

May 23, 1961

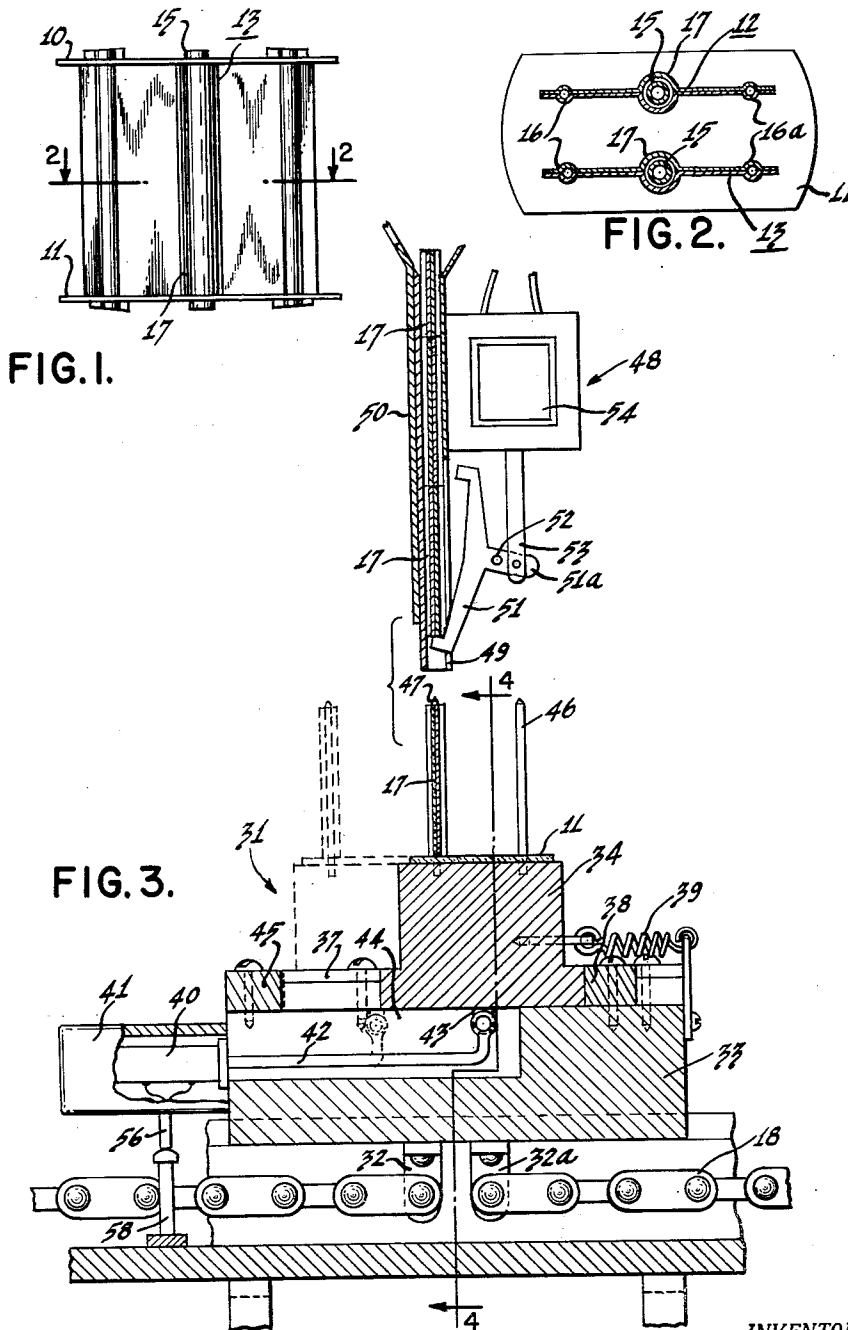
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2,984,891

AUTOMATIC ELECTRON TUBE CAGE ASSEMBLING APPARATUS AND METHOD

Filed Dec. 13, 1957

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

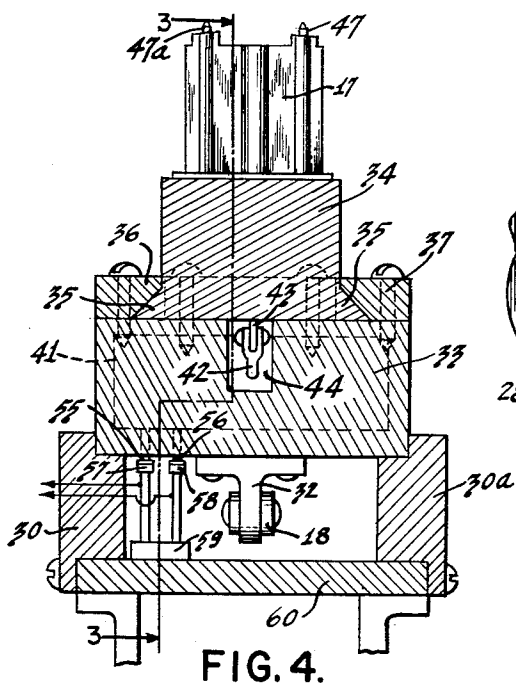


FIG. 4.

