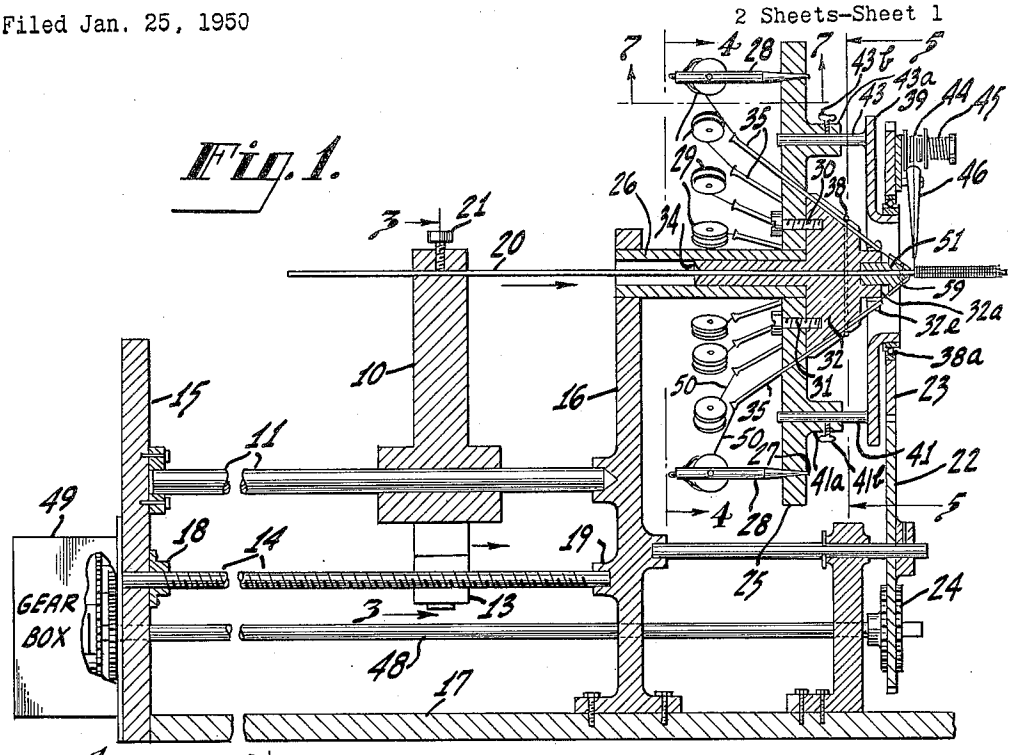
Oct. 4, 1955 J. HIRMANN 2,719,544

APPARATUS FOR MAKING FINELY MESHED GRIDS

Filed Jan. 25, 1950 2 Sheets-Sheet 1

Fig. 1.



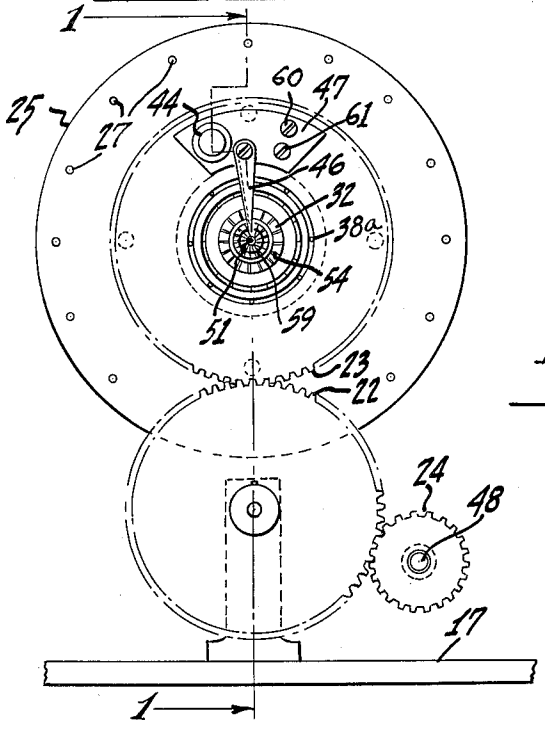


Fig. 2.

