

Nov. 7, 1933.

H. SIMON

1,934,097

MANUFACTURE OF GRID ELECTRODES

Filed April 12, 1930

3 Sheets-Sheet 1

Fig. 1

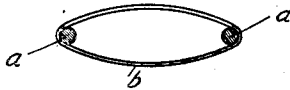


Fig. 2

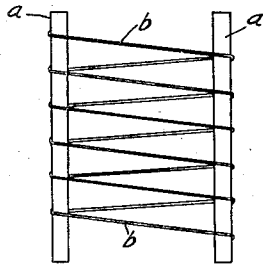


Fig. 3

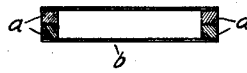


Fig. 4

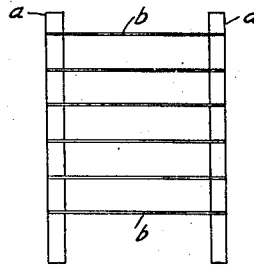


Fig. 5

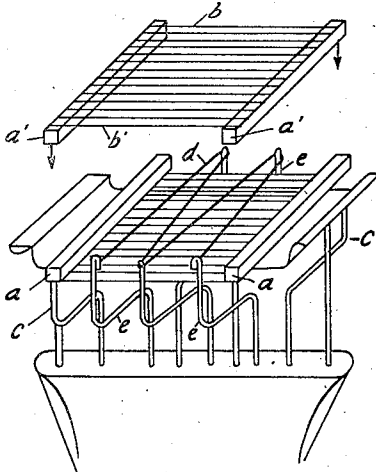


Fig. 8

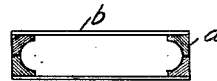


Fig. 9

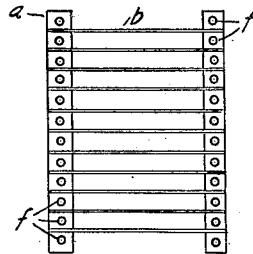


Fig. 6

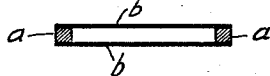
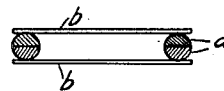


Fig. 7



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Fig. 10

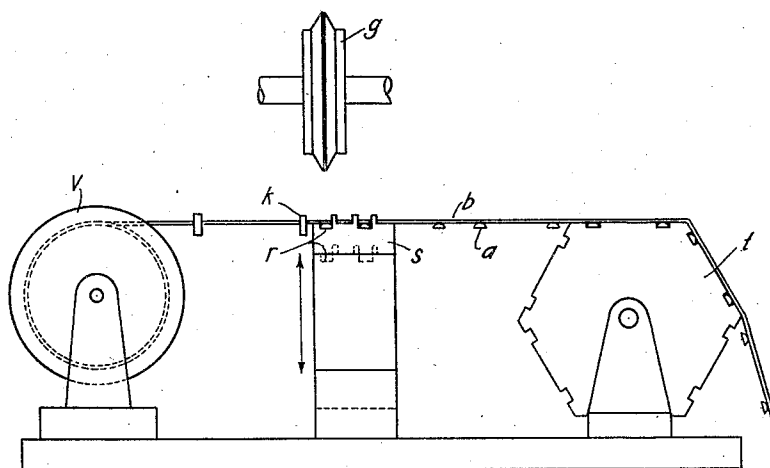
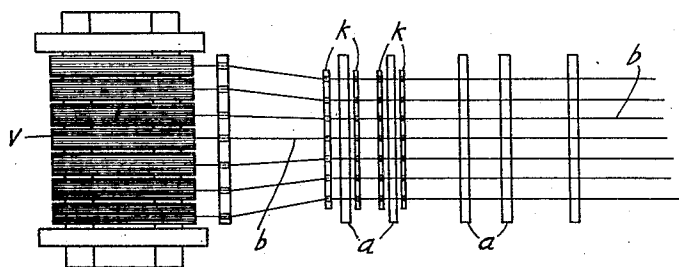


