

Sept. 30, 1958

A. R. STAHL

2,853,769

MULTIPLE GRID ASSEMBLY DEVICE

Filed March 11, 1954

3 Sheets-Sheet 1

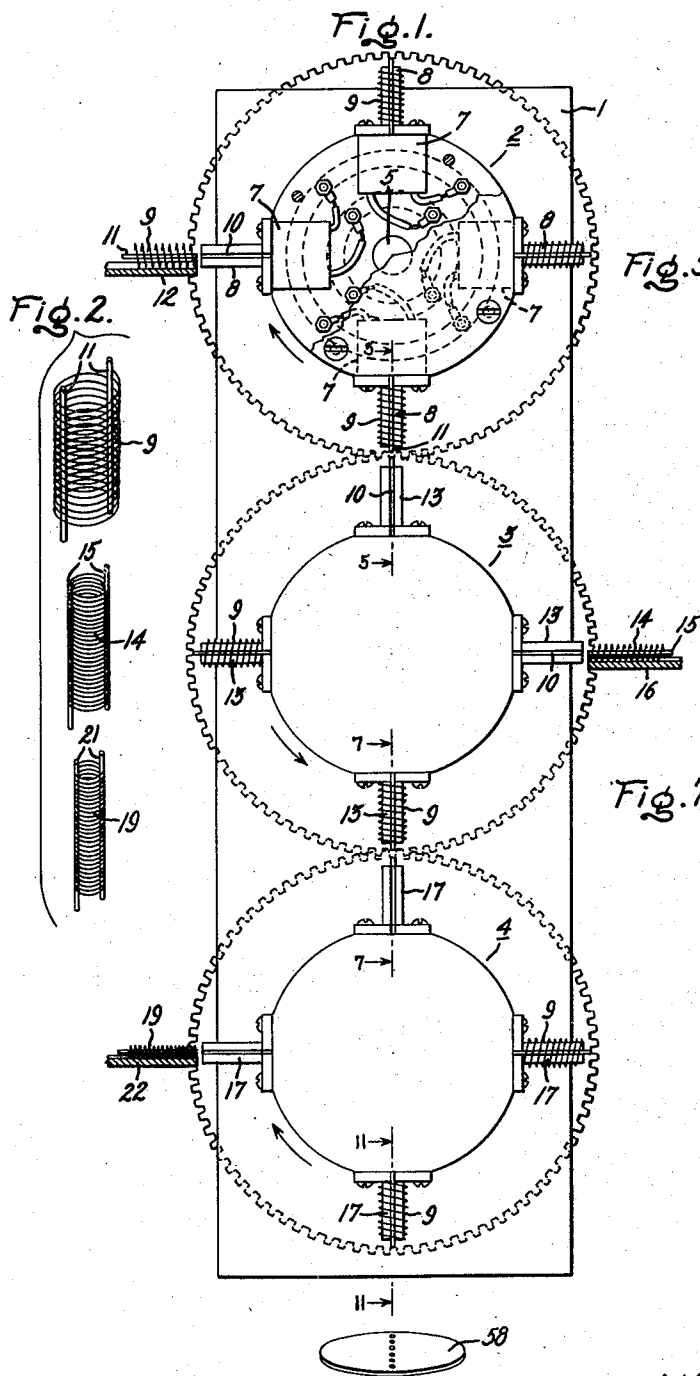


Fig. 5.

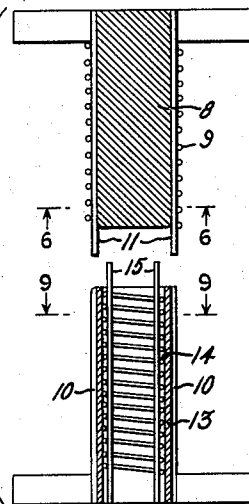


Fig. 7.

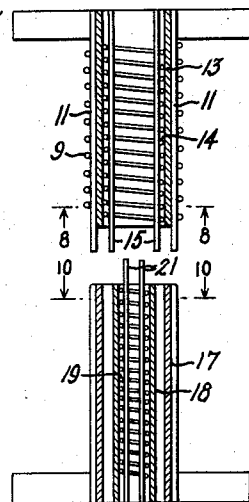
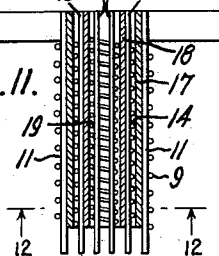


Fig. 11.



