said support.

12. In a machine of the character described, the combination of a rotatable mandrel for carrying on its rim a support parallel to its axis of rotation, a wire carrier mounted adjacent said mandrel, a compression member mounted adjacent said mandrel to leave between it and the rim of said mandrel a space sufficient for the passage of said support only, and means for rotating said mandrel to wind wire from said carrier over said support on said mandrel into a helix and to cause each turn of said helix where it crosses said support to pass under said compression member and thereby be mechanically pressed into said support.

13. A machine for making grids comprising a rotary head, an arbor in said head, means for moving a support wire over said arbor, means associated with said head for forming slots in said wire, means for inserting a wire in said slot and means for deforming the metal at the edges of said slots to secure the grid wire therein.

14. A machine for securing a helically wound wire to another wire comprising means for forming slots in spaced relation on one wire, means for bending another wire into a helix with its convolutions engaged in the said slots and means for displacing the edges of said slots to secure the convolutions of said helix.

15. A machine for making a grid electrode comprising means for moving a support wire, means for forming notches in spaced relation along said wire, means for winding another wire in a series of convolutions disposed in said notches to provide a helix having its pitch determined by the spacing of said notches and means for closing said notches to secure said wound wire to said support wire.

16. A machine for uniting a wire of substantially helical form to a rod comprising a support for a rod, means for moving said rod relative to said support, a slot forming-member, means for intermittently engaging said member with said rod to produce a series of slots in said rod and means for guiding a wire into said slots and helically about said rod.

17. A machine for uniting a wire of substantially helical form to a rod comprising a support for a rod, means for moving said rod relative to said support, a slot-forming member, means for intermittently engaging said member with said rod to produce a series of slots in said rod, means for guiding a wire into said slots and helically about said wire and means for displacing the edges of said slots to secure said wire.

18. A machine for making a grid electrode comprising means for holding a support-wire, means for forming slots in spaced relation along the support-wire, means for helically winding a wire about said support-wire with the convolutions of said wound wire in the slots in said support-wire and means for reducing the dimensions of the slots to secure the convolutions of the helically wound wire.

19. A machine for making a grid electrode comprising means for moving a support wire, means for forming notches in spaced relation along said wire, means for winding another wire into a helix having a series of turns disposed in said notches, and means for closing a pre-determined number of said notches to secure an equal number of said turns to said support wire and for leaving a pre-determined number of succeeding notches open.

20. A machine for making a grid electrode comprising means for moving a support wire, means for forming notches in spaced relation along said wire, means for winding another wire into a helix having a series of turns disposed in said notches, and means for closing one of said notches to secure one of said turns to said support and for leaving the next notch open and thereby leaving the next turn free.

21. A machine for making a grid electrode comprising means for holding a support wire, means for forming slots in spaced relation along the support wire, means for helically winding a wire into a helix with the turns of said helix in the slots in said support wire, and means for closing and for leaving open alternate series of slots in said support wire.

22. A machine for making a grid electrode comprising means for moving a support wire, means for forming notches in spaced relation along said wire, means for winding another wire into a helix having a series of turns disposed in said notches, notch closing means for closing said notches to secure said wound wire to said support wire, and control means for rendering said notch closing means inoperative for pre-determined intervals during the winding of said helix.

23. A grid making machine comprising an arbor for holding a support wire, a grid wire carrier mounted adjacent said arbor, a notching device for notching a support wire on said arbor, a notch closing device for deforming the edges of the notches in said support wire, and common actuating mechanism for producing relative movement of said arbor and said wire carrier and for actuating said notching device to make in said support wire a series of notches in spaced relation and to wind the grid wire from said

carrier into a helix with its turns in said notches and for actuating said notch closing device to close said notches upon the turns of said helix and thereby secure said turns in said notches.

24. A grid making machine comprising an arbor for holding a support wire, means for making notches in spaced relation in a support wire on said arbor, winding means for winding a grid wire into a helical coil with its turns disposed in said notches, a notch closing device, and means controlled by said winding means for rendering said notch closing device operative on a pre-determined number of notches in said support wire and inoperative on a pre-determined number of succeeding notches in said support wire.

25. A grid making machine comprising an arbor for holding a support wire, means for making notches in spaced relation in a support wire on said arbor, winding means for winding a grid wire into a helical coil with its turns disposed in said notches, a notch closing wheel movable into and out of operative relation to said arbor, said arbor and said notch closing wheel being relatively movable in a direction transverse to said arbor, and control mechanism operative in synchronism with said winding means for moving said device into and out of operative relation to said arbor at pre-determined points in the winding of said grid wire.

In witness whereof I have hereunto set my hand this 8th day of February, 1926.

JOHN FLAWS, JR.