

June 11, 1935.

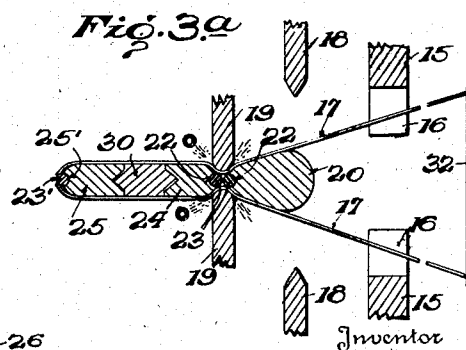
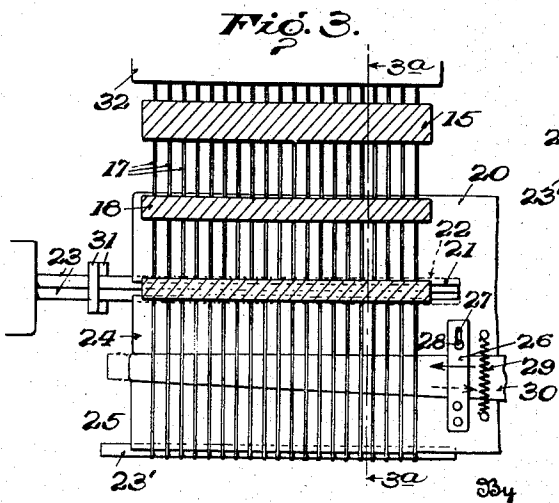
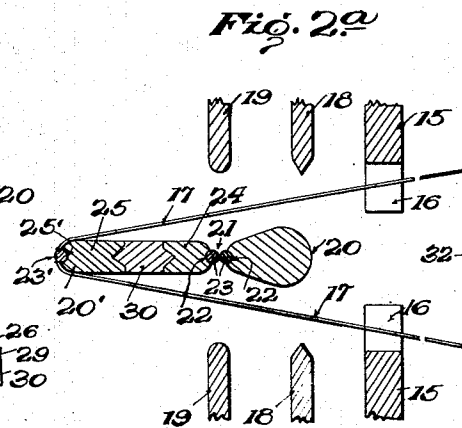
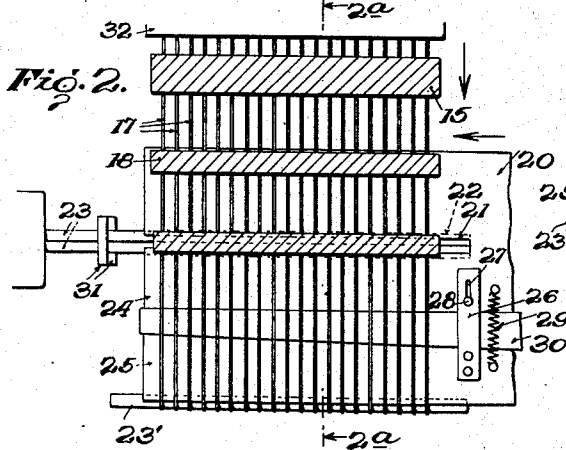
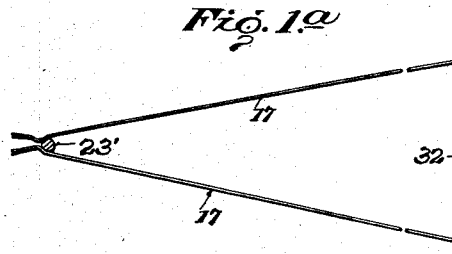
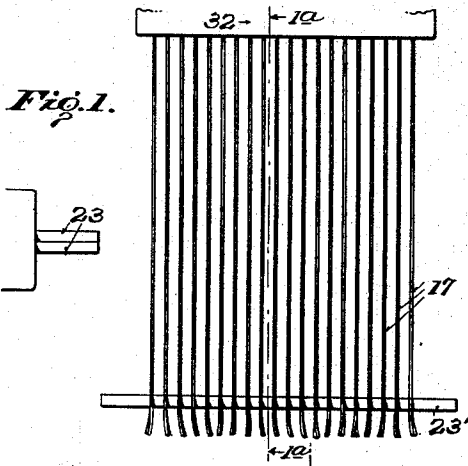
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2,004,246