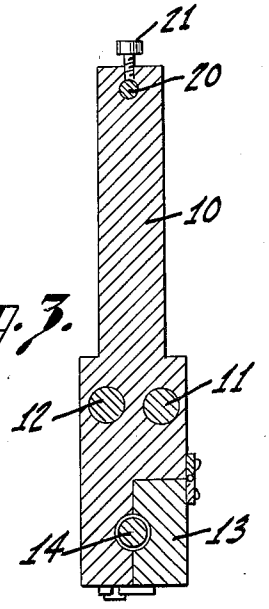


Fig. 3.

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APPARATUS FOR MAKING FINELY MESHED GRIDS

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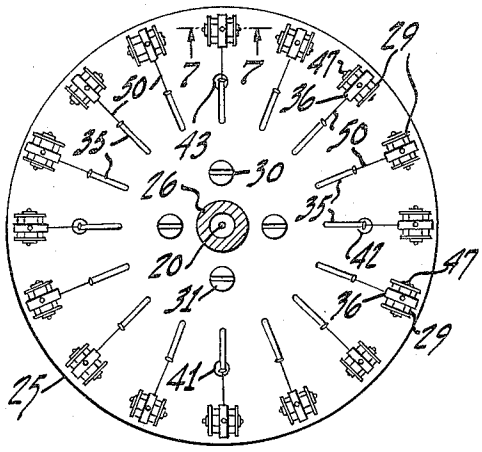


Fig. 4.

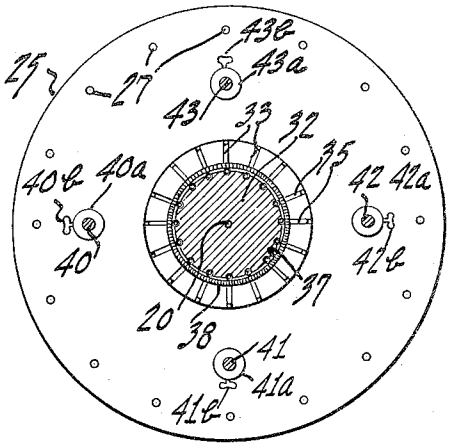


Fig. 5.

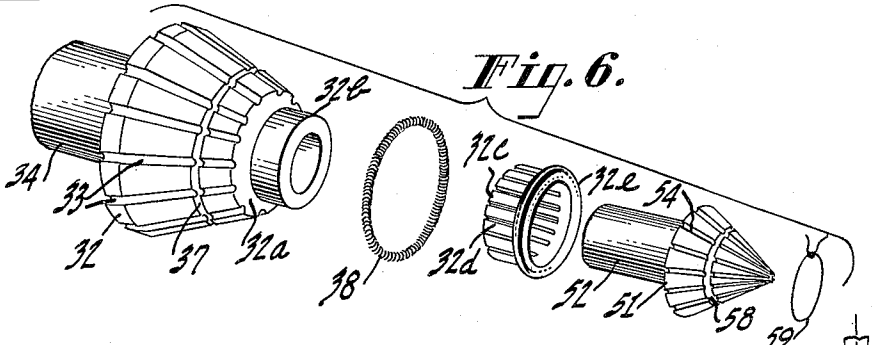


Fig. 6.

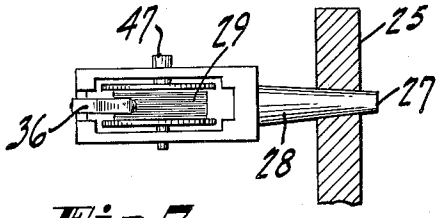


Fig. 7.