Fig. 11



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MANUFACTURE OF GRID ELECTRODES

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Fig. 12

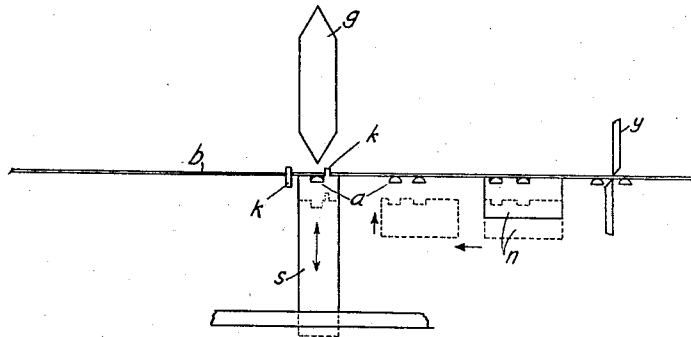
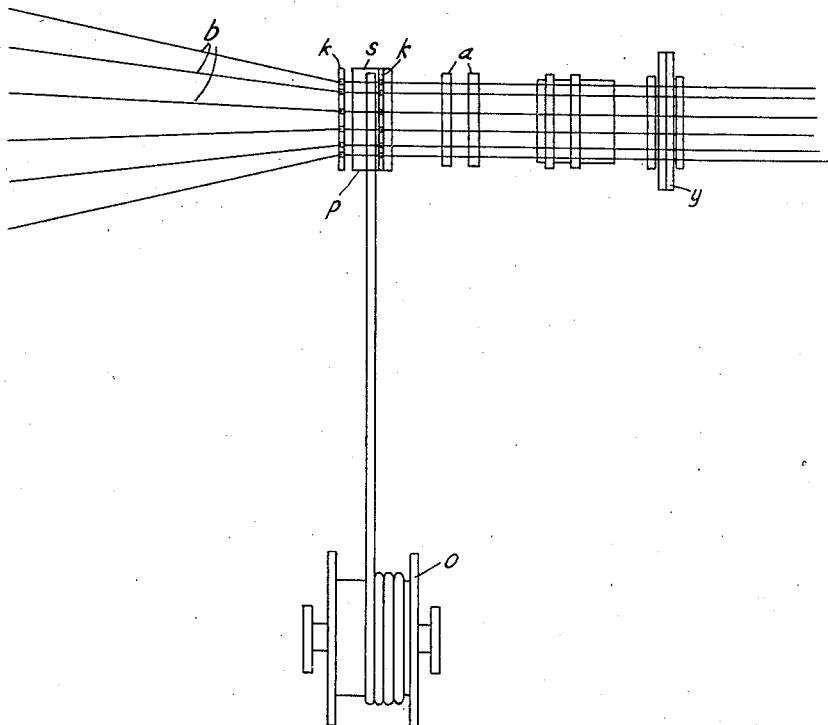


Fig. 13



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UNITED STATES PATENT OFFICE

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MANUFACTURE OF GRID ELECTRODES

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Application April 12, 1930, Serial No. 443,653,
and in Germany April 29, 1929

3 Claims. (Cl. 140—71)

In amplifier tubes with a box-like plate, the grids have hitherto been constructed by winding wires, by means of suitable devices, around two posts which were kept at a definite distance from one another. There were produced thereby two more or less parallel surfaces which were connected to a closed grid by means of two semi-cylinder-like pieces disposed at the sides. Due to the stiffness of the wire, however, the two surfaces seldom were kept within a plane but were slightly curved towards the outside.