METHOD OF PRODUCING RADIO TUBE GRIDS

Filed Dec. 6, 1934

2 Sheets-Sheet 1



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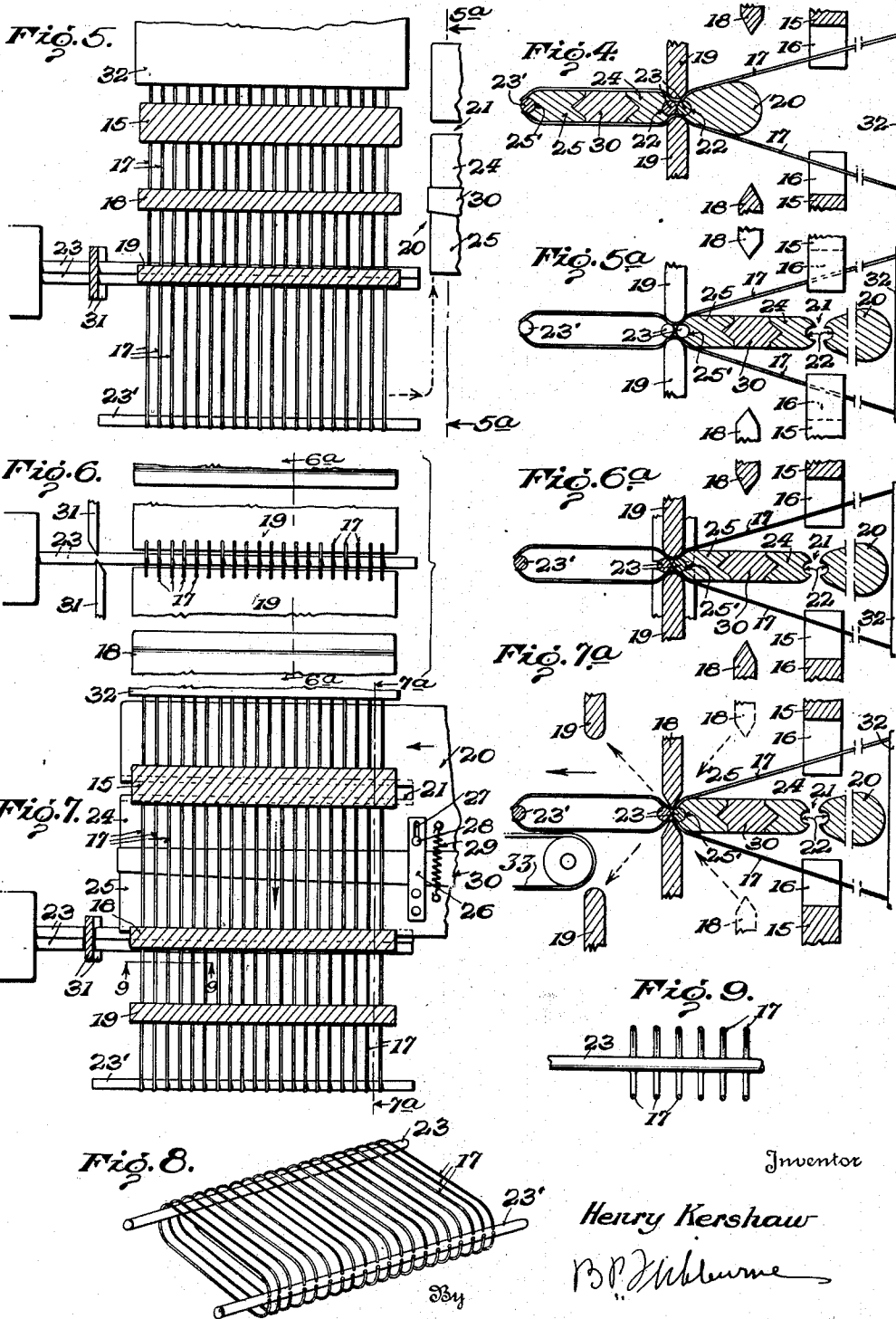
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METHOD OF PRODUCING RADIO TUBE GRIDS

Filed Dec. 6, 1934

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,004,246 METHOD OF PRODUCING RADIO TUBE GRIDS

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Application December 6, 1934, Serial No. 756,354
22 Claims. (Cl. 140—71)

My invention relates to a method of producing radio tube grids.