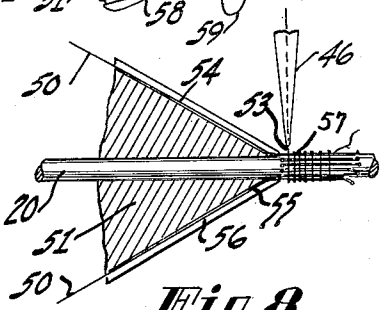


Fig. 8.

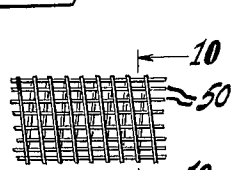


Fig. 9.



Fig. 10.

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2,719,544

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APPARATUS FOR MAKING FINELY MESHED GRIDS

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Application January 25, 1950, Serial No. 140,429

7 Claims. (Cl. 140—71.5)

The present invention relates to grid making apparatus and more particularly to an apparatus for making relatively fine mesh grids.

One type of meshed grid comprises a mesh-like tubular structure including a plurality of lateral wires disposed in parallel relation and extending axially of the structure, and a helix of grid wire wound transversely of the lateral wires to provide a network or mesh. For some grid applications, such as in ultra high frequency and relatively small sized electron tubes, it is desirable that the mesh of the grid be relatively fine to improve the control function of the grid. To provide a relatively fine meshed grid it is necessary that the lateral wires as well as the grid wire be relatively fine and that a relatively large number of lateral wires be used.

Prior machines for making wound grids have relied on the rigidity of the side rods or lateral wires for an appropriate feed thereof from a guide to the position at which grid wire is wound thereon. Such machine is described in U. S. Patent 1,976,522 to G. M. Rose, Jr. Some grid-making machines employ spools for supporting supplies of lateral wires and these spools are sometimes spaced appreciably from the winding head. This requires the lateral wires to travel a substantial distance from their supporting spools to the location at which grid wire is wound thereon. When the lateral wires are rigid and relatively large in cross-section they can be fed from the spools to the winding location without danger of deformation, their massiveness providing the necessary self-support against deformation. However, when the lateral wires are relatively fine they are incapable of the self-support required for feeding them to the winding location. Moreover, prior grid making machines have been unable to accommodate the relatively large number of lateral wires necessary for a relatively fine meshed grid. Furthermore, such prior machines have included a feed means for the lateral wires that is incapable of adaptation for handling a different number of lateral wires than that for which the feed means was originally designed.

Two of the principal requirements of an apparatus for making fine mesh grids having relatively thin lateral wires are a feed means of the lateral wires that provides a positive restraint to deformations of the wires during their transit from wire supplies to the location at which grid wire is wound thereon, and means for disposing the winding location substantially at the delivery end of the feed means. Where the feed means includes a structure having one of several different lengths to permit fabrication of a grid having any one of different diameters, it is necessary to provide for relative movement between the feed means and the winding means in order to dispose the winding means in a critical position with respect to the delivery end of the feed means required in the practice of my invention.

Accordingly it is the object of the invention to provide a grid-winding apparatus for making relatively fine meshed grids.

Another object is to provide a feed means in a grid-making apparatus whereby relatively fine lateral wires are fed to a grid-winding location without deformation of the wires.

A further object is to provide a grid-making apparatus wherein the means for feeding lateral wires and the winding head are movable with respect to each other to assure a critical positioning of the winding head with respect to the delivery end of the feeding means.

Another object is to provide an apparatus wherein the winding head is movable rectilinearly with respect to a lateral wire feed assembly for suitably orienting the winding head with a feed assembly of any desired length required for disposing the winding head adjacent the delivery end of the feed assembly.

A further object is to provide a feed means for lateral wires in a grid-making apparatus that extends substantially from the supply of such wires to the grid winding location for controlling the travel of the lateral wires substantially in their entire path of travel from said supply to said winding location for preventing deformation of the wires and for making a uniform grid.

Another object is to provide a grid-making machine wherein the winding head is in relatively close proximity to an extremity of the feed means for lateral wires to assure desired positions of the lateral wires at the winding head.