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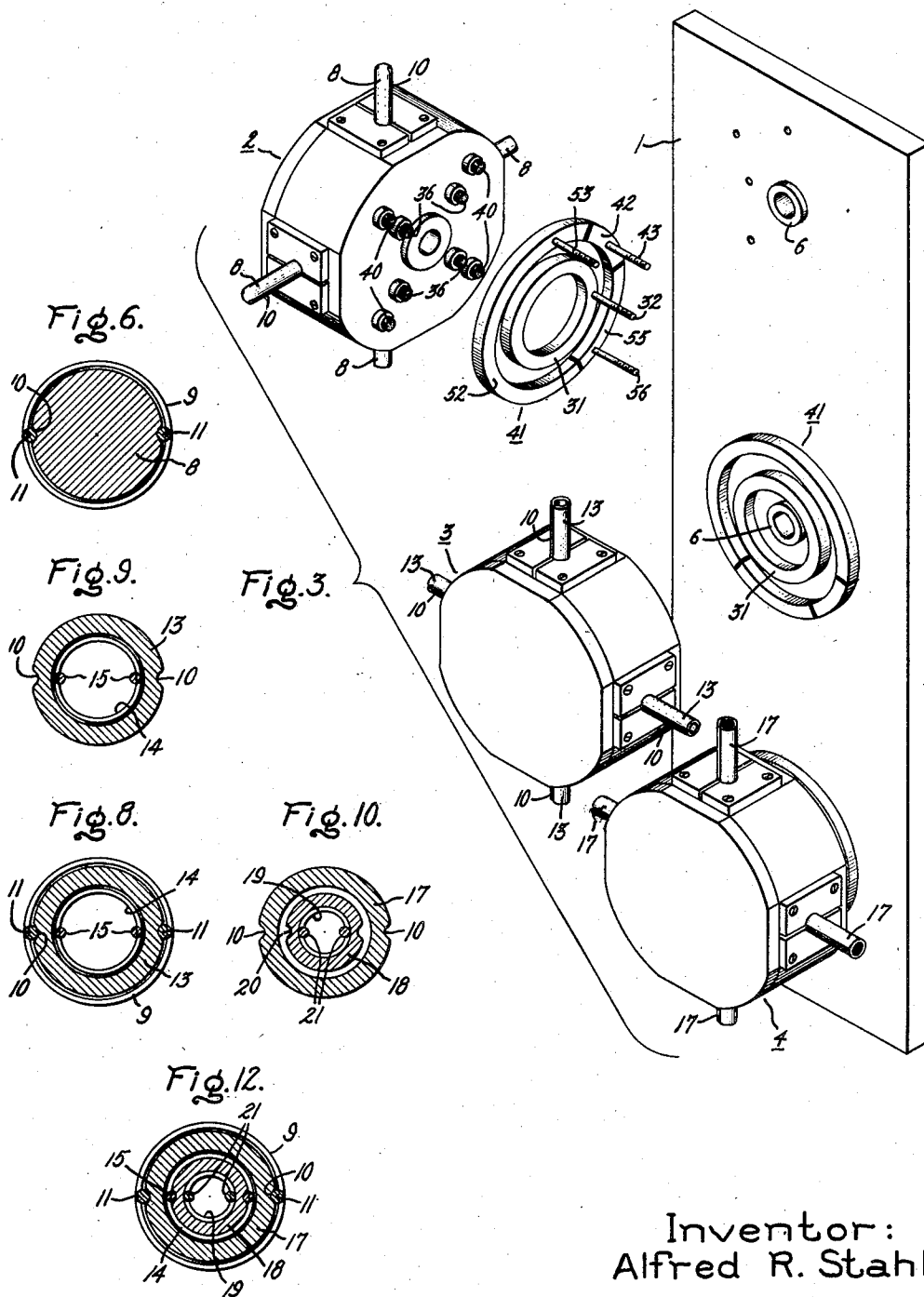
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3 Sheets-Sheet 2