In the method generally practiced in the production of radio tube grids the support wires or side rods are notched at spaced intervals and the grid wire is wound around these side rods within the notches and the notches are then swaged so that the grid wire is attached to the side rods. The side rods are cut at intervals to produce the grid, and when this is done, two adjacent grids are connected by a section of the grid wire, several of the notches between the adjacent grids not being swaged. To separate the grids the connecting portion of the grid wire is cut and the grid is trimmed. This practice results in the loss of considerable grid wire which is a source of expense in the manufacture of these articles. After the grid is cut from the adjacent grid it is then handled by an operator who places the same upon a collapsed expanding mandrel which is then expanded so that the grid is stretched and the grid shaped and sized. The expanded mandrel is now collapsed and the operator removes the grid from the same which is then in the form of the completed article. This stretching and sizing of the grid constitutes a separate operation by an operator and which is expensive.

In some instances, the side rods are not notched and swaged but the grid wire is wound about the same and welded thereto. In either case, the grid wire is applied to the side rods by a winding operation which is time consuming.

In accordance with my invention the grid is produced by applying sets of separate grid wires to the opposite sides of the side rods and attaching the grid wires to the side rods preferably by welding, although the attachment may be effected by notching and swaging the side rods. By this method the usual winding step is entirely eliminated and it is possible to have the grid wires in one set disposed precisely opposite the corresponding grid wires on the other set, which is not possible where a winding operation is employed, but in some instances the grid wires of one set are disposed out of alignment with the grid wires in the other set. Further, in the practice of my method the grid may be advantageously expanded and stretched for shaping and sizing the same before the completion of the product, whereby the separate step of stretching and expanding for sizing, after the completion of the article, is eliminated. The several steps of the method may be carried out in a correlated manner, in proper succession, whereby the output of the product is greatly increased.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a plan view of the sets of grid wires attached to a side rod in the starting of the method.

Figure 1a is a transverse section taken on line 1a—1a of Figure 1,

Figure 2 is a plan view of the sets of grid wires and associated devices showing the second step in the method, wherein the expanding mandrel in the collapsed condition has been inserted between the sets of grid wires and the combined welding and holding jaws disposed in a location to be moved to the welding position.

Figure 2a is a transverse section taken on line 2a—2a of Figure 2,

Figure 3 is a view similar to Figure 2, with the combined welding and holding jaws shifted inwardly to the welding position,

Figure 3a is a transverse section taken on line 3a—3a of Figure 3,

Figure 4 is a view identical with Figure 3a, except that the mandrel is expanded,

Figure 5 is a plan view similar to Figure 2, except that the mandrel has been collapsed and withdrawn from within the partly completed grid and shifted longitudinally of the grid wires in the direction of the arrow to assume a position to be passed between the sets of grid wires,

Figure 5a is a transverse section taken on line 5a—5a of Figure 5,

Figure 6 is a side elevation of the partly completed grid with the associated tools showing the starting of the cutting of the side rods,

Figure 6a is a transverse section taken on line 6a—6a of Figure 6,

Figure 7 is a plan view similar to Figure 2 illustrating the cutting of the grid wires between adjacent side rods for completing the grids,

Figure 7a is a transverse section taken on line 7a—7a of Figure 7,

Figure 8 is a perspective view of the completed grid, and,

Figure 9 is an enlarged central longitudinal section through the grid.

