March 21, 1950 H. W. PARKER 2,501,002

CONTROL GRID

Filed Oct. 26, 1946

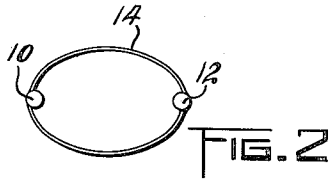


FIG. 2

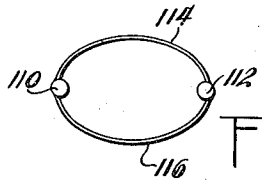


FIG. 4

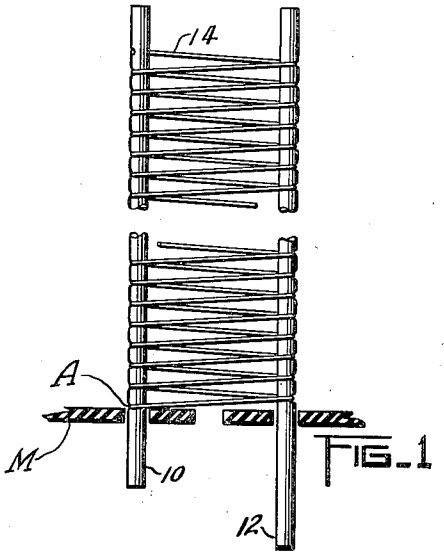


FIG. 1

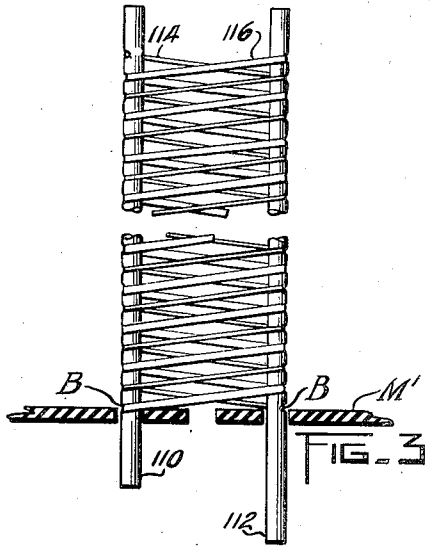


FIG. 3

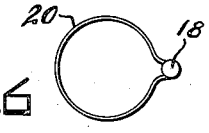


FIG. 6

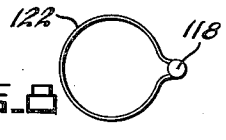


FIG. 8

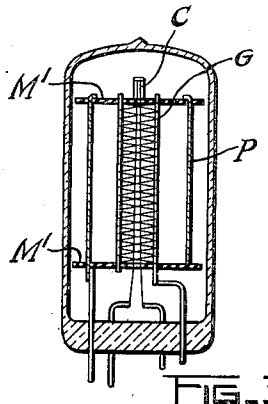


FIG. 3A

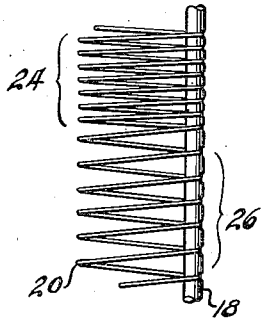


FIG. 5

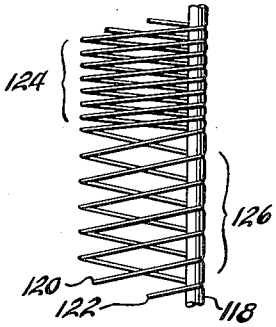


FIG. 7

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CONTROL GRID

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4 Claims. (Cl. 250—27.5)

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The present invention relates to electron discharge devices. An object is to improve the manufacture of grids for such devices where the grid is to meet close tolerances of performance. A further object is to devise a novel grid construction to impart improved and more uniform operating characteristics to the electron discharge devices in which they are incorporated. An additional object is to devise a novel grid construction having superior resistance to deformation due to contact with the end-spacer used in many types of radio tubes.

