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METHOD OF MAKING TENSION GRID

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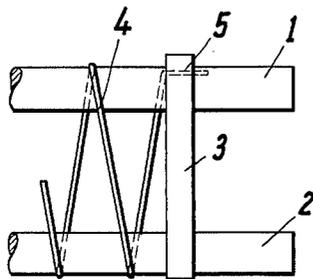


Fig. 1

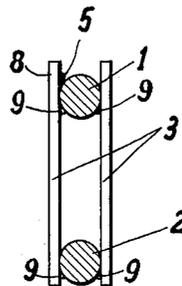


Fig. 2

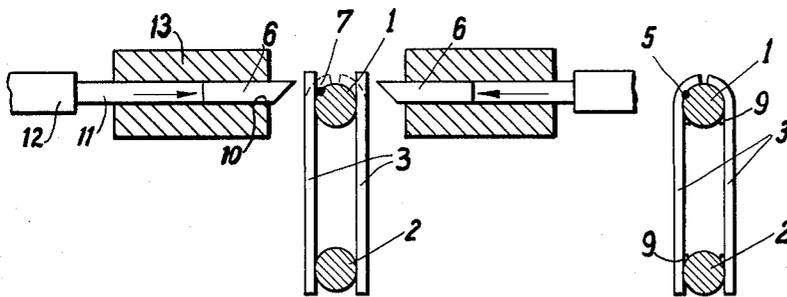


Fig. 3

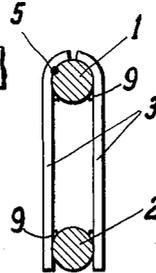


Fig. 4

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METHOD OF MAKING TENSION GRID

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6 Claims. (Cl. 140—71.5)

The present invention relates generally to the production of tension grids for electric discharge tubes, and more particularly to a process and mechanism for fastening the ends of the coiling wire to the tension frame which includes two struts and two transverse members, each connecting the struts at two opposed positions.

With the increasing diminution in size of electrode constructions, there has been a changeover to tension grid technology in the production of grids because the small distances required between the individual electrodes could no longer be maintained when using coiling grids of the type which had formerly been in general use. These distances, especially the grid to cathode spacing must be kept extraordinarily small in order to make it possible to operate the tubes in the desired upper frequency ranges.

In the production of such grids, frames are generally used which comprise two struts or rods and four transverse members connecting these two struts with one another. Both the struts and the transverse members are usually made of molybdenum.

According to this method grids are produced today wherein the struts have a diameter of 0.8 mm. and the coiling wire of the grid has a diameter of 0.008 mm. The grid wire is put onto these frames with a tension corresponding to about 70 to 80 percent of the tear strength of tungsten.

In order to make sure that the grid surface proper, which is enclosed by the two transverse members, is entirely filled with grid windings, the coiling process ordinarily starts about five to six windings before and ends about two to six windings after the coiling space proper has been covered or filled with windings.

After finishing this coiling process, the windings and the ends of the coiling wire are fixed with glass paste and subsequently annealed at about 800° C. After such a grid has been finished, the additional windings placed onto the ends of the grid frame, must then be unwound so that actually only the portion of the grid frame between the transverse members is covered with grid windings. This unwinding of the ends of the grid wire, however, is an extraordinarily difficult operation when using, for example, a tungsten wire having a thickness of 0.008 mm. Such a grid coiling wire cannot be seen with the naked eye and the coiling operator must therefore carry out the removal of the coiling wire ends under an eyepiece.

There have also been known further methods for fastening the ends of the grid windings. In one of these known constructions the first and last windings of the coiled grid wire are fixed together with a transverse member on a longitudinal strut by spot welding or spot soldering. The end of the coiling wire and the tension frame may also be fused together with the addition of metallic powder.

It is furthermore known to fasten these coiling wire ends to a metal piece by clamping and to weld this metal piece, in turn, to the grid frame.

Finally, it is known, according to a further method, to carry the coiling wire end of one grid and the beginning of the coiling wire of the following grid around the respective ends of the transverse members and along the same longitudinal strut. In this known method, the intermediate piece of the grid wire is fastened by means of a

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metal band welded onto the intermediate piece of the strut, which metal band clamps the intermediate piece of the grid wire.

As far as welding processes are concerned, there is a danger of combustion with the comparatively thin grid wire. The other known methods appear quite complicated, thereby raising the costs of manufacturing the grids.

An object of the present invention is to simplify the manufacture of such grids.

Another object of the invention is to provide a tension grid which may be manufactured without welding the thin grid wire.

A further object of the invention is to provide a method, article and apparatus which are simple yet exceedingly effective for the purposes for which they have been designed.