I will now proceed to describe the devices which I may use in the practice of the method. The numeral 15 designates opposed upper and lower horizontal combs, having teeth 16, between which the upper and lower sets of strands of grid wire 17 pass. These several strands of grid wire are held upon spools, and the strands are unwound or fed from the spools during the method, as

be described. The teeth of the combs serve to hold the grid wire strands in the selected spaced relation, and the spacing of these strands will of course depend upon the desired pitch which the finished grid will have. The grid may have any suitable number of opposed pairs of grid wires, which of course is controlled by the spacing of the same. Disposed upon one side of the stationary blades or cutters 18, of a length to extend entirely across the sets of grid wires, and 19 designed and holding jaws which also have a suitable length to extend entirely across the grid wires. The numeral 20 designates a mandrel, having at the ends of the combined welding and holding jaws 19. The side walls of this passage 21 are provided with grooves 22, for receiving two contacting side rods or supports 23, which are fed therein by a longitudinal movement of the side rod. The mandrel has an expansible portion, comprising a stationary jaw 24 and a laterally movable jaw 25, which is connected with the movable jaw by means of a transverse plate 26 rigidly attached to the movable jaw 25 and having an elongated slot 27, receiving screws or bolts 28, which are rigidly attached to the mandrel or jaw 24. The movable jaw is ordinarily collapsed by a retractile coil spring 29, and is expanded by a longitudinally movable wedge 30, operating between the stationary and movable jaws. It is thus seen that the movable jaw is bodily shiftable with the mandrel as a unit, but is laterally contractible and expansible with relation to the stationary jaw of the mandrel. The numeral 31 designates upper and lower opposed cutters or blades to cut the side rods or supports 23.

In the practice of the method the grid wires 17 pass through a hydrogen furnace 32 and the side rods or supports 23 also pass through a hydrogen furnace and the purpose of this treatment is to degasify these elements. The first step in the method is to arrange the leading ends of the upper and lower sets of grid wires 17 upon opposite sides of a cut side rod or support 23' and to suitably attach these wires to the rod 23' by welding or the like. The leading end portions of the grid wire strands thus assembled are moved longitudinally in the direction of the arrow in Figure 2 until they assume the position shown with relation to the mandrel 20 and this mandrel is now shifted longitudinally in the direction of its arrow so that it passes between the upper and lower sets of grid wires 17 and the side rod or support 23' will enter the groove 25' of the jaw 25. The side rods or supports 23, which are held and guided at a given fixed point, are now shifted longitudinally in the direction of their arrow and extend longitudinally within the passage 21 and are held within the grooves 22. The combined welding and holding jaws 19 are now arranged above and below the grid wires 17 in vertical alignment with the passage 21. The relative position of the various parts is shown in Figures 2 and 2a. The combined welding and holding jaws 19 are now moved inwardly for clamping engagement with the grid strands 17 and the free ends of these rods 23, which are held in contacting relation with each other. Just prior to the clamping engagement between the jaws 19 and the grid wires 17, hydrogen gas is blown upon the grid wires 17 and side rods 23 at the points of welding, and the instant that the jaws 19 clamp the grid wires to the side rods 23, the current is automatically turned on and the grid wires are spot-welded to the side rods 23. The welding operation continues for a short time, just sufficient to fuse the grid wires with the side rods, and the jaws are retained in the closed position for holding engagement with the grid wires 17. The function of retaining the jaws 19 in holding engagement with the grid wires 17 is to retain these rods 23 until the welded joints have properly cooled and further for retaining the partly completed grid in a proper position, during other steps of the operation. The welding and holding steps are illustrated in Figures 3 and 3a. The partly completed grid for sizing the same, and this expanding and stretching is effected by shifting the wedge 30 in the direction of its arrow, causing the movably jaw 25 to be shifted laterally and outwardly. The expanded step is shown in Figures 3, 3a and 4. The next step in the method is to collapse the expansible portion of the mandrel, and this is effected by shifting the wedge 30 in an opposite direction to its arrow and after the jaw 25 has moved inwardly the entire mandrel is shifted in an opposite direction to its arrow and withdrawn from within the partly completed grid and is then shifted longitudinally of the grid strands 17, in the direction of its arrow in Figure 5. The mandrel 20 is now in the position shown in Figure 5 and is now retained in this position until the completed grid is produced. This position of the mandrel is shown in Figures 5 and 5a. The next step in the method is to cut the side rods or blades 21 together. During all of these several steps the jaws 19 have remained in gripping engagement with the grid strands 17 and hence hold the partly finished grid in position. The next step in the method is to move the mandrel longitudinally in the direction of its arrow so that it passes between the grid wires 17 and the adjacent cut side rod 23 enters the groove 25' of the jaw 25. The mandrel will now hold the partly completed grid in position, and the jaws 19 will now be moved to the open position and are shifted forwardly in the direction of the arrows, Figures 7 and 7a, and the blades or cutters 18 are moved inwardly and forwardly in the direction of their arrows so that their edges cut the grid wires 17 between the side rods, thus separating the completed grid from the grid wires 17. During this cutting operation the short ends of the grid wires are bent inwardly about the side rods, thus dispensing with trimming of the same. This grid falls upon the conveyor 33 and is supported thereby, and the mandrel 20 is now moved forwardly in the longitudinal direction of the sets of grid wires, as shown in Figure 7, to feed the sets of grid wires longitudinally for an extent for determining the width of the next grid, whereby the parts will assume the relative position as shown in Figure 1, after which the cycle of operation is completed.