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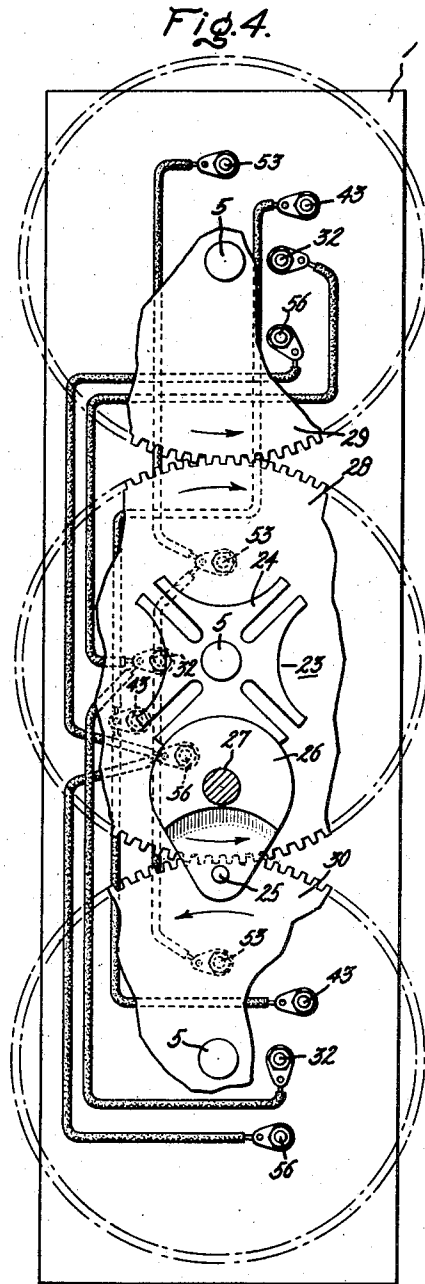
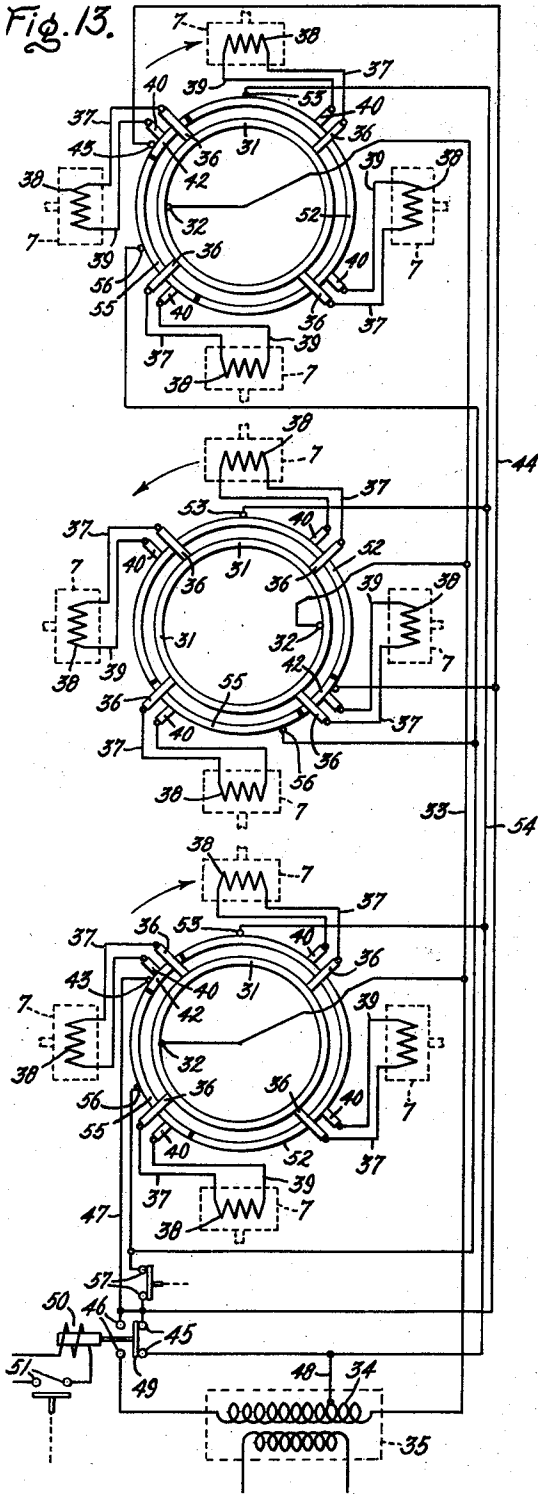
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MULTIPLE GRID ASSEMBLY DEVICE

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3 Sheets-Sheet 3



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2,853,769

MULTIPLE GRID ASSEMBLY DEVICE

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Application March 11, 1954, Serial No. 415,588

14 Claims. (Cl. 29—203)

My invention relates to the manufacture of electronic tubes and pertains more particularly to new and improved means for automatically assembling multiple grids for electronic tubes.

Some tube grids are formed by securing fine helically wound wires to parallel spaced grid rods. Often to provide multiple grids, grid elements of different sizes are arranged concentrically and spaced from each other as by fitting the rod ends into suitably spaced apertures in insulators such as mica discs. Heretofore, this operation was carried out manually and often had a deforming effect on the grid wires. Additionally, such manual operation proved both tedious and costly. Accordingly, the primary object of my invention is to provide new and improved means for automatically assembling multiple tube grids.

Another object of my invention is to provide means adapted for automatically assembling multiple grids without effecting deformation of the grid elements.

Another object of my invention is to provide automatic means adapted for increasing production and minimizing the cost of production of multiple grids.

