April 17, 1962 W. H. SIMMONDS 3,029,844

GRID MAKING MACHINE

Filed May 22, 1959 3 Sheets-Sheet 1

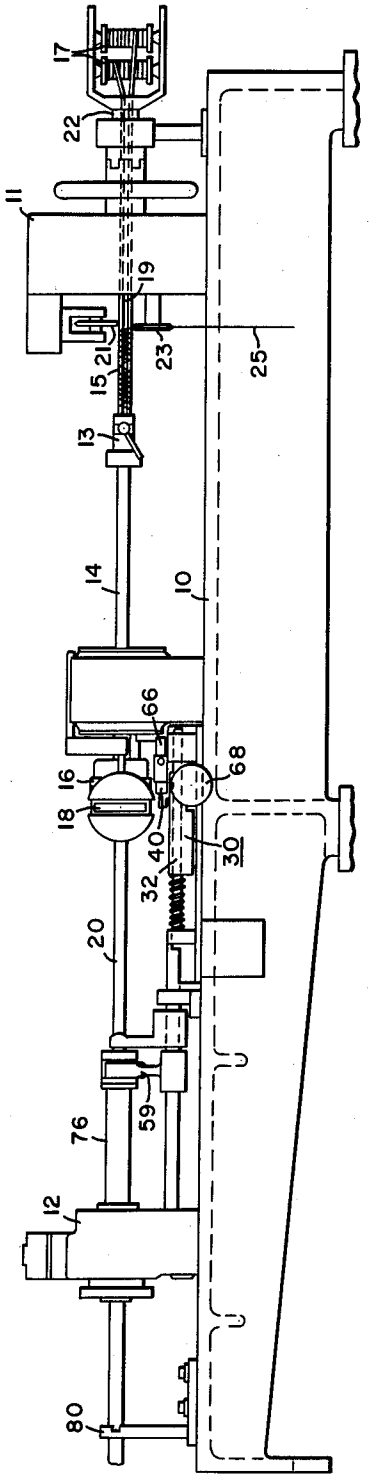


Fig. 1

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Fig. 2

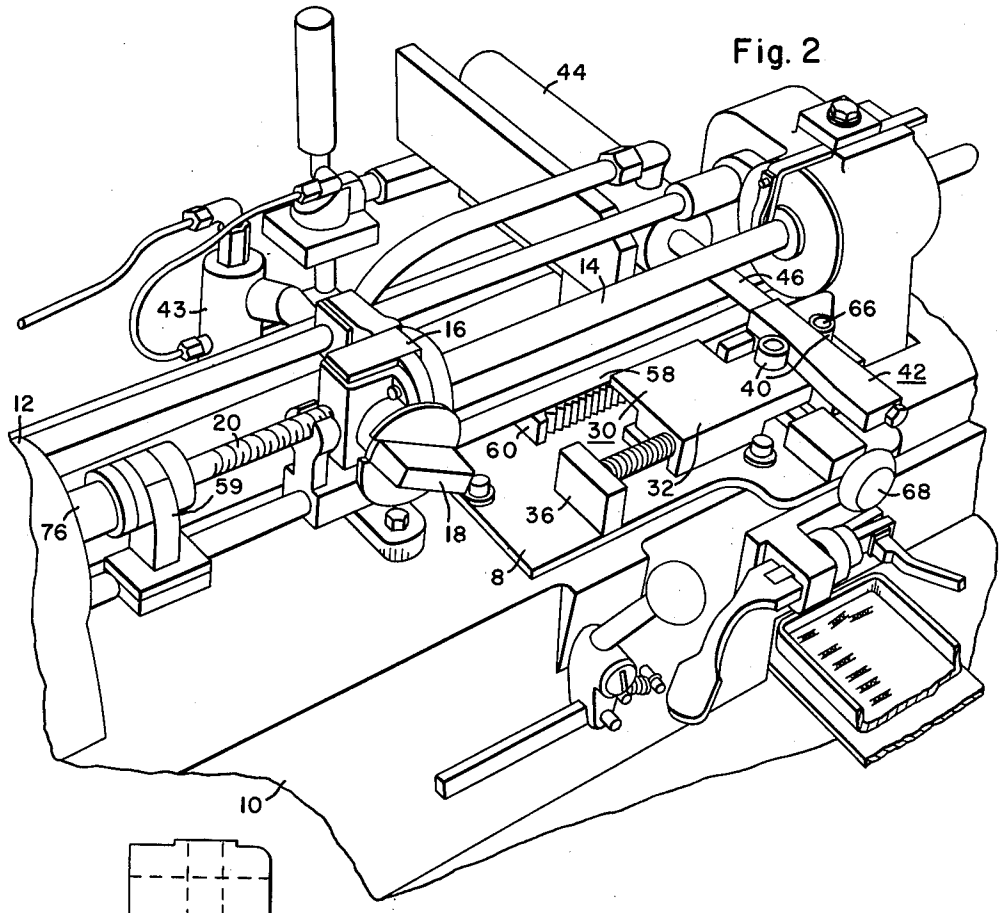
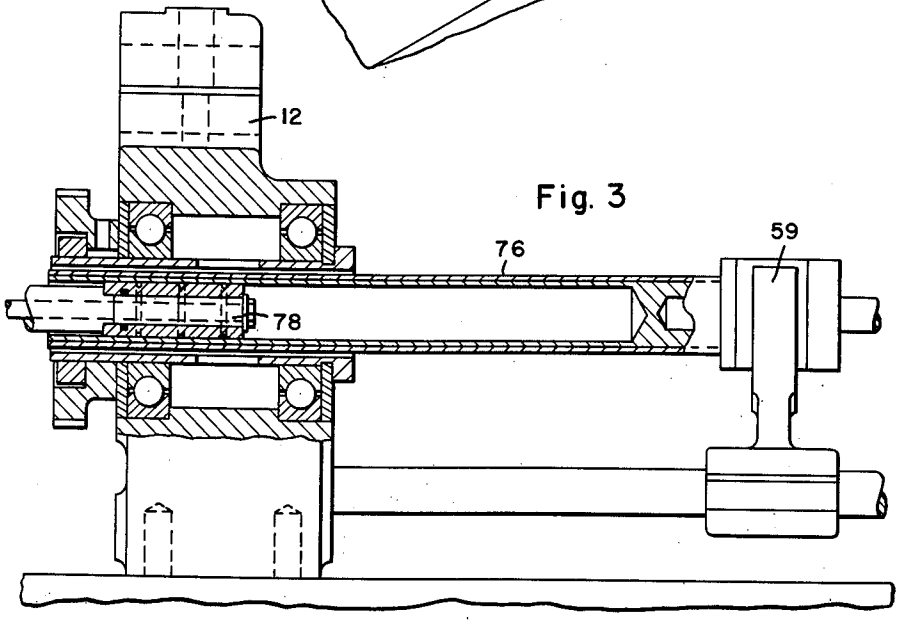


Fig. 3



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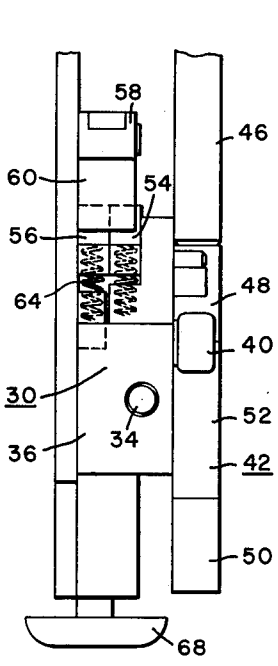


Fig. 5

Fig. 4

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GRID MAKING MACHINE

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5 Claims. (Cl. 140—71.5)

This invention relates to the manufacture of grid electrodes for electron discharge tubes and, more particularly, to a method and automatic machinery for making grid electrodes for electron tubes.

A grid structure of the type to which the present invention relates usually comprises a pair of relatively heavy wires which are generally known as support wires or side rods about which is wound a relatively thin wire termed a lateral wire or a grid wire. The grid wire is secured to the support wires by a suitable means, such as welding or notching and peening.

A grid for an electron tube is usually formed so that the turns of the grid wire are terminated a short distance from the ends of the support wires so that the ends of the support wires may be readily attached to the supporting structure within the tube. Since the grid is physically relatively short, the grid wires are usually wound continuously on the support wires into grid strips which comprise alternate lengths of the wanted or tight turns of grid wire which are secured to the support members and the unwanted or loose turns of grid wire which are not usually secured to the support wires.