In the practice of the method the side rods 23 before being fed between the sets of grid wires are held and guided in a stationary guide main longitudinal movement of the sets of grid wires for the given distances to determine the width of the grids is with respect to the fixed guiding

tion of the side rods. After the completion of at least one grid the cycle of operation may be regarded as arranging the pair of side rods between the sets of grid wires, welding or attaching the grid wires to the side rods, cutting off the side rods, cutting the grid wires between the side rods, longitudinally advancing the sets of grid wires for a distance to determine the width of the grid, inserting another pair of side rods between the sets of grid wires at the same guiding point, cutting off the second pair of side rods, expanding the partly completed grid (which may be omitted at this point in the method) and then cutting the grid wires between the second pair of side rods.

It is preferred that the side rods which are disposed side by side should be in close or substantial contacting relation as this will cause the cut ends of the grid wires to be short and these short ends may be bent inwardly about the side rods, whereby it is unnecessary to trim such short ends, but the distance between the pairs of side rods may be varied, if desired.

The invention is not restricted to the production of a grid having the flat shape as shown, as the grid may be formed in any suitable shape and the mandrel will then have a correspondingly suitable shape.

It is to be understood that the form of my method herewith shown and described is to be taken as a preferred example of the same and that various changes in the order of the steps of the method may be resorted to and other devices employed in the practice of the method, without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. In a method of producing radio tube grids, the steps of supporting spaced sets of spaced grid wires in such a manner that the corresponding wires in the sets are in substantial alignment, moving the sets of wires longitudinally as a unit, holding the side rods against movement in a position between the sets of grid wires, and attaching the sets of grid wires to the opposite sides of the side rods.

2. In a method of producing radio tube grids, the steps of supporting sets of grid wires in spaced relation and moving such sets longitudinally while guiding the wires in each set for maintaining them properly spaced, supporting side rods in a position between the sets of grid wires, attaching the sets of grid wires to the side rods, and cutting the grid wires between the side rods.

3. In a method of producing radio tube grids, the steps of holding side rods against movement, supporting spaced sets of grid wires and moving them longitudinally and transversely of the side rods, moving the side rods longitudinally so that they travel transversely of the sets of grid wires and are positioned between such sets, attaching the sets of grid wires to the opposite sides of the side rods, and cutting the grid wires between the side rods.

4. In a method of producing radio tube grids, the steps of supporting pairs of side rods in succession at the same point with the rods in each pair in close relation while arranging sets of grid wires upon opposite sides of each pair of side rods, attaching the sets of grid wires to the opposite sides of the side rods, moving the sets of grid wires longitudinally, and cutting the sets of grid wires between the closely arranged pair of side rods.