A further object is to provide a machine for making fine grid mesh in which lateral wires are fed angularly to a mandrel adjacent the winding head and are deflected by the mandrel to paths extending parallel and adjacent to the mandrel.

Another object is to provide a support means for a relatively large number of spools of lateral wire in a grid-making apparatus to permit fabrication of a relatively fine meshed grid having a relatively large number of lateral wires.

Another object is to provide a grid-making apparatus having a support for a relatively large number of spools of lateral wire and mounting means on said spools for rapidly and easily mounting and removing the spools on said support.

A further object is to provide a grid-making apparatus having a guide for lateral wires that is easily exchangeable for other guides to accommodate any desired number of lateral wires.

Further objects and advantages of the invention will become apparent as the description proceeds.

The apparatus according to the invention includes a rectilinearly movable winding head, means for feeding a mandrel across the winding head, and a disc-like support spaced from the winding head and having a central aperture for permitting travel therethrough of the mandrel and for supporting a cone-shaped lateral wire guide. The base of the cone-shaped guide engages the disc support, the apex of the guide extending relatively close to the winding head. The cone guide is provided with a plurality of slots or grooves extending from its base to its apex which are adapted to support a plurality or tubular guides extending angularly through the disc. Adjacent the periphery of the disc and on the side thereof remote from the winding head are supported for ready replacement a plurality of spools of lateral wire. The spools are mounted relatively close to one end of the tubular guides referred to. The tubular guides extend along the cone guide to within a relatively short distance of the apex of the cone, the grooves, however, continuing to the apex. As a consequence the bases of the grooves terminate at the mandrel surface, while the walls of the grooves continue lengthwise of the mandrel for a short distance beyond the terminations of the bases to provide side re-

straints for the lateral wires when they angularly abut against the mandrel. This structure requires a minimum of self-support of the lateral wires during their feed to the mandrel and permits the use of relatively fine lateral wires.

The feed control is extended to a point beyond the location at which the laterals first engage the mandrel surface which is also advantageous in connection with a practice that applicant has found desirable of tying the leading end portions of the laterals to the mandrel to hold the laterals in proper parallel positions on the mandrel when grid wire is wound thereon. This extension serves to orient the laterals in parallel relation along the mandrel so that the tying operation may be performed on the portion of the laterals properly positioned on the mandrel. The laterals are preferably tied as closely as possible to the apex of the feed means so that they observe substantially the same relationship when tied as that determined by the feed means.

Referring to the drawing;

Figure 1 is a sectional elevation of a grid making apparatus according to the invention;

Figure 2 is an end view from the right in Figure 1;

Figure 3 is a section along the line 3—3 of Figure 1 and shows the mandrel feed assembly;

Figure 4 is a sectional view along the line 4—4 of Figure 1 and shows one side of the support disc for the spools of lateral wire;

Figure 5 is a sectional view along the line 5—5 of Figure 1 and shows the other side of the support disc and the cone-shaped guide and tubular guides of the invention;

Figure 6 is an exploded view of the cone-shaped lateral wire guide assembly of the invention;

Figure 7 is a sectional view along the line 7—7 of Figure 1 and shows one of the lateral wire spools and the manner in which it is mounted on the support disc;

Figure 8 is a greatly enlarged view of a portion of the apparatus shown in Figure 1 and more clearly depicts the relationships between the transverse or bottom portions of the grooves in the nose piece forming part of the lateral wire guide assembly, and the surface of the mandrel, and also shows the extension of the walls of the grooves along the mandrel for side restraint of the lateral wires fed to the mandrel;

Figure 9 is a perspective view of a tubular fine mesh grid made by the apparatus of the invention; and

Figure 10 is a cross-sectional view taken along the line 10—10 of Figure 9 and shows the grid side rod array of the grid depicted in Figure 9.

The grid-making apparatus according to the invention includes a mandrel feed mechanism, a lateral wire feed assembly for feeding lateral wires to the mandrel at a predetermined location thereon, and a winding head for winding grid wires around the mandrel and the lateral wires fed thereto at said predetermined location.