A common form of grid for electron discharge devices involves a helical wire secured to relatively heavy supporting rods. The helical pitch of these grids is determined by automatic machinery on which the grids are made. Because of this fact, the performance tolerance that may be expected for grids in a given type of discharge device is dependent on the tolerance of the gauge of wire that is used for the helix. Where there is wide variation among the reels of wire used in the manufacture of grids, wide variations in the performance characteristics of the discharge device are to be expected. In order to maintain close performance tolerance it becomes necessary to have extremely close tolerance in the diameter specifications for the helical grid wires. Close tolerances result in excessive costs, and even when practical limits of refinement have been reached there is still an appreciable variation that should be further reduced if reasonably possible.

According to the present invention, grids of the above-described type are to incorporate multiple helical wires in place of the single helix of the prior art. The spacing of the turns of the multiple helix grid is to be essentially the same as the spacing in the prior art grid, the pitch of the helixes of the novel grid being correspondingly increased to this end. There is this important advantage to be realized from the use of multiple helical wires in grids of this type: An under-sized grid-wire may be chosen for winding in spaced alternation with an over-sized wire so that the two may average the optimal gauge more closely than would be attained using the same stocks of wire for single-helix grids. This flexibility in utilization of given wire supplies is an important technical gain, for greater uniformity in radio tube characteristics is realized in this manner than with the old single-helix method and construction. Additional advantages will become apparent from the detailed description.

The invention will be better understood from the following detailed description and the drawings showing two specific embodiments thereof in contrast to prior art construction, from which

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disclosure further objects and features of novelty will be apparent.

Fig. 1 is a typical example of prior art grid construction and Fig. 2 is a plan view thereof.

Fig. 3 is a lateral view of the grid improved in accordance with this invention and Fig 4 is a plan view thereof.

Fig. 3A is a sectional view of a triode embodying the grid of Fig. 3.

Fig. 5 is another type of prior art grid construction and Fig. 6 is a corresponding plan view.

Figs. 7 and 8 are elevation and plan views respectively of a similar grid constructed in accordance with the present invention.

In Figs. 1–8 the scale is enlarged, and in elevation views 1, 3, 5 and 7 the showing is fragmentary.

Referring now to Figs. 1 and 2 a prior art form of grid is shown. In Fig. 1 a pair of straight and parallel metal rods 10 and 12 support helical grid wire 14. The pitch and gauge of the helix must accurately meet specifications if the electron discharge device into which the grid is to be incorporated is to have the standardized characteristics. The grid is made in automatic machinery and therefore there in no convenient way of varying the pitch to adjust for gauge variations. But because of the variations in wire gauge from reel to reel as commercially supplied, performance characteristics will be variable, unless some compensation is provided.

A grid constructed is accordance with the present invention is shown in Fig. 3. Just as in the case of Fig. 1 the turns of the helical grid wire are evenly spaced. This is characteristic of sharp cut-off amplifier tubes. However, in the form shown in Fig. 3 two grid wires 114 and 116 are used, secured to metal rods 110 and 112. The pitch of each helix in Fig. 3 is essentially twice that of the helix in Fig. 1.

According to prior practice, when a series of reels of grid wire within a specified gauge tolerance are procured, they must either be used in making single-helix grids regardless of their departure from the optimum, or they must be discarded. According to the present invention, plural grid wires which differ from the optimal gauge may still be used to produce optimal results. An over sized wire may be wound in alternation with an undersized wire chosen so that the two mutually compensate for the individual departures. In Figure 3 the difference in size between wires 114 and 116 has been relatively enormously exaggerated in order to illustrate this feature of the invention. These primary results follow: A wider tolerance in the gauge of grid wires is permissible, producing important economies in grid manufacture. Also, superior conformity to performance specifications is realized irrespective of the wire-gauge tolerance that

is adopted. In addition, the multiple helix grids may be wound in a fraction of the time required for winding single helix grids. The maximum speed of the grid making machine is the limiting factor, and grids are turned out twice as fast with two wires as with one wire at the same machine speed.

Fig. 3A illustrates the use of a grid of the type in Fig. 3 as the control grid G in a triode. This grid is coaxial with plate P and with filament-type cathode C, each of the elements being properly spaced from the others by spacers M' of mica or similar material. There is likely to be a certain amount of stress on the elements due to impact applied to the tube in rough applications, and due to shocks during their assembly. Where one grid wire is used with each of the two side rods, as in Fig. 3, balanced load transmission from the side rods to spacer M' B is realized. But this advantageous condition would not obtain were the prior art grid of Fig. 1 used, for while rod 10 has a stress-transmission point A where the grid wire is attached, there is none for rod 12. Balanced stress transmission tends to prevent deformation of the grid and contributes to superior operating characteristics. Three helical wires on three rods, and four helical wires on two or four rods are obvious extensions of this feature.