Still another object of my invention is to provide automatic multiple grid assembly means adaptable for use with other automatic electronic tube assembly means for arriving at complete automation of electronic tube assembly.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In carrying out the objects of my invention I provide means for automatically picking up grid elements of different sizes, axially aligning the larger elements above the smaller elements and dropping the large elements over the smaller elements for concentrically assembling the differently sized grid elements.

For a better understanding of my invention reference may be had to the accompanying drawing in which:

Fig. 1 is a front elevation of a preferred embodiment of my invention;

Fig. 2 is a perspective illustration of the grid elements to be assembled into a multiple grid;

Fig. 3 is a partially exploded perspective view of my invention;

Fig. 4 is a rear elevation view of my device partially broken away to illustrate the wiring arrangement thereof;

Fig. 5 is an enlarged section taken along the line 5—5 in Fig. 1;

Fig. 6 is an enlarged section taken along the line 6—6 in Fig. 5;

Fig. 7 is an enlarged section taken along the line 7—7 in Fig. 1;

Fig. 8 is an enlarged section taken along the line 8—8 in Fig. 7;

Fig. 9 is an enlarged section taken along the line 9—9 in Fig. 5;

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Fig. 10 is an enlarged section taken along the line 10—10 in Fig. 7;

Fig. 11 is an enlarged section taken along the line 11—11 in Fig. 1;

Fig. 12 is an enlarged section taken along the line 12—12 in Fig. 11; and

Fig. 13 is a schematic wiring diagram of the controlling circuits of my device.

Referring to Fig. 1, I have shown a preferred embodiment of my new and improved means for assembling multiple grids of the type comprising a plurality of different sized helical wire grid elements formed of magnetic material, such as those shown in Fig. 2. My multiple grid assembly means includes a vertically extending base plate 1 formed of an insulating material and upon which are rotatably mounted substantially cylindrical first, second, and third grid elements pickup heads or turntables generally designated 2, 3 and 4, respectively. As seen in Figs. 1 and 4, the rotatable mounting of the pickup heads is effected by means of stub shafts 5 which are secured in the rear sides of the pickup heads. The stub shafts 5 extend rotatably through bushings 6 secured and arranged in vertical alignment in the base plate 1 in the manner shown in Fig. 3.

The pickup heads are each constructed to carry internally a plurality of radially arranged electromagnets 7. I have shown each head as having four electromagnets spaced 90° apart from each other. However, as it will be seen hereinafter, the number of electromagnets used may be increased or decreased as desired.

Suitably mounted on the periphery of the first pickup head 2 is a plurality of radially extending cylindrical pickup members 8 corresponding in number and position to the electromagnets carried in the head. Each member 8 is formed of a non-magnetic material such as brass and is coaxially aligned with its corresponding electromagnet 7. The members 8 are dimensioned for receiving thereover, in the manner shown in Figs. 1, 5 and 6, the largest of the grid elements comprising the multiple grids to be assembled, specifically large sized grid elements such as the one designated 9 in Fig. 2. Additionally, the members 8 are each formed to include diametrically opposed longitudinally extending grooves 10 for receiving the supporting rods 11 of the grid elements 9.

In a manner to be described in detail hereinafter and as seen in Fig. 1, the pickup head 2 is adapted for being rotated and the members 8 thereon are adapted for being positioned seriatim at a pickup station designated 12 at which grid elements 9 may be positioned in axial alignment with the members 8 for being drawn thereover by the corresponding electromagnets 7.

As further seen in Fig. 1 the members 8 are adapted for being positioned for cooperation with pickup members 13 suitably mounted on the periphery of the second pickup head 3. The pickup members 13 are similar to the members 8 in that they correspond to and are axially aligned with the electromagnets carried in the second pickup head 3 and in that the outer dimension of the members 13 is such that they also are adapted for receiving the largest grid elements 9 thereover, in the manner shown in Figs. 1, 7 and 8. Additionally the members 13 are each formed to include diametrically opposed longitudinal grooves 10 for receiving the rods 11 of the grid elements 9. The members 13 are different from the members 8 in that they are tubular; and, the inside dimension thereof is such that they are adapted for receiving the next smaller or medium size grid elements designated 14 in Fig. 2, in the manner shown in Figs. 7 and 8.

In a manner which also will be described in detail hereinafter and as seen in Fig. 1 the members 13 are adapted for being positioned seriatim first at a pickup

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station designated 16 at which medium sized grid elements 14 may be positioned in axial alignment for being drawn thereinto by the corresponding electromagnets 7, then at a position of vertical axial alignment beneath the members 8 on the first head 2 in the manner shown in Fig. 5 for receiving thereover the largest grid elements 9 from the members 8 and then at a position of axial alignment with pickup members 17 on the third head 4 in the manner shown in Fig. 7 for cooperation therewith.