5. In a method of producing radio tube grids,

the steps of arranging sets of grid wires in spaced relation, supporting a pair of side rods in close relation and transversely of and between the sets of grid wires, attaching the sets of grid wires to the opposite sides of the side rods, and cutting the sets of grid wires between the closely arranged side rods and bending the ends of the cut grid wires inwardly about the side rods.

6. In a method of producing radio tube grids, the steps of arranging sets of spaced grid wires upon opposite sides of a pair of side rods disposed in such close relation that their sides substantially contact with the side rods being arranged transversely of the grid wires, attaching the sets of grid wires to the opposite sides of the side rods, and cutting the sets of grid wires between the side rods and bending the cut ends of the grid wires inwardly about the side rods.

7. In a method of producing radio tube grids, the steps of supporting spaced sets of grid wires and imparting to said sets a step-by-step movement in a longitudinal direction, passing a pair of side rods arranged side by side in close relation transversely of the sets of grid wires and between the same between each step movement of said sets of grid wires, attaching the sets of grid wires to the opposite sides of the pair of side rods for producing a partly formed grid, stretching the grid wires of the partly formed grid to impart to the same the desired size, and cutting the sets of grid wires between the pair of side rods for completing the grid.

8. In a method of producing radio tube grids, the steps of supporting spaced sets of grid wires and imparting to said sets a step-by-step movement in a longitudinal direction, effecting a longitudinal movement of a pair of side rods arranged side by side in close relation to cause the same to travel transversely of the sets of grid wires and between the same between each step-by-step movement of said sets of grid wires, moving the sets of grid wires into contact with the opposite sides of the side rods and welding the grid wires to the side rods and holding the welded grid wires and side rods for producing a partly formed grid, subjecting the grid wires of the partly formed grid to a stretching action to impart to the same a proper size, cutting the pair of side rods, releasing the holding action of the welded grid wires and side rods, and cutting the sets of grid wires between the pair of side rods.

9. In a method of producing radio tube grids, the steps of supporting spaced sets of grid wires and imparting to said sets a step movement in a longitudinal direction, effecting a longitudinal step movement of a pair of side rods arranged side-by-side to cause the rods to pass transversely of the sets of grid wires and between the same, welding the sets of grid wires to the side rods and holding the welded grid wires and side rods for producing a partly formed grid, subjecting the grid wires of the partly formed grid to a stretching action to impart to the same a proper size, cutting the side rods, releasing the holding action upon the welded grid wires and side rods and supporting one side rod, and cutting the sets of grid wires between the pair of side rods.

10. In a method of producing radio tube grids, providing spaced sets of separate grid wires, attaching a side rod to the leading ends of such sets, passing an expansible and collapsible mandrel between said sets and in engagement with the side rod, passing a pair of side rods transversely of the said sets and between the same

and in engagement with the mandrel, moving oppositely arranged jaws into engagement with the sets of grid wires to weld the same to the pair of side rods and to then hold the welded grid wires and side rods, expanding the mandrel so that it acts upon the first named side rod and stretches the grid wires of the partly formed grid to size the same, collapsing the mandrel and removing the same from within the partly formed grid, cutting the pair of side rods, passing the collapsed mandrel between said sets of grid wires and rearwardly of the trailing side rod of said pair to support the same, moving the jaws from the pair of side rods, and then moving an oppositely arranged pair of blades toward the pair of side rods to cut the grid wires between such pair of side rods.

11. In a method of producing radio tube grids, assembling the sets of spaced grid wires, assembling a pair of side rods side by side in close relation and arranging the same between said sets and transversely of said sets at a given point, welding said sets of wires to the side rods, cutting the wires between the side rods, longitudinally advancing the sets of wires for a distance to determine the width of the grid, arranging another similar pair of side rods between the sets of wires and transversely thereof at the given point, welding the sets of wires to the second pair of side rods, and cutting the wires between the second pair of side rods.