In Figs. 5 through 8 there are shown grids made in accordance with the prior art and in accordance with the present invention. These differ from the grids in Figs. 1 through 4 in that groups of turns are spaced unequally in Figs. 5 through 8 to impart variable-mu characteristics, rather than sharp cut-off, to the electron discharge device in which the grid is to be used, and in Figs. 5 through 8 only a single supporting rod is used. The single rod construction is of limited value, but is illustrated to show that this invention is applicable to other forms of grids than one having two side rods as in Figs. 1–4.

In Fig. 5 helical grid 26 is conductively secured to metal rod 18 and is divided into closely spaced turns 24 and widely spaced turns 26 which impart the variable-mu characteristic. There is the same difficulty in making grids of this type as in making grids of the type shown in Fig. 1, insofar as grid wire tolerances are concerned. The spacing between the turns is controlled by cams in automatic machinery. Consequently the functional characteristic of the grid is inflexibly dependent upon the conformity of the gauge of the helical grid wire to specifications.

The grid of Fig. 7 corresponds to that in Fig. 5 in that there are closely spaced turns and widely spaced turns of helical grid wire. However, there are two helical wires 120 and 122 in Fig. 7, conductively secured to metal rod 118. The multiple helix feature in Fig. 7, has the same advantages over that in Fig. 5 as the grid in Fig. 3 has over that in Fig. 1. Primarily, the conformity of the grid to performance specifications is superior to that which may be expected with a single helix grid. Just as in Fig. 3, grid wires 120 and 122 of Fig. 7 are to be selected so as to jointly have the same effect as a single helix of optimal gauge.

This invention applies primarily to grids of the type having straight relatively heavy supporting rods which may vary in number from one to usually not more than four. The multiple-helix construction enables flexibility in utilization of a given stock of grid wire and promotes improved standardization of operating characteristics. The invention has only a broad application to grids of the so-called cage type and to grids having straight heavy supports wherein the grid is not helical but is made of multiple short wires separately secured transversely to the rods: grids of these types may be improved through proper combination of available stocks of grid wire. It has special application to that type of grid having helical grid wire and straight supporting rods in that the broad concept, to be applied, requires the disclosed structural change.

While the grids illustrating the invention have only two grid-wires it is evident that three or more mutually compensating grids may be used in like manner. The repeating succession of mutually differing gauges of wire averages the effect of a single wire of optimal gauge, and this arrangement is intended to be described by the term "intercoiled" in the claims.

What I claim is:

1. A precision grid for an electron discharge device having a multiplicity of grid wires of sizes larger than and smaller than an optimal size, the sizes being distributed with a larger size alternating with a smaller size to average in effect a grid formed of the optimal size.

2. A precision grid for electron-discharge devices having a support comprising at least one straight relatively heavy rod and a pair of intercoiled, mutually spaced, multi-turn helixes of fine wire secured to said support, the gauge of the wire of one helix being above the optimal gauge and the gauge of the wire of the other helix being below the optimal gauge and the average of the two gauge sizes being substantially the optimal gauge.

3. An electron-discharge device including a grid wound about a plurality of support rods, said rods passing through a number of insulating spacers, said grid being wound of a number of mutually spaced, multi-turn helixes of fine wire, the number of said helixes being equal to the number of said support rods and each of said helixes being started at a different rod where it passes through a spacer the average of the gauges of the wires of the helix being equal to optimal gauge of wire for said grid.

4. An electron-discharge device including a grid wound about a plurality of support rods, said rods passing through a number of insulating spacers, said grid being wound of a number of mutually spaced, multi-turn helixes of fine wire, the number of said helixes being equal to the number of said support rods and each of said helixes being started at a different rod where it passes through a spacer, the gauges of the wires of the helixes differing by the average of said gauges being equal to the optimal gauge of wire for said grid.

HENRY W. PARKER.

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