The members 17 are mounted on the periphery of the third pickup head 4 in the same manner as the members 13 on the second pickup head 3 and are identical thereto. Concentrically disposed in each member 17, however, is another tubular pickup member 18. The members 18 are of such dimension as to be able to receive therein small sized grid elements designated 19 in Fig. 2 and to receive thereover the medium size grid elements 14. The external surfaces of the members 18 are formed to include diametrically opposed longitudinally extending grooves 20 for receiving the rods 15 of the medium size grid elements 14.

As seen in Fig. 1, the concentric members 17 and 18 are adapted for being positioned seriatim, by means which will also be described in detail hereinafter, first at a pickup station designated 22 at which the smallest grid elements 19 may be positioned in axial alignment with the members 17 for being drawn thereinto in the manner shown in Figs. 7 and 10, then at a position in vertical alignment with one of the members 13 on the second head 3 in the manner also shown in Fig. 7 for receiving a medium size grid element 14 over the member 18 and one of the largest grid elements 9 over the member 17 in the manner shown in Fig. 11. Thus, it will be seen that the multiple grid elements will be fully assembled on the head 4 from which they may be taken off at the horizontal position opposite the pickup position 22 or dropped off the lower vertical position.

The turntables or pickup heads 2, 3 and 4 are all adapted for being driven and positioned at the various operating positions thereon by a drive mechanism common to all the pickup heads which comprise a single Geneva movement arrangement generally designated 23 in Fig. 4. The arrangement 23 includes a Geneva wheel 24 secured on the extremity of the stub shaft 5 secured to the second pickup head 3 and extending through the base plate 1 on the opposite side of the head 3. The Geneva wheel 24 includes 4 equally spaced radially extending open-end slots for cooperating in a conventional manner with a stud 25 carried on a drive member 26 secured on a drive shaft 27. Means not shown is provided for rotating the drive shaft 27 counterclockwise in Fig. 4 and upon rotation thereof the stud 25, which is eccentrically disposed relative to the shaft, engages the slots in the Geneva wheel 24 and causes the pickup head 3 to rotate counterclockwise in Fig. 1 with an intermittent movement whereby the pickup members 13 thereon are caused to be positioned and to dwell seriatim at the pickup station 16 and the vertical position in which they cooperate with the pickup members on the first and third heads 2 and 4.

Secured on the stub shaft 5 of the second head 3 between the Geneva wheel 24 and the base plate 1 is a drive gear 28. The drive gear 28 meshes with both a driven gear 29 secured on the stub shaft 5 of the first pickup head 2 and an identical driven gear 30 secured on the stub shaft 5 of the third head 4. Thus, the first head 2 and the third head 4 are both caused to rotate clockwise intermittently in Fig. 1 when the second pickup head is rotated in the manner described above whereby the pickup members thereon are caused to be positioned and dwell at their respective pickup stations and at their vertical cooperating positions with respect to the pickup members on the intermediate or second head 3.

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As seen in Figs. 3, 4 and 13, means is provided for controlling the energization of the electromagnets carried by the several pickup heads thereby to control the operation of the device in automatically effecting assembly of multiple grids. This means comprises an electric switching circuit mounted with said pickup head which includes a conductive annulus 31 fixedly disposed between each of the pickup heads and the base plate. Each annulus 31 is connected by a terminal 32 which is secured in the side of the annulus and extends through the insulative base plate 1 to a line 33 which in turn is connected to one side of the secondary coil 34 of a transformer generally designated 35. The transformer 35 is adapted for being connected to any suitable power source (not shown).

As best seen in Fig. 3 each of the pickup heads carries four equally spaced contact brushes 36 adapted for engaging and making an electrical contact with one of the annuli 31. As seen in Fig. 13 the brushes 36 are each connected by a lead 37 to one side of a coil 38 of a respective one of the electromagnets 7 carried by the heads. The other sides of the four coils 38 in each pickup head are each connected by a lead 39 to one of four other contact brushes 40 arranged to cooperate with a second and larger annulus 41. Each annulus 41 comprises three conductive segments of different lengths and suitably insulated from each other. The segments designated 42 are the shortest. The segments 42 of the annuli associated with the first and second heads are electrically connected by means of terminals 43, which are secured thereto and extend through the base plate 1, to a line 44 which in turn is connected to one side of both a first switch 45 and a second switch 46. The segment 42 of the annulus associated with the third head is electrically connected by means of a terminal 43 to another line 47 which is also connected to both the first switch 45 and the second switch 46 in the same manner as the line 44.