The grid strips are cut apart into the individual grid electrodes and the unwanted turns of grid wire are removed from the leg portions of the individual grid electrodes producing a grid having wanted turns of grid wire attached to the support wire and having the ends of the support wire free of grid wire. This loose wire is not only entirely wasted but the cost of producing grids is increased due to the necessity of an operation for removing these extra turns.

When winding grid electrodes with uniform pitch, especially those having a high number of turns per inch, a great amount of lateral wire is wasted in the form of turns covering the legs of the grid. Grid making machines utilizing a device known as a skipspace cam have been in use in the industry to overcome this wasted. U.S. Patent 1,970,599, issued August 21, 1934, to A. J. Franke and entitled "Grid Making Machine" is an example of this type machine. The skipspace cam is in effect a variable mu cam and like all such cams the correct pitch of the tight portion of the grid electrode is produced by the difference between the leadscrew advance and the constant decrement of the cam.

Considerable difficulty and expense is encountered in making skipspace cams of sufficient accuracy since the pitch of the turns of the grid electrode are dependent upon the accuracy to which the cam is machined. This often results in tubes having different characteristics for grids wound on different grid machines since it is very difficulty to obtain identical skipspace cams for use on different machines.

It is, therefore, an object of this invention to provide a grid making machine which eliminates any action of the cam during the winding of the tight turns and in which an expensive cam which does not require a precise contour is used to shift the leadscrew during the winding of the loose turns.

It is another object of this invention to produce a machine for making grid electrodes efficiently by reducing the waste of grid wire to a minimum.

It is a further object of this invention to produce a machine for making grid electrodes efficiently by reducing the time necessary for making such grid electrodes.

These and other objects of this invention will be apparent from the following description taken in accordance with the accompanying drawing, throughout which like reference characters indicate like parts, which drawing forms a part of this application and in which:

FIG. 1 shows a diagrammatic front view of a grid lathe embodying the invention;

FIG. 2 shows a perspective view of the invention as attached to a standard grid lathe;

FIG. 3 shows a more detailed sectional view of the bearing in the tailstock;

FIG. 4 shows a more detailed view of the ratchet assembly; and

FIG. 5 shows a partial left side view of the ratchet assembly.

Briefly, in a preferred embodiment of this invention, grid strips are wound in the conventional manner throughout the tight turn section in which the pitch of the turns of grid wire is determined by the pitch of the leadscrew. About one-half a turn after the last tight turn has been peened into the support member, the whole system of leadscrew, clamp and strip will be pushed toward the tailstock in a time such that only about two turns of grid wire are wound over the leg portion of the grid strip. This movement is accomplished by the use of a cam member which, when actuated, advances a ratchet rod member which is attached to the leadscrew by a distance calculated as a difference between the desired leg lengths and the advance of the grid strip while winding the loose turns. The actual distribution of five loose turns is approximately one turn at the pitch of the tight turns, two turns at a greater pitch during which the skip is accomplished and two turns at the pitch of the tight turns. This mode of operation is continued throughout the strip.

The invention comprises, in general, a precision system that takes the form of an attachment that can be easily added to a standard rotary grid lathe. With specific reference to the particular grid machine shown in the drawing, the grid making machine embodying this invention is constructed similar to a lathe and comprises a bed plate 10, upon which is supported at one end a headstock 11 and at the other end a tailstock 12 is provided. A rotary head comprising a main spindle is driven by suitable drive means. A tubular drawbar 14 is provided at one end with a strip clamp 13 and on its other end with a half nut 16 or split nut. The half nut 16 may be opened and closed by means of a handle 18. A leadscrew 20 is provided in which one end is rotatably mounted in the tailstock 12 and the other end is positioned to engage the half nut 16. Each support member or side rod wire 15 is automatically fed in a continuous length from a spool 17 carried in a yoke on the outer end of the head spindle. The support members 15 pass through channels extending longitudinally through the head spindle 22. A mandrel 19 is secured to the head spindle and grooves are provided in the mandrel for the support members 15. A notching wheel 21 is supported from a suitable bracket from the head stock immediately above the mandrel 19. A suitable lateral wire tension and guide system is also provided (not shown).