After a grid has been completed by my apparatus the mandrel with the grid supported thereon may be removed from the machine, the laterals brazed to the grid wire thereon, the grid cut into desirable lengths, and the grid lengths slid off the mandrel.

The mandrel feeding mechanism

The mandrel feeding mechanism as shown in Figure 1 includes a carriage **10** riding on a pair of rods **11**, **12** shown in Figure 3 and a split nut **13** fixed to the carriage and having threads for engaging a lead screw **14**. The rods **11** and **12** are supported on uprights **15**, **16** fixed to base **17** and the lead screw **14** is mounted in bearings **18**, **19** in said uprights. A mandrel **20** is fixed to carriage **10** by a screw **21** for movement therewith.

A driving spur gear **24** connected to a power source, not shown, drives shaft **48** connected to a gear box **49**. Spur gear **24** also drives spur gear **23** on which the winding head is mounted, through an idler gear **22**. One end of lead screw **14** extends into gear box **49**. Shaft **48** and lead screw **14** are fixed to suitable gears in the gear box for providing a desired ratio of rotation of the lead screw with respect to the rotation of the winding head, to secure a predetermined number of turns per lineal inch on the grid made by the apparatus.

Rotation of gear **24** in a predetermined direction therefore imparts rotation to gear **23** and the lead screw **14**. The rotation imparted to the lead screw causes the carriage **10** to travel to the right as viewed in Figure 1 and results in a feed of the mandrel **20** in a rectilinear path to the right. When the limit of such feed is reached the split nut **13** shown in Figure 3 may be opened and the carriage **10** moved to the left to start a fresh feeding operation.

The lateral wire feeding assembly

The lateral wire feeding assembly includes a disc support **25** fixed to sleeve **26** which in turn is fixed to upright **16**. The disc support includes a plurality of apertures **27** extending therethrough adjacent its periphery which are adapted to receive supports **28** of lateral wire spools **29** shown in Figure 7.

The apertures **27** and the support **28** are preferably tapered as shown in Figure 7 to permit ready mounting and removal of the spools from the disc support. By disposing the spools of lateral wire adjacent the periphery of the disc support there results added space for accommodating a relatively large number of pools. Applicant has mounted as many as **76** spools in this manner on the disc support referred to.

Also fixed to the disc support **25** in a suitable manner as by means of screws **30**, **31** is a frusto-conical shaped guide **32** having slots or grooves **33** extending from its base to its apex. The guide **32** includes a shank **34** extending into sleeve **26** for added support.

Within grooves **33** are disposed tubular guides **35** extending through disc support **25** at an angle with respect to the axis of said support. One end of the guides **35** is funnel shaped as shown in Figure 1 for ease in threading lateral wire therethrough, and is disposed in close proximity to the spools **29** for supporting the lateral wire **50** fed by said spool. The other ends of the tubular guides **35** extend to the flat surface **32***a* at one end of the frustrated cone **32**.

Mounted at said end of the frusto-cone **32** is a nose-piece **51**, shown in Figures 1 and 6, which includes a shank **52** preferably having a taper toward its free end for forming a snug fit in a tapered recess in cone **32**. The nose piece is provided with slots **54** extending from its base to its apex, which slots are suitably aligned with the slots **33** in the cone, by rotating the nose-piece in the recess in cone **32** prior to forcing it tightly therein. Slots **54** are smaller transversely than the slots **33** in cone **32**, since they are only required to receive the relatively thin laterals, and not the wider tubular guides **35** as in the case of slots **33**. As shown in the enlargement of the nose-piece in Figure 8, the bottoms **55** of the slots **54** extend to the surface of mandrel **20**, while the side walls **56** of the slots extend along the mandrel an appreciable distance from the juncture of the bottom surface **55** and the mandrel **20**, to thereby provide side restraints to deformation of the laterals **50** a short distance along the mandrel.