The other side of the first switch 45 is connected to a tap 48 connected intermediate the ends of the secondary coil 34 of the transformer 35. The other side of the second switch 46 is connected to the side of the secondary coil 34 of the transformer 35 opposite the line 33. Both of these switches are controlled by a single contact member 49 which is adapted for being operated by a normally deenergized solenoid 50 and is normally biased to a position in which it effectively closes the first switch 45 and opens the second switch 46. Thus, it will be seen that as each pickup member is moved into position and dwells at its respective pickup station the associated brushes 36 and 40 thereof concurrently engaged the inner annulus 31 and the shortest segment 42 of the associated outer annulus whereby a circuit is completed through the coil of the respective one of the electromagnets 7, the first switch 45 and a portion of the secondary coil 34 of the transformer 35. As a result a predetermined low voltage is supplied to the electromagnets at the pickup stations and these magnets are energized to a predetermined low degree of energization. At a predetermined time during the dwell of these members at the pickup stations timing means (not shown) is effective for momentarily closing a switch 51 for energizing the solenoid 50 thereby to actuate the contact member 49 for opening the first switch 45 and closing the second switch 46. Thus circuits are completed through the several electromagnets at their respective pickup stations and all of the secondary coil 34 of the transformer 35 whereby these magnets are relatively highly energized. When so energized, the member 8 at pickup station 12 is effective for drawing one of the large size grid elements 9 thereover in the manner shown in Fig. 5, the member 13 on the second head 3 is effective for drawing one of the medium size grid elements 14 thereinto and the member 18 at the pickup station

22 is effective for drawing thereinto one of the small size grid elements 19.

The segment designated 52 of each annulus 41 is the longest and is electrically connected by means of terminals 53, which are secured thereto and extend through the base plate, to a line 54 connected both to the tap 48 on the secondary winding of the transformer 35 and the side of the first switch 45 opposite the line 44. Thus when the switch 45 is normally closed and the two contact brushes 36 and 40 of an electromagnet are concurrently engaged with the annulus 31 and the segment 52 of an annulus 41, a circuit is completed through that electromagnet and a portion of the secondary winding 34 of the transformer, thereby to effect the same predetermined relatively low degree of energization of the electromagnet effected when the electromagnet is initially positioned at the various pickup stations. It will be clearly seen from Fig. 13 that the segments 52 are of such length that each electromagnet will be energized in the just described manner from the time that the switch 51 opens until the time the pickup member moves to its downwardly extending vertical position. Thus the grid elements picked up at the various pickup stations are held on or in their respective members, as the case may be, during rotation of the pickup heads.

When the members are in their downwardly extending vertical positions, the brushes 40 associated therewith engage the medium length segments 55 of the outer annuli 41. Segments 55 each include a terminal 56 secured thereto and extending through the base plate 1. Segments 55 are all suitably electrically connected to one side of a switch 57. The other side of the switch 57 is connected to the line 44. The switch 57 is controlled by the above mentioned timing means (not shown) and is adapted for remaining closed until the switch 51 is opened. Therefore, normally, when an electromagnet 7 is so positioned that its brush 40 is in engagement with a segment 55, a circuit is completed through its coil 38 and through the above mentioned portion of the secondary winding of the transformer 35 and a relatively low degree of energization of the electromagnet is effected. However, at a predetermined time during the positioning of each electromagnet at its downwardly extending vertical position and at precisely the same time the preceding electromagnets are highly energized for drawing grid elements from the various pickup stations, the switch 57 is opened and momentarily the electromagnets in the lower positions are deenergized, permitting the grid elements thereon and therein to fall freely. In summary, the operation of my device is such that as each pickup member is positioned at its respective pickup station, its corresponding electromagnet is momentarily relatively highly energized in the above described manner for drawing thereinto or thereover, as the case may be, a grid element from its pickup station. The members 8 on the first head 2 draw thereover the large size grid elements 9. The tubular members 13 on the second head 3 draw thereinto the medium size grid elements 14 and the tubular members 18 on the third head 4 draw thereinto the small size grid elements 19. Subsequently, each pickup member is moved to its downwardly extending vertical position during which movement its corresponding electromagnet is energized to a lesser degree adequate for retaining its picked up grid element but insufficient for deforming it. In its downwardly extending vertical position the corresponding electromagnet of each pickup member is momentarily deenergized for permitting the grid element carried thereby to fall freely. As best seen in Fig. 5 when a pickup member 8 on the first head 2 is in its downwardly extending vertical position it is positioned above and in axial alignment with a pickup member 13 on the second head 3 and containing a previously picked up medium size grid element 14. Thus, when the grid