The winding operation is started by securing the support members 15 by means of the clamp 13 on the drawbar 14. The half nut 16 is closed on the leadscrew 20 so that as the leadscrew 20 retreats due to the rotation of the drawbar 14 the support members 15 are drawn through the channels in the head spindle and along the opposite edges of the mandrel 19. The notching wheel 21 is mounted in such a position that its periphery cuts a notch in each support member 15 as the support member 15 is carried under the notching wheel 21 by the rotation of the mandrel 19. The grid wire 25 is secured

in each of these notches in the support members 15 by a peening wheel 23 as the support member 15 and the grid wire 25 is carried over the peening wheel 23 by the rotation of the mandrel 19. This operation is continued throughout the tight turn portion of the grid strip. Immediately after the start of the winding of the leg portion of the grid strip, the notching and peening wheels are deactivated, a cam member 42 is actuated which cooperates with a ratchet assembly 30 to move the leadscrew 20 toward the tailstock 12 within a time such that about two turns of grid wire are wound on the leg or unwanted turn portions of the grid strip. This operation will be described in detail below.

Referring now to the particular embodiment of the invention shown in the drawings, the ratchet assembly 30 comprises a slide member 32 which is slidably mounted on a slide rod member 34. The slide rod member is secured within an opening in a block 36 which is secured to a base plate 38. The other end of the slide rod member is secured within an opening within a block 33 which is secured to the base plate 38. The slide member 32 comprises a block of suitable material, such as steel, to which is attached on its upper surface a cam follower 40. Adjacent to the cam follower 40 is a cam member 42. The cam member 42 is actuated by a suitable means. This actuating means must operate in a sufficiently short period of time to enable the shifting of the slide member 32 within about two turns of the grid wire. The actuating means shown in the drawing is an air cylinder 44. The time of actuation of the air cylinder 44 is controlled by a solenoid-operated valve 43 which is operated by means of the electrical contacts of a suitably placed microswitch. This air cylinder 44 is attached to the base plate 38 by means of a suitable bracket and has its operating shaft 46 attached to one end of the cam member 42. The cam member is made of a suitable material, such as tool steel, and the cam member 42 shown in the drawing is an elongated member which has a rectangular cross section and which has one width at one end 48, a second width at the other end 50 and a portion of changing width 52 connecting the two end portions. The difference in the widths of the two ends of the cam member 42 is equal to the calculated length of leg of the grid strip minus the advance of the strip during the five or six loose turns. The portion of changing width 52 between these two end portions is not critical since only the pitch of the turns in the unwanted area is controlled by this portion of the cam 42. The pitch of the turns in the tight turns or wanted turns portion of the grid strip is controlled solely by the leadscrew. A feed pawl 54 is provided on the slide member 32 to push a ratchet rod 58 forward during the winding of the turns on the leg portion of the grid strip. A locking pawl 56 is provided on the base plate 38 to prevent the ratchet rod 58 from moving back. The ratchet rod 58 is slidably mounted in suitable guides and is rigidly attached to the leadscrew by means of connecting member 59. The ratchet rod 58 comprises an elongated member to which is attached a ratchet bar member 60. The ratchet bar member 60 is made of a suitable material, such as tool steel, which resists wear during use and which can be machined to an accurate dimension. The form of ratchet bar 60 shown in the drawing comprises an elongated rectangular member having notches 62 along one face of the elongated portion. The corresponding portions of adjacent notches 62 are spaced apart the distance of the skip. It is therefore apparent that the only changes necessary to transfer from the manufacture of a given grid to the manufacture of a different grid is to change the ratchet bar and the cam member to one machined for the particular skip length for the new grid. When the cam member 42 is actuated by means of the air cylinder 44, the slide member 32 is moved toward the tailstock 12 by an amount equal to the space 62 on the ratchet bar member 60. A sliding portion 76 which acts as an extension of the leadscrew 20 is provided to provide a means for the leadscrew 20 to slide toward the tailstock 12 when the ratchet rod member 58 is moved by means of the driving pawl 54. The minimum length of the sliding portion 76 must be the sum of the length of all the skip portions in one grid strip. The sliding portion 76 is made hollow like an air cylinder. The piston 78 within 76 is retained axially by bracket 80. Fluid pressure within the sliding portion 76 urges it, the leadscrew 20, the bar 58, and the ratchet 60 against the locking pawl 56, thereby holding these parts fixed axially during the winding of the tight turns of the grid. During the skip, the advance of the ratchet 60, the bar 58, the leadscrew 20, and the sliding portion 76 is made against the fluid pressure within the sliding portion 76. This fluid pressure is held constant and acts as a spring of constant force. The ratchet rod member 58 is moved by means of a driving pawl 54 which is adjacent a locking pawl 56. The locking pawl 56 is spring loaded by means of spring 64 so as to move into a notch as soon as the slide member 32 has been advanced by the amount of one notch 62 to prevent the leadscrew from moving back toward the head stock. An idler cam follower 66 is attached to the guide rod block 33 on the opposite side of the cam member 42 from the cam follower 40. The action just described continues throughout the winding of the grid strip. On reaching the end of the grid strip, and after the completed strip is removed from the lathe, a release bar button 68 is depressed. This release bar button is attached to a shaft 70 which extends toward the ratchet bar and ends in a bar 72 which is connected at right angles to the release bar button mounting shaft 70. This bar 72 extends adjacent to pins 74 which are inserted in holes in the end of the driving pawl 54 and the locking pawl 56. This release bar button 68 is depressed to disengage the pawls 54, 56 from the ratchet bar member 60 and allows the fluid pressure within the sliding portion 76 to move the sliding portion 76, the leadscrew 20, the ratchet rod 58, and the ratchet bar member 60 to return to the starting position where the first tooth 61 of the ratchet bar member 60, which is purposely higher than the other teeth, rests against pawl 56 after which the operator slides the leadscrew 20 to its original position to commence another grid strip.