The frusto-conical structure **32** includes a sleeve portion **32***b* on which a comb **32***c* having a plurality of strands **32***d* and a wiring support **32***e*, shown in Figure 6, may be telescoped for providing additional guide means for the lateral wires.

In practice the leading ends of the laterals are tied to the mandrel **20** by means of a thin wire at a location indicated at **53** in Figure 8. This location is relatively close to the apex of the nose piece **51**. At this location of the mandrel the laterals **50** retain their appropriate orientation around the mandrel and are thus suitably fixed to the mandrel for application of grid wire thereto.

The cone **32** may also be provided with an annular groove **37** shown in Figure 6 adapted to receive a spring **38**, shown in Figure 6, for holding the tubular guides **35**

in appropriate position on the cone. The spring may easily be removed when removal and replacement of a tubular guide becomes necessary.

The nose piece **51** may also be provided with an annular groove **58** for receiving a wire **59** to restrain the laterals in the grooves of the nose piece.

The spools **29** may be provided with means for preventing slack in the lateral wires carried thereby. This means may comprise a spring **36** shown in Figure 7 for pressing against the wire on the spool. The spools are also provided with tapered pins **47** for mounting the spools on their supports. This tapered structure of the pins permits the spools to be easily removed from their supports when this becomes necessary.

The winding head

The winding head includes spur gear **23** mounted for rotation on bearing **38***a* provided on disc member **39**. The disc member **39** is mounted on support **25** for rectilinear movement to and away from said support. Thus studs **40**, **41**, **42**, **43** shown in Figure 4 telescope into sleeves **40***a*, **41***a*, **42***a*, **43***a*. Set screws **40***b*, **41***b*, **42***b*, **43***b*, serve to fix the disc member **39** to disc support **25** in any desired space relation that may be required for disposing the wire feed finger **46** adjacent the delivery end of the lateral wire guide assembly. When the nose piece **51** is removed from the assembly, for example, when a grid of relatively large diameter is desired and a relatively thick mandrel is used, the support disc **39** of the winding head may be moved rectilinearly toward the support disc **25** to bring the finger **46** adjacent to the delivery end of the remaining portion of the guide assembly. This relative movement is also advantageous when a nose-piece of one length is substituted for a nose-piece of a different length for providing a grid of a desired diameter. Spur gear **23** is engaged by idler gear **22** which is actuated by power gear **24** for rotation at a predetermined angular velocity.

Mounted on one face of spur gear **23** is a winding head comprising a spool **44** of grid wire having a spring **45** for preventing excessive unreeling of grid wire by the spool. Also mounted on the spur gear **23** is a wire guide **46** extending toward the mandrel **20** at a location thereon adjacent the apex of nose-piece **51**. This disposition of the wire guide with respect to the nose-piece of the lateral wire feed means assures continuous support of the lateral wires from the spools **29** to the winding head and permits the use of relatively fine lateral wire.

The spool **44** and wire guide **46** are mounted on a plate **47** shown in Figure 2 which is in turn fixed for easy removal to spur gear **23** by means of screws **60**, **61**.

Operation of the device

Before operation of the device is started the carriage **10** should be moved to the left as shown in Figure 1 and the lateral wires **50** should be threaded through the tubular guides **35** and through the slots **54** in nose piece **51** until the leading end portions of the lateral wires extend from the apex of the nose piece and lie against the mandrel **20** slightly to the right of location **57** shown in Figure 9. At location **57** the laterals are tied to the mandrel. The leading end of the grid wire to be wound around the laterals by the winding head, should also be tied to the mandrel to provide suitable tension in the initial grid turns.

Actuation of a switch, not shown, causes rotation of spur gears **22**, **23** and **24**, and shaft **48**, as well as the lead screw **14**. Rotation of spur gear **23** causes the winding head to rotate around the mandrel **20** and the lateral wires tied thereon. Rotation of lead screw **14** causes the carriage **10** and the mandrel **20** supported thereby to travel to the right as viewed in Figure 1. By a proper choice of gears in the gear box **49** any desired number of turns per lineal inch may be secured.