element 9 is permitted to fall it falls over the member 13 and the elements 9 and 14 are thereby concentrically arranged or assembled. The grid elements 9 and 14 are held in this arrangement on the member 13 magnetically until the member 13 is moved to its downwardly extending vertical position in the manner shown in Figs. 1 and 7. In this position its corresponding electromagnet is momentarily deenergized in the above described manner whereby both the large grid element 9 and the medium element 14 are permitted to fall freely, the large element 9 falling over an axially aligned pickup member 17 on the head 4 and the medium size grid element 14 falling over the member 18 concentrically disposed in the member 17. The member 18 at this position contains a previously picked up small sized grid element 19 and thus the large, medium and small grid elements are concentrically arranged or assembled. The elements are retained thus assembled by the corresponding electromagnet until they assume the downwardly extending vertical position best shown in Figs. 1 and 11. In this position the corresponding electromagnet is deenergized and the three grid elements are dropped in assembled form into suitable receiving means such as a mica insulating disc designated 58 in Fig. 1 and preperforated for receiving the support rods of the several grid elements thereby to maintain the spacing between the rods and therefore between the assembled grid elements. It will be seen that the disc 58 can be placed on the ends of the grid rods before the related electromagnets are deenergized and thus the grid elements will be in assembled form with the rod ends thereof fitted in the disc 58 when the grid elements are released.

It will be seen further that while I have provided means for automatically assembling multiple grids utilizing electromagnetic forces, other means could alternatively be used for drawing the grid elements into and onto the several pickup members. For instance, vacuum means could alternatively be employed.

While I have shown and described a specific embodiment of my invention, I do not desire my invention to be limited to the particular form shown and described, and I intend by the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a device for assembling a plurality of concentrically arranged tubular elements, a first rotatably mounted turntable having at least one pickup member adapted for receiving a first tubular element, a second rotatably mounted turntable having at least one pickup member adapted for receiving a second tubular element having a diameter different from said first tubular element, said second turntable being disposed adjacent said first turntable with a pickup member thereof axially alignable with a pickup member on said first turntable, and means effective for drawing the first tubular element from the pickup member on said first turntable onto the axially aligned pickup member on said second turntable whereby said first and second tubular elements are concentrically arranged on the pickup member of said second turntable.

2. In a device for assembling a plurality of concentrically arranged tubular elements, a first rotatably mounted turntable having at least one pickup member adapted for receiving a first tubular element, a second rotatably mounted turntable having at least one pickup member adapted for receiving a second tubular element having a diameter different from said first tubular element, said second turntable being disposed adjacent said first turntable with a pickup member thereof axially alignable with a pickup member on said first turntable, and means for effecting release of the first tubular element from the pickup member on said first turntable, means for drawing the released first tubular element onto the axially aligned pickup member on said second turntable holding

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said second tubular element whereby said first and second tubular elements are concentrically arranged on the pickup member of said second turntable, and means for effecting release of both said tubular elements from said second turntable in concentric arrangement.

3. The combination set forth in claim 2 further characterized by electromagnets secured adjacent each of said pickup members for drawing the tubular elements onto said pickup members, retaining the elements in position on the pickup members, and effecting release of the elements from said pickup members.

4. The combination set forth in claim 2 further characterized by a drive mechanism common to both said first and second turntables for rotating the turntables in synchronism, electromagnets secured adjacent each of said pickup members for drawing the tubular elements onto the pickup members, retaining the tubular elements into position on the pickup members, and effecting release of the tubular elements from the pickup members, and electric switching circuits mounted on each of said turntables and actuated thereby for sequentially energizing said electromagnets in accordance with a preselected program.

5. The combination set forth in claim 2 further characterized by electromagnets secured adjacent each of said pickup members for drawing the grid elements onto said pickup members, retaining the grid elements in position on the pickup members, and effecting release of the grid elements from said pickup members.

6. In a device for assembling concentrically arranged helically coiled grid elements, a first rotatably mounted turntable having at least one pickup member adapted for receiving a first grid element, a second rotatably mounted turntable having at least one pickup member adapted for receiving a second grid element having a diameter different from said first grid element, said second turntable being disposed adjacent said first turntable with at least one pickup member thereof axially alignable with a pickup member of said first turntable, and means effective for drawing a first grid element from the pickup member of said first turntable onto the axially aligned pickup member of said second turntable whereby said grid elements are concentrically arranged on said second turntable.

7. In a device for assembling concentrically arranged helically coiled grid elements a first rotatably mounted turntable having at least one pickup member adapted for receiving a first grid element, a second rotatably mounted turntable having at least one pickup member adapted for receiving a second grid element having a diameter different from said first grid element, said second turntable being disposed adjacent said first turntable with at least one pickup member thereof axially alignable with a pickup member of said first turntable, and means for effecting release of the first grid element from the pickup member of said first turntable, means for drawing the released first grid element onto the axially aligned pickup member of said second turntable holding the second grid element whereby said grid elements are concentrically arranged on the pickup member of said second turntable, and means for effecting release of both said grid elements from said second turntable in concentric arrangement.