To ensure that the leadscrew is not advanced beyond its desired stopping point during the winding of the loose-turn portion of the grid strip a combination braking-bearing unit is provided. The rear extension or sliding portion 76 of the leadscrew 20 must slide within the tailstock housing and a bearing has been devised which also provides the desired braking action. The rear portion of the leadscrew is made hollow and an air piston type insert 78 is made into the interior of the tubular shaped rear portion of the leadscrew 20. A fluid pressure is provided in this section to provide the desired action.

The operation of the skip attachment is best understood when described in full operation in conjunction with a grid lathe. In the following description only the activities taking place during the winding operation which are directly connected with the skip mechanism will be described. The grid lathe is set up in the conventional manner and the grid is wound in conventional fashion throughout the tight turn section of the grid. During this portion of the winding of the grid strip, the strip will advance in the normal way by the pulling action of the leadscrew 20. After the start of the winding of the leg portion of the grid strip the cam actuating means are energized by means of a suitably placed microswitch and the operation of the cam actuating means moves the cam at a rapid rate. One suitable place for mounting the microswitch is adjacent the rear camshaft which makes one revolution for each complete grid. A suitable cam member is mounted on the camshaft so as to operate the microswitch at the desired point in each rota-

tion of the cam shaft. The movement of the cam 42 imparts a movement to the slide members. Since the cam 42 contacts the cam follower 40, the feed pawl 54 moves the ratchet rod member 58, which is attached to the leadscrew 20, forward by an amount equal to the desired skip length. The locking pawl 56 then prevents the leadscrew 20 from retreating toward the head stock. This movement has taken place in a time equal to the time required for winding about two turns of grid wire on the leg portion of the grid strip. One turn of grid wire is made on the legs before the skip and two after the skip. This is to allow reaction time for the cam actuating means, to allow for some variation in the actual time for actuating and to insure that ratchet 60 has completed its motion before the next tight turns are started. It can thus be seen that the pitch of the tight turn section of the grid strip is controlled in the normal way by the pitch of the leadscrew while the cam controls the pitch of the turns in the leg portion of the grid strip. It can therefore be seen that the cam does not have to have a precise contour since the purpose of the cam is only to move the leadscrew during the leg portion of the grid strip to conserve the grid wire and to conserve the winding time required to wind the leg portion of the grid strip.