As the grid wire is wound on the lateral wires it serves to hold the lateral wires against the mandrel **20** and the lateral wires are consequently held frictionally against movement with respect to the mandrel. Travel of the mandrel to the right therefore results in a pulling action on the lateral wires from their spools **29** and through the tubular guides **35** and the grooves **54** in the nose-piece **51**. The feeding of the lateral wire is against the tension of springs **36** and prevents an undesired unreeling of the lateral wires from the spools.

When a desired grid length has been wound the initiating switch referred to may be opened to stop further grid winding action. The mandrel with the grid length thereon may then be removed by unloosening screw **21** and severing the grid wire and the lateral wires adjacent the wire guide **46**. The finished grid may then be subjected to a grazing step not described herein for brazing the grid wire to the lateral wires. It is preferable to sever the lateral wires in such a manner that a portion of the remaining wire stock extends across the wire guide **46** to facilitate the start of a new grid winding cycle. A new mandrel may then be inserted in the apparatus and a fresh cycle of operation initiated.

It will be noted from the foregoing that I have provided a novel grid making apparatus for making relatively fine meshed grids and involving the use of relatively fine lateral wires which cannot be handled by existing grid-making machines. The provision of a novel guide for the relatively thin lateral wires and disposing the guide relatively close to the grid wire guide permits a grid winding operation to take place on a portion of the lateral wires that is relatively close to the grid wire guide. The distance between the apex of the nose-piece of the guide for laterals and the grid wire guide is so small that the spacing required for deformation of the laterals after leaving the guide and before grid wire is wound thereon is avoided and the fabrication of a good grid is facilitated.

The cone-shaped guide assembly for the lateral wires according to the invention is also advantageous in that it is adapted for use in making fine mesh grids of any desired diameter. Thus, if a relatively large diameter grid is desired the nose piece **51** may be omitted and the ends of the tubular guides **35** may directly engage the surface of mandrel **20**. With the nose piece **51** removed an enlarged channel is provided through the guide assembly for extension therethrough of a relatively thick mandrel. In addition, the nose piece **51** may be provided in different sizes to permit further variation in the diameter of grids made by my novel apparatus.

An extremely fine meshed grid can be made by my apparatus in view of the provision thereof for a relatively large number of individual lateral wire supplies. My apparatus furthermore may be easily modified to provide a meshed grid having any desired number of laterals and any desired number of turns per lineal inch. Moreover, my apparatus is relatively simple in structure and is easily serviced.

The foregoing is presented as an illustrative embodiment only of my invention and is not to be construed as a limitation thereof. Various modifications and changes may be suggested therein by persons skilled in the art without departing from the invention and it is intended that such modifications and changes be included within the scope of the appended claims.

I claim:

1. A grid-making apparatus comprising a winding head rotatable in a predetermined plane, a support for lateral grid wires extending in a plane spaced from and parallel to said first mentioned plane, a guide for lateral wire between one face of said support and said winding head and having grooves extending substantially to said first mentioned plane, said guide having a removable nose piece for replacement by one of several other nose pieces having different lengths for making grids of different diameter, tubular guides mounted in said grooves, and reels for lateral grid wire supported on the opposite face of said

support, said tubular guides extending through said support toward said reels and being spaced from said nosepiece, said winding head being adjustably mounted on said support for movement relative thereto only when said apparatus is stopped for disposing the winding head adjacent an end of any one of several nose pieces of different lengths.