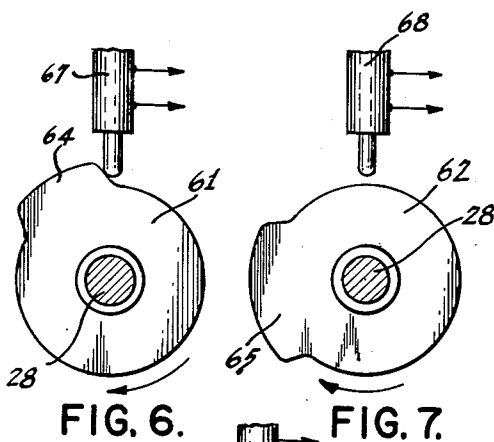


FIG. 6.

FIG. 7.

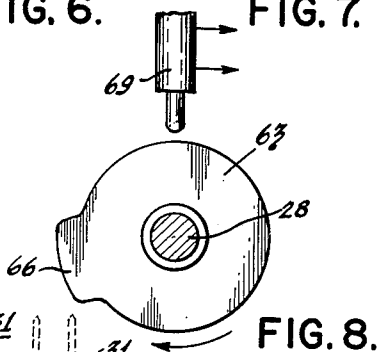


FIG. 8.

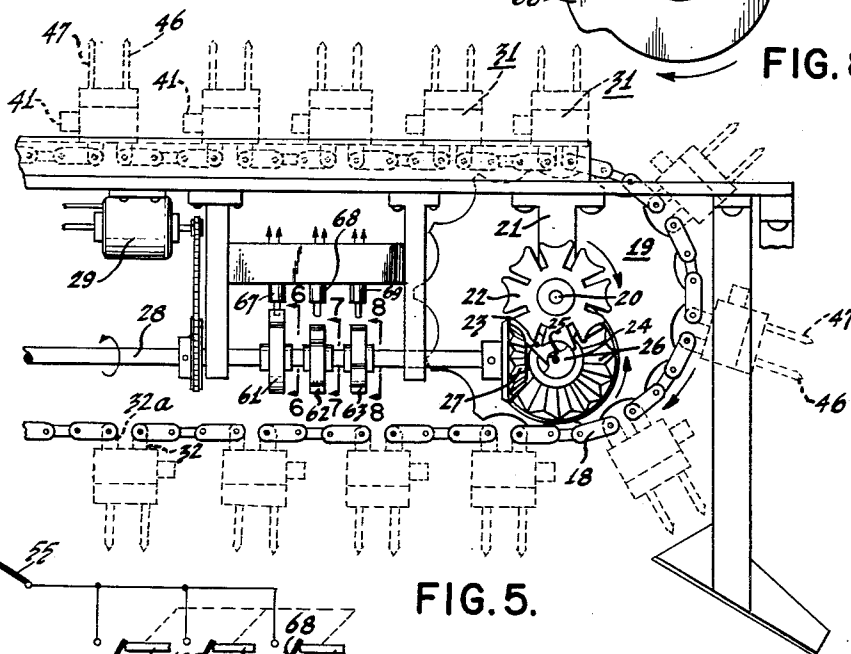


FIG. 5.

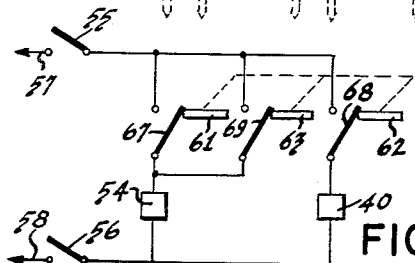


FIG. 9.

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1

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AUTOMATIC ELECTRON TUBE CAGE ASSEMBLING APPARATUS AND METHOD

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4 Claims. (Cl. 29—25.13)

The present invention relates to a method of and apparatus for assembling electron tube parts, and particularly to an apparatus and method for assembling such parts to form an electron tube cage having two electrode assemblies in side by side relation.