While the present invention has been shown in one form only, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit and scope thereof.

I claim as my invention:

1. A machine for making a strip of grid electrodes, said strip of grid electrodes comprising a plurality of spaced support members about which is wound a plurality of turns of grid wire, means for advancing said support members axially as said turns of grid wire are wound thereby producing a first winding pitch in said turns of grid wire, a cam member adapted for indexing motion, actuating means for energizing said cam member at a predetermined time, said indexing movement of said cam member adapted to move said advancing means and said support members axially while winding of grid wire continues whereby the resulting turns of grid wire are wound at a second pitch, said second pitch being much larger than said first pitch, means for sustaining movements of said advancing means, and means for accumulating successive said movements.

2. A grid making machine comprising a main spindle, means for rotating said main spindle, a mandrel associated with said main spindle, a pair of support members held in spaced relation by said mandrel, means for advancing said support members longitudinally, means for feeding grid wire to said support members whereby upon said rotative and longitudinal movement thereof said grid wire is wound therearound at a first pitch, means for securing said grid wire wound at said first pitch at each of its points of contact with said support member, a cam member adapted for indexing motion, a cam follower operatively associated with said support member advancing means, actuating means for energizing said cam member at a predetermined time, said reciprocal movement of said cam member imparting a motion to said cam follower to rapidly advance said support members and said advancing means a predetermined distance while winding of grid wire continues whereby the resulting turns of grid wire are wound at a much larger pitch than said first pitch, means for sustaining the movement of said advancing means, and means for accumulating successive such movements.

3. A machine for making a strip of grid electrodes, said strip of grid electrodes comprising a pair of spaced support members about which is wound a plurality of turns of grid wire, a leadscrew for advancing said support members axially as said turns of grid wire are wound thereby producing a first winding pitch in said turns of grid wire, means for securing said turns of said first winding pitch at each of its points of contact with said support members, an elongated cam member adapted for reciprocal motion, actuating means for energizing said cam member after a predetermined length of turns of said first pitch on said support members, a cam follower operatively associated with said leadscrew and positioned adjacent said cam member, said reciprocal movement of said cam member causing said cam member to contact said cam follower thereby imparting a motion to rapidly advance said support members and said leadscrew a predetermined distance, said advance of said support members and said leadscrew occurring while the winding of grid wire continues whereby the resulting turns of grid wire are wound at a much larger pitch than said first pitch, means for sustaining the movement of said leadscrew, and means for accumulating successive such movements.

4. A machine for making a strip of grid electrodes, said electrodes, said strip of grid electrodes comprising a plurality of spaced support members about which is wound a plurality of turns of grid wire, leadscrew means for advancing said support members axially as said turns of grid wire are wound thereby producing a first uniform winding pitch in said turns of grid wire, said pitch determined solely by said leadscrew means, a cam member adapted for indexing motion, actuating means for energizing said cam member at a predetermined time, said indexing movement of said cam member adapted to move said leadscrew and said support members axially while winding of grid wire continues whereby the resulting turns of grid wire are wound at a different pitch from said first pitch, said second pitch being much larger than said first pitch, means for sustaining the movement of said leadscrew means due to the indexing movement of said cam member, and means for accumulating successive said movements.

5. A machine for making a strip of grid electrodes, said strip of grid electrodes comprising a pair of spaced support members about which is wound a plurality of turns of grid wire, a leadscrew for advancing said support members axially as said turns of grid wire are wound thereby producing a first winding pitch in said turns of grid wire dependent entirely on said leadscrew, means for securing said turns of said first winding pitch at each of its points of contact with said support members, and an elongated cam member adapted for linear motion, actuating means for energizing said cam member after a predetermined length of turns of said first pitch on said support members, a cam follower operatively associated with said leadscrew and positioned adjacent said cam member, said linear movement of said cam member causing said cam member to contact said cam follower thereby imparting a motion to rapidly advance said support members and said leadscrew a predetermined distance, said advance of said support members and said leadscrew occurring while the winding of the grid wire continues whereby the resulting turns of grid wire are wound at a much larger pitch than said first pitch, means for sustaining the movement of said leadscrew due to movement of said cam member, and means for accumulating successive said movements.

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