The invention will be more clearly understood with the aid of the accompanying drawings. Figs. 1 and 2 show, respectively, in section and in plan view a grid manufactured according to the former method. Figs. 3 and 4 show, respectively, in section and in plan view a grid manufactured according to my invention. Fig. 5 shows how the two grid halves as illustrated in Figs. 3 and 4 are combined to form the grid. Fig. 6 shows another form of grid manufactured according to my invention. Fig. 7 shows still another form of grid manufactured according to my invention. Figs. 8 and 9 show in section and in plan view, respectively, still another form of grid manufactured according to my invention. Figs. 10 and 11 show in elevation and plan view respectively the means for manufacturing grids according to my invention. Figs. 12 and 13 show in elevation and plan view respectively a modified form of the means for manufacturing grids according to my invention.

A grid of the former type is illustrated in Fig. 1 in section and Fig. 2 in plan view. *a* represents the two grid posts around which is wound the grid wire *b*. The curved form of the grid surfaces entails some disadvantages. Under treatment (e. g. in the heat treatment) the grids easily change their form with the result that grid short-circuits and also disturbing irregularities in the action of the grid due to the changed distance of the grid from the filament occur.

These disadvantages may be avoided according to the invention if the grid electrodes are constructed so that a plurality of grid wires are placed in one plane over the grid posts and are connected with the latter, for instance by means of welding. The grid surfaces, respectively the grid halves, formed in this manner may be disposed thereby at the exact distance from the plane of the filament. In this case the distance may be maintained much more exactly than this was possible formerly, and it is also less subject to variations during the construction of the grids

than was the case formerly. This results in a much greater uniformity of the tube with respect to slope and amplification factor.

The practical application of the method according to the invention is very simple. Straight stretched wires, whose number and distance from one another may be chosen at will, according to the purposes to which the grids are intended, are welded with great rapidity by means of a welding device in one working operation to one grid post, moved forward, welded to a second grid post, and cut off. With this, one grid half is finished. The further procedure may now consist in joining together two grid halves of this type to a closed grid by placing the grid posts one on top of the other and fixing the same in such a manner that the grid wires are located on the outside.

In this case the joining together of the grid halves is suitably accomplished simultaneously with the introduction of the filament so that first one grid half, as shown in Fig. 5, is attached to the supporting wires *c*, after which the filament *d* is drawn in parallel to the plane of the grid wires, by coiling it around the supporting wires *c*, and that subsequently the second grid half with the posts *a'* is placed on the posts *a* of the first grid half and fixed in suitable manner. Thereby the grid is imparted the form according to Fig. 3 and Fig. 4. Since in this case the distance of the grid wires from one another and from the filament is determined by the thickness of the grid posts, this distance may be maintained exactly by means of a suitable choice of the cross-section of the posts.

But the grids may also be finished so that the same grid posts are used for both halves of the grid (Fig. 6), the filament, attached to the lead wires, being subsequently installed in the complete grid.

Fig. 7 illustrates a particularly suitable form of the grid posts, insuring an easy and reliable welding on of the grid wires. As may be seen, the grid posts are given a semi-circular profile. The welding on of the grid wires takes place on the rounded side, while the joining together of the finished grid halves is accomplished with the flat side.

In the plane grid, constructed in the described way, the grid wires are disposed on only two sides of the filament, i. e.; they do not so completely surround the latter as in the constructions known in the prior art. This disadvantage may be eliminated so that the grid posts are in the very beginning imparted such a form, by means of perforated or toothed bands or the like, that a uni-

form grid action is effected in all directions. An embodiment by way of example with perforated grid posts is represented in Fig. 8 and Fig. 9. *f* indicates the holes provided in the posts. The same purpose may also be accomplished by the insertion of a small strip of suitable form in the open sides.

The method of manufacturing grids according to the above described manner has proven especially useful in amplifier tubes which may be produced with great uniformity and quality. A particular advantage of the method consists in that it is possible to change the distance between, and the material of, individual grid wires. For instance, the distance between the outer grid wires may be chosen narrower or wider than that between the inner wires, or individual wires may be made, for instance, of nickel, others of molybdenum. This is not directly possible with the method of preparing the grids, known in the prior art, by means of the winding on of a continuous wire.