2. A grid making apparatus for making a meshed grid of relatively fine lateral and transverse wires, comprising an axially movable mandrel, means for moving said mandrel axially across a predetermined plane, a fixed plate extending in a plane parallel to and spaced from said predetermined plane, plurality of supports for a plurality of lateral wires, said supports being mounted on the face of said plate remote from said predetermined plane and disposed radially of said mandrel, said plate having a plurality of passageways extending therethrough, each of said passageways being in alinement with one of said supports and a portion of said mandrel in said predetermined plane, a plurality of tubular guides extending substantially from said supports and through said passageways, a member fixed to the opposite face of said plate and having grooves extending from said passageways to said portion of said mandrel, said tubular guides being supported in said passageways and extending into said grooves and being spaced from said plane, said tubular guides and said grooves confining the travel of said lateral wires from said supports to said mandrel and to said plane in substantially straight paths, whereby said lateral wires are preserved from deformation, and a winding head substantially in said predetermined plane for winding transverse wire on said lateral wires while said lateral wires are under restraint by said guides.

3. In a grid making apparatus including an axially movable mandrel, means for moving said mandrel axially, a plurality of supplies of lateral grid wire directed to said mandrel for engagement thereby, and a winding head for winding transverse grid wires on said laterals engaged by said mandrel, the improvement comprising a plurality of elongated guides for said lateral wires extending in substantially straight paths from said supplies to said mandrel, said guides including tubular portions adjacent said supplies and a member having a plurality of grooves, communicating with said tubular portions and extending to said mandrel, and a fixed plate extending in a plane normal to the axis of said mandrel and intermediate the ends of said guides, said plate having a plurality of passageways extending therethrough, said tubular portions extending through said passageways for support by said plate, said member being fixed to one face of said plate with said grooves therein in alinement with said passageways, said tubular portions being received in said grooves, whereby said lateral wires are preserved from deformation in their travel from said supplies to said mandrel.

4. A guide for lateral grid wire in a grid making machine, comprising a conical member having grooves in its outer surface for receiving and guiding lateral grid wires, the side walls of said grooves extending axially of said member beyond the bottom portions of said grooves, for providing a continuity of support of said lateral grid wires to a cylindrical surface defined by a mandrel of said machine extending axially of said member.

5. A guide for lateral grid wires in a grid making machine comprising a fixed plate having passageways extending therethrough, a cone-shaped assembly having its base fixed to one face of said plate and having grooves in its outer surface extending from its base to its apex and in alinement with said passageways, and tubular members mounted in said passageways and extending through said plate and into said grooves and spaced from the apex of said assembly, said grooves adjacent said apex being of smaller transverse dimension than adjacent said base whereby said lateral grid wires are effectively guided from a supply of said wires to a winding head.

6. In a grid making machine, a guide assembly for guiding lateral grid wire to a grid winding location, said assembly including a fixed plate spaced from said location, and having one face remote from said location, a plurality of reels of lateral grid wires mounted on said face, a plurality of tubes extending from said reels and passing through said plate, a conical member having a base mounted on the other face of said plate and extending from said base and terminating in an apex adjacent said grid winding location, said conical member having grooves extending from its said base to its said apex, said grooves receiving portions of said tubes extending from said other face of said plate, and means for retaining said tubes in said grooves, said tubes terminating at portions of said grooves spaced from said apex, whereby said lateral grid wires are adapted to be guided continuously by said tubes and a portion of said grooves, from said reels to said grid winding location.

7. In a grid winding machine, including a grid winding head rotatable in a given plane on a predetermined axis, a mandrel, and reels of lateral grid wire, the improvement comprising a guide assembly for guiding the travel of said mandrel and said lateral grid wire in rectilinear paths to said plane, said guide assembly including a fixed plate disposed in a plane spaced from and parallel to said given plane, a cone-shaped structure supported on the face of said plate adjacent said given plane to dispose its axis in coincident relation to said predetermined axis and to dispose its apex adjacent said given plane, said structure having a rectilinear passageway extending axially therethrough for receiving and guiding the travel of said mandrel therethrough and having rectilinear grooves on its outer surface extending from its apex to its base in planes including the axis of said structure, supports mounted on the opposite face of said plate for supporting said reels to dispose their axes in said last named planes, and a plurality of elongated tubular guides mounted in said grooves and extending through said plate in alignment with said grooves and toward said reels, for advantageous guidance of relatively thin wires from said reels to said winding head for winding grid wire thereon.

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