These objects and others ancillary thereto are accomplished according to preferred embodiments of the invention the method of which comprises placing the end of the coiling wire between one leg of a transverse member and the respective strut before the start of the coiling process, and subsequently bending the free leg of the transverse member onto the strut to clamp the end of the coiling wire. As is known, the transverse members are connected with the struts by welding. In the process according to the invention, there are irregularities present on the surface of the welding breast between the transverse member and the struts, and the coiling wire when pressed onto this surface conforms to these irregularities and is thus drawn around many small corners which prevents the coiling wire from being pulled out.

Due to the clamping of the coiling wire ends between the struts and the overlying portions of the transverse members, the pasting and annealing operations are eliminated, thus resulting in a considerable simplification of the manufacturing process.

For the automatic operation of the coiling process, it is only necessary to carry the guide of the grid coiling machine in such a way as to make a movement enabling the clamping of the coiling wire end before the beginning of each coiling process. After the end of the coiling wire has been put in, the free legs of the transverse members are pressed against the grid strut by means of two pressure pins arranged at the grid coiling machine. For this purpose it is necessary for the free ends of the transverse members to project far enough to enclose, from the center of the strut, about one fourth of the circumference of the strut.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a fragmentary elevation of a part of a tension grid produced by the process of the invention.

FIGURE 2 is a side elevation of the grid during an initial step in the process.

FIGURE 3 is a side elevation similar to FIGURE 2 illustrating the pins 6 and the final position of the ends of the transverse members, in dotted lines.

FIGURE 4 is a side elevation of the finished grid.

The two spars or struts of the grid are designated as 1 and 2 and the transverse members are designated as 3 which are connected at welds 9. Before the beginning of the coiling process, end 5 of the grid coiling wire 4 is placed between one leg of the transverse member 3 and the strut 1. By means of a tool shown in FIGURE 3, consisting of two pins 6, the ends of the transverse members are subsequently bent in the direction of the strut 1 in such manner as to clamp end 5 of the coiling wire. For this purpose, the two pressure pins 6 move in the direction of the two arrows shown. The front edges of the two pressure pins are so designed as to bend off the

ends of the transverse members in such a way as to cause them to closely engage the arcuate surface of the strut 1. This position of the ends of the transverse members is shown in FIGURE 3 by dashed lines and designated as 7.

The movement of pins 6 may be accomplished in any desired manner. For example, pin guiding blocks 13 may be mounted near or on the grid coiling machine. The blocks have guide openings 10 formed therethrough in which pressure pins 6 are slidably movable. The piston rods 11 of hydraulic cylinders 12 are connected to pins 6 and when the cylinders are actuated to extend their piston rods the pins 6 are moved toward each other while when their piston rods are retracted, the pins 6 are moved away from each other.

FIGURE 4 shows a completely coiled grid viewed from the front side. The clamp wire end 5 may be seen from this figure.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. In the production of tension grids for electric discharge tubes, a method of fastening the ends of the coiling wire to the tension frame including two struts and two transverse members each connecting the struts at two opposed locations, the improvement comprising the steps of: placing the end of the coiling wire between one leg of a transverse member and the respective strut prior to initiating the coiling process; and subsequently bending the free leg of the transverse member onto the strut to clamp the end of the coiling wire.

2. In a grid coiling machine for clamping a coiling wire to a tension frame including a strut and two transverse members having projecting portions, an assembly for clamping the coiling wire between the strut and one of said transverse members, a guide cooperable with said assembly and mountable on the machine for movement

making possible the clamping of the end of the coiling wire before the beginning of each coiling cycle.

3. The device of claim 2, wherein said assembly includes two pressure pins for pressing the projecting portions of the transverse members toward the strut after the coiling wire has been placed between the strut and one of said projecting portions.

4. A method of clamping a coiling wire to a tension frame having a strut and two transverse members connected at opposed points to the strut and having projecting portions, comprising the steps: placing an end of the coiling wire between the projecting portion of a transverse member and the strut, and then bending the projecting portions of the transverse members against the strut to clamp the coiling wire therebetween.

5. The method of claim 4, wherein said steps are performed prior to initiating coiling of the wire onto the frame.

6. Means for retaining the coiling wire of a tension grid for electric discharge tubes in place, comprising, in combination: a strut; two transverse members connected thereto at opposed points and having portions projecting beyond said strut; two pressure pins in alignment with the projecting portions of said transverse members with one disposed on each side thereof; and means for moving said pins toward said strut to bend the projecting portions against the strut to clamp a coiling wire therebetween.

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