12. In a method of producing radio tube grids, assembling sets of spaced grid wires, assembling a pair of side rods side by side in close relation and arranging the same between said sets of wires and transversely thereof at a given point, welding said sets of wires to the side rods, cutting the wires between the side rods, longitudinally advancing the sets of wires for a distance with respect to the given point to determine the width of the grid, arranging another pair of similar side rods between the sets of wires and transversely thereof at the given point, welding the sets of wires to the second pair of side rods to produce a partly completed grid, expanding the partly completed grid to stretch the wires thereof and to impart to the same a selected width, and then cutting the wires between the second pair of side rods to complete the grid.

13. The method of forming a radio tube grid, comprising supporting side rods, substantially simultaneously arranging separate spaced sets of grid wires upon the opposite sides of each side rod, and substantially simultaneously attaching the sets of grid wires to the opposite sides of each side rod.

14. In a method of producing radio tube grids, the steps of supporting sets of grid wires in spaced relation, supporting side rods and effecting a relative movement between the side rods and the sets of grid wires for arranging the sets of side rods between the sets of grid wires and transversely of the sets of grid wires, and attaching the sets of grid wires to the opposite sides of each side rod.

15. In a method of producing radio tube grids, the steps of supporting sets of grid wires in spaced relation, supporting side rods near the sets of grid wires, moving the sets of grid wires in a longitudinal direction, effecting a relative movement between the side rods and the sets of grid wires for arranging the side rods transversely of and between the sets of grid wires, attaching the

sets of grid wires to the opposite sides of each side rod, and cutting the grid wires between the side rods.

16. In a method of producing radio tube grids, the steps of supporting spaced sets of spaced grid wires, arranging and supporting side rods transversely of and between the sets of spaced grid wires, and subsequently attaching the sets of grid wires to the opposite sides of each side rod.

17. In a method of producing radio tube grids, the steps of supporting sets of spaced grid wires in spaced relation, arranging and supporting side rods transversely of and between the sets of spaced grid wires, and substantially simultaneously pressing the sets of grid wires into contact with the opposite sides of each side rod and attaching the sets of grid wires to the opposite sides of each side rod.

18. In a method of producing radio tube grids, the steps of supporting in spaced relation sets of spaced grid wires, moving the sets of spaced grid wires longitudinally as a unit, arranging and supporting side rods transversely of and between the sets of grid wires, and attaching the sets of grid wires to the opposite sides of each side rod.

19. In a method of producing radio tube grids, the steps of assembling grid wires in generally parallel spaced relation to provide separate sets of the same, supporting the sets of spaced grid wires in spaced relation, arranging and supporting side rods transversely of and between the sets of grid wires at a selected location, attaching the sets of grid wires to the opposite sides of each side rod, cutting the sets of grid wires between the side rods, effecting the longitudinal travel of the sets of grid wires for a distance to determine substantially the width of the grid, again arranging and supporting side rods transversely of and between the sets of grid wires, attaching the grid wires to the opposite sides of each of the last named side rods, and cutting the grid wires between the last named side rods.

20. In a method of producing radio tube grids, the steps of supporting in spaced relation sets of spaced grid wires, supporting side rods exteriorly of the sets of spaced grid wires and effecting the longitudinal movement of the side rods to arrange them transversely of and between the sets of grid wires, and then moving the sets of grid wires into engagement with the side rods and attaching the sets of grid wires to the opposite sides of each side rod.

21. In a method of producing radio tube grids, the steps of supporting in spaced relation sets of spaced grid wires, supporting side rods exteriorly of the sets of spaced grid wires and effecting the longitudinal movement of the side rods to arrange them transversely of and between the sets of grid wires, moving the sets of grid wires into engagement with the opposite sides of each side rod and attaching the same to the opposite sides of each side rod, and cutting the sets of grid wires between the side rods.

22. In a method of producing radio tube grids, the steps of supporting in spaced relation sets of spaced grid wires, arranging and supporting side rods transversely of and between the sets of grid wires, and substantially simultaneously moving the sets of grid wires toward the opposite sides of each side rod and attaching the same to such opposite sides.

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