The construction of the grids, respectively the grid halves, is suitably accomplished by means of devices represented in a schematic manner in Figs. 10 and 11. According to Fig. 10 the grid wires *b* are conveyed in any desired number from the reserve coils *v* to the welding electrode *s*. The welding electrode is provided with two cross grooves *r* which serve for the reception of the grid posts. The latter are inserted into the grooves from the side and welded together with the grid wires *b* by means of the counter electrode *g* of the welding device and constructed in the form of a roll. The combs *k* serve the purpose of guiding the grid wires and of fixing the distance of the latter among one another. The left comb in the drawings is stationary, while the other combs are attached to the welding electrode *s* and move with the latter. The combs are exchangeable. The reserve rolls *v* may likewise be exchanged, thereby insuring the selection of another material for some of the wires. For the purpose of an easy insertion of the grid posts as well as for the faultless transport of the grid band, the electrode *s* is movable in the direction of the arrow. The finished grid band is wound on the conveying drum *t*, which insures the desired rate of feed of the grid wires by its rotation in steps. After this, the grid halves are cut off.

The individual operating runs are as follows: The electrode *s* is moved downward, the grid wires are moved towards the right by the rotation of the conveying drum *t*, two grid posts of suitable length are placed in the grooves *r*, the electrode *s* is raised so that the grid posts bear against the grid wires, the welding roll *g* is guided over the grid posts in transverse direction to the grid wires, and the welding of the grid wires to the grid posts is thereby accomplished. Subsequently, the welding electrode *s* is again moved downward, and so forth.

The device may be imparted a still simpler form in that the conveying drum *t* takes over at the same time the function of the welding electrode *s*.

Figs. 12 and 13 illustrate a modified device. The guiding of the grid wires up to the welding electrode *s* is accomplished in the same manner as in Fig. 10 and is for this reason not shown in the drawings. The guiding combs *k* are of the same type as shown in Fig. 10. The teeth of the comb are in this case, however, closer together at the edge than in the center, with the result that the grid wires are placed closer at the ends of the grid. The welding electrode *s* is likewise movable in the direction of the arrow. In the present case, however, the feed of the grid posts is accomplished in such a manner that the wire used for the grid posts is reeled off in suitable length from a reserve roll *o* and guided under the grid wires *b* and cut off by means of a knife *p*. The grid wires *b* are welded to the corresponding grid posts *a* by means of the welding rolls *g*. The conveying carriage *n* moves the finished grid band. The carriage moves in the direction indicated by arrows and determines the mutual distance of the grid posts *a*. The shear *y* cuts off the finished grid halves.

I claim:

1. The method of making a flat grid electrode consisting of two independent and similar halves which comprises making each half of said electrode independently of the other half by stretching a plurality of straight parallel grid wires transversely across and in contact with a pair of parallel rigid supports, securing said grid wires to said supports, assembling said two halves to form a complete grid electrode by superposing said supports of each half with the grid wires outside, and securing said superposed supports to each other.

2. The method of making a flat grid electrode consisting of two independent and similar halves which comprises making each half of said electrode independently of the other half by positioning parallel to each other a pair of rigid supports each having a flat side, stretching a plurality of straight parallel grid wires transversely across and in contact with said supports opposite said flat sides, securing said grid wires to said supports, bringing said two halves together with the flat sides of the corresponding supports of said halves in contact, and joining said supports.

3. The method of making a flat grid electrode consisting of two independent and similar halves which comprises making each half of said electrode independently of the other half by positioning a pair of rigid perforated supports parallel to each other, stretching a plurality of straight parallel grid wires transversely across and in contact with said supports at points between the perforations in said supports, securing said grid wires to said supports at the points of contact assembling said two halves into a complete electrode by bringing them together with the corresponding supports of said halves in contact and with said grid wires on the outside, and fastening said supports together.

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