An electron tube cage is a structure comprising a complement of electrodes suitably supported in spaced relation by two spaced parallel mica plates, for example. Some electron tube cages comprise only one electrode assembly, consisting for example of one each of a cathode, grid and anode. Other cages comprise two electrode assemblies in side by side relation. For example, a cage of the latter type may comprise two triode assemblies supported on common mica plates in laterally spaced relation. When a cage of this kind is incorporated in an electron tube, the tube is capable of performing dual functions.

Apparatus and method for automatically assembling parts to form a cage having a single electrode assembly are known. One apparatus of this type for assembling parts to form a diode cage, is shown in copending application Serial No. 218,838, filed April 2, 1951, and another apparatus for this kind for assembling a triode cage is shown in copending application Serial No. 407,758 filed February 2, 1954. Both of the applications referred to have been assigned to the assignee of the present application.

While it is feasible to employ either of the machines described in the applications aforementioned to assemble a cage having two electrode assemblies, costly and objectionable revision of the machines would be necessary. Thus, if two triode assemblies are to be mounted to form a single cage, the facilities on the machine for loading a cathode, grid and anode would have to be doubled. That is to say, while the loading stations presently provided on the machine shown in application Serial No. 407,758 are adequate for loading a cathode, grid and anode, besides the two mica plates referred to, to form one triode assembly, additional loading stations would be necessary for loading the cathode, grid and anode of the second triode assembly. Not only would the addition of such facilities be costly, but it would be objectionable from the standpoint of additional space requirements.

It is therefore, an important object of the invention to facilitate the automatic assembly of an electron tube cage having two electrode assemblies.

A further aim is to provide an assembling apparatus adapted to assemble an increased number of parts without requiring an increase in the number of loading stations.

Another purpose is to provide a novel method and apparatus for loading two parts in differently oriented positions at a single loading station.

A feature of the invention resides in a build-up jig having thereon two groups of build-up elements spaced in a predetermined plane, and movable not only from

2

one loading station to another to dispose one of said groups of build-up elements in register with a loading member, but also movable in said plane at a loading station to dispose the other of the groups of build-up elements in register with the aforementioned loading member. The jig referred to therefore, renders it feasible to load two work pieces in differently oriented positions at one loading station.

More particularly, this feature concerns a build-up jig comprising a movable support and a carriage or slide movable on the support. Means connected to the support is adapted to move the support and the carriage thereon as a unit to dispose a first portion of the carriage in register with a loading member. Other means connected to the carriage is adapted to move it in relation to the support, for disposing a second portion of the carriage in register with the loading member referred to.

A further feature resides in a desired correlation of the loading member to the movements of the support and carriage, so as to assure a loading by said member of two parts on spaced regions of the carriage.

Further objects and features of the invention will become evident as the present description proceeds.

Referring now to the drawing for a detailed consideration of an embodiment of the invention,

Fig. 1 shows a front elevation of an electron tube cage having two electrode assemblies, the parts of which are adapted to be assembled by the method and apparatus of the invention;

Fig. 2 is a sectional view along line 2—2 of Fig. 1, and shows the electrode complement of the electrode assembly of Fig. 1;

Fig. 3 is a side elevational view, partly in cross-section, of a portion of an automatic assembling apparatus according to the invention;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary side elevational view of another portion of the apparatus according to the invention, and depicts power transfer and control features thereof;

Figs. 6, 7, and 8 are views partly in section along lines 6—6, 7—7, and 8—8 respectively of Fig. 5, and show control features of the apparatus in greater detail; and

Fig. 9 is a schematic diagram showing the relationship between the control features and the apparatus elements controlled thereby.

According to the invention, an apparatus and method are provided for automatically assembling or mounting electron tube parts to form an electrode cage of the multi-electrode-assembly variety. One type of such cage is shown in Fig. 1. The cage comprises upper and lower mica spacer plates, 10, 11, between which similar electrode assemblies 12, 13, shown in Fig. 2, are mounted in side-by-side relation. Each electrode assembly as shown in Fig. 2, includes a sleeve type cathode 15, and a tubular anode 17. As shown in Fig. 1, end portions of these electrodes extend through the plates 10, 11 for anchoring the electrodes thereto. Each anode 17 includes two side wings having channels 16, 16a therein.

While the invention will be described in connection with an apparatus and method for assembling parts to form a double diode type of electron tube cage, as shown in Figs. 1 and 2, it is not restricted to this utility. Indeed, the invention may be employed in apparatus for assembling parts to form any type of electrode cage having two electrode assemblies in side-by-side relation. For example, the invention may be incorporated in apparatus for assembling parts to form a double triode.

For simplicity in presentation, the embodiment chosen for illustration will be described in relation to one as-

sembling station of an automatic assembling apparatus of the type shown in the aforementioned applications Serial No. 218,838 and 407,758. The assembling station selected for illustration is the station at which a tubular anode is loaded. Both of the applications referred to provide for the automatic loading of an anode of this type.