8. The combination set forth in claim 7 further characterized by a drive mechanism common to both said first and second turntables for rotating the turntables in synchronism, electromagnets secured adjacent each of said pickup members for drawing the grid elements onto the pickup members, retaining the grid elements in position on the pickup members, and effecting release of the grid elements from the pickup members, and electric switching circuits mounted with each of said turntables and actuated thereby for sequentially energizing said electromagnets in accordance with a preselected program.

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9. In a device for assembling a plurality of concentrically arranged helically coiled grid elements, a first rotatably mounted turntable having at least one pickup member adapted for receiving a first grid element, a second rotatably mounted turntable having at least one pickup member adapted for receiving a second grid element having a diameter different from the diameter of said first grid element, said second turntable being disposed adjacent said turntable with a pickup member thereof axially alignable with a pickup member of said second turntable, a third rotatably mounted turntable having at least one pickup member adapted for receiving a third grid element having a diameter different from the diameters of said first and second grid elements, said third turntable being disposed adjacent said second turntable with a pickup member thereof axially alignable with a pickup member of said second turntable, means for effecting release of the first grid element from the pickup member on said first turntable, means for drawing the released first grid element from said first turntable onto an axially aligned pickup on said second turntable having a second grid element thereon whereby said tubular elements are concentrically arranged on said second turntable, means for rotating said turntables to bring the pickup member having said concentrically arranged first and second grid elements thereon into axial alignment with a pickup member on said third turntable having a third grid element thereon, means for combining the first and third grid elements concentrically arranged on said second turntable onto one of the axially aligned pickup members with said third grid element whereby all of said grid elements are concentrically arranged on a single pickup member, and means for effecting release of all said concentrically arranged first, second and third grid elements from said third turntable in concentric arrangement.

10. The combination set forth in claim 9 further characterized by electromagnets secured adjacent each of said pickup members for drawing the grid elements onto said pickup members, retaining the elements in position on the pickup members, and effecting release of the element from said pickup members.

11. The combination set forth in claim 9 further characterized by a drive mechanism common to all of said rotatably mounted turntables for rotating the turntables in synchronism, electromagnets secured adjacent each of said pickup members for drawing the grid elements onto the pickup members, retaining the grid elements in position on the pickup members, and effecting release of the grid elements from the pickup members, and electric switching circuits mounted with each of said turntables and actuated thereby for sequentially energizing said electromagnets in accordance with a preselected program.

12. In a device for assembling a plurality of concentrically arranged helically coiled grid elements, a first rotatably mounted turntable having at least one pickup member adapted for receiving a first grid element, a second rotatably mounted turntable having at least one pickup member adapted for receiving a second grid element having a diameter different from the diameter of said first grid element, said second turntable being disposed adjacent said first turntable with a pickup member thereof axially alignable with a pickup member of said second turntable, a third rotatably mounted turntable having at least one pickup member adapted for receiving a third grid element having a diameter different from the diameters of said first and second grid elements, said third turntable being disposed adjacent said second turntable with a pickup member thereof axially alignable with a pickup member of said second turntable, means for effecting release of the first grid element from the pickup member on said first turntable, means for drawing the released first grid element from said first turntable onto an axially aligned pickup member on said second turntable having a second grid element thereon whereby said tubular elements are concentrically arranged on said second turn-

table, means for rotating said turntables to bring the pickup member having said concentrically arranged first and second grid elements thereon into axial alignment with a pickup member on said third turntable having a third grid element thereon, means for effecting release of the concentrically arranged first and second grid elements from the pickup member on said second turntable, means for drawing the released concentrically arranged grid elements onto said axially aligned pickup member on said third turntable whereby all of said grid elements are concentrically arranged on said third turntable, and means for effecting release of all said concentrically arranged first, second and third grid elements from said third turntables in concentric arrangement.

13. The combination set forth in claim 12 further characterized by electromagnets secured adjacent each of said pickup members for drawing the grid elements onto said pickup members, retaining the elements in position on the pickup members, and effecting release of the elements from said pickup members.

14. The combination set forth in claim 12 further char-

acterized by a drive mechanism common to all said rotatably mounted turntables for rotating the turntables in synchronism, electromagnets secured adjacent each of said pickup members for drawing the tubular elements onto the pickup members, retaining the grid elements in position on the pickup members, and effecting release of the grid elements from the pickup members, and electric switching circuits mounted with each of said turntables and actuated thereby for sequentially energizing said electromagnets in accordance with a preselected program.

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