It should be noted, however, that the invention may also be utilized for assembling parts other than an anode. For example, the invention may be employed at a station for assembling a sleeve type cathode in the apparatus described in application Serial No. 218,838, and at the stations for assembling a cathode and grid shown in application Serial No. 407,758. Where the cage is of a type that requires only one top and bottom mica spacer plate, it is feasible according to the invention to restrict spacer plate loading stations to load one top and bottom spacer plate, while the other stations load two each of the electrodes required for a particular double assembly cage. However, where two or more spacer plates are required at one end of a cage, it is feasible to mount them in accordance with the invention.

Thus, only the anode assembling or loading station of an apparatus incorporating the invention will be described, since application of the invention to other loading stations, such as those at which other cage parts are loaded, will be appreciated readily. That is to say, the principles involved are substantially the same no matter what type of part it is desired to load and assemble.

A description of the anode assembling station of an apparatus incorporating the invention, will involve consideration of (1) an intermittently movable carrier, (2) a build-up jig mounted on the carrier and on which the parts to form a cage of the double assembly variety are received in a predetermined order, (3) a loading mechanism for loading anodes, and (4) a correlating system for providing desired co-action among the carrier, the build-up jig and the loading mechanism in an assembling operation.

The carrier

The carrier or conveyor utilized in practicing the invention is shown in Figs. 3 and 5. The carrier includes an endless chain 18 mounted on two sprocket wheels, one of which, 19, is shown in Fig. 5. The sprocket wheel 19 is fixed to a shaft 20, which rides in a suitable bearing, not shown, supported by a bracket 21. Also fixed to shaft 20 is a Geneva gear 22 mounted in operative relation with respect to a driving pin 23 and a locking member 24. The pin 23 and member 24 are in fixed relation with respect to a shaft 25. Also, fixed to shaft 25 is a bevelled gear 26 meshing with a bevelled gear 27 fixed to a shaft 28. A motor 29 is connected to the shaft 28 for rotating the same in the direction of the arrow encircling shaft 28.

Continued rotation of the shaft 28 by motor 29, causes intermittent rotation of sprocket wheel 19, through the bevelled gears 27, 26, and the Geneva assembly comprising gear 22, pin 23 and locking member 24. Such intermittent movement is in turn transferred to the endless chain 18 carried by the sprocket wheel referred to. The magnitude of this intermittent movement is of a predetermined value for a purpose that will become apparent in the following. This movement will also be transmitted to a build-up jig to be described.

To supplement the chain 18, a track comprising spaced rails 30, 30a as shown in Fig. 4, may be provided for engaging the build-up jig to be described, during its travel in a rectilinear path along the upper course of chain 18.

The build-up jig

A plurality of spaced build-up jigs 31 are mounted on chain 18 for movement therewith and on rails 30, 30a. As shown in Figs. 3 and 5, each jig includes two spaced lugs 32, 32a engaging adjacent links of the chain, to

permit the jig to follow the curved and rectilinear paths of the chain with reduced strain.

Each build-up jig 31 comprises a structure including a support or track member 33, shown in Figs. 3 and 4, and a carriage or slide 34 movable on the support referred to. The support 33 engages the carriage 34 in dove-tail fashion by means of bevelled portions 35 on the carriage and the bevelled plates 36, 37, fixed to the support 33, as shown in Fig. 4. The carriage 34 is normally held against an abutment 38 fixed to the support, by means of a spring 39. For moving the carriage 34 to the left as viewed in Fig. 3, a solenoid 40 mounted in a housing 41 fixed to support 33, is provided with a piston or plunger 42 engaging a bracket 43 depending from the carriage into a cavity 44 in the support referred to. Retraction of the plunger 42 into the solenoid will therefore cause the carriage 34 to slide to the left between the aforementioned bevelled plates 36, 37, shown in Fig. 4. The magnitude of movement of the carriage 34 to the left as viewed in Fig. 3, is determined by a stop 45 fixed to support 33 and bridging the cavity 44. This magnitude is critical, as will be clear from the following.

Mounted on and extending upwardly from carriage 34 as viewed in Fig. 3, are two groups 46, 47 of mandrels adapted to receive the parts to be loaded. While each group is shown as constituted of two mandrels, one group 47, 47a being shown in Fig. 4, it is to be understood that an adequate mandrel complement is provided in each group for satisfying the build-up requirements of any desired electrode assembly.

As will be evident from Fig. 3, the carriage 34 is movable on support 33 in a path parallel to the chain 18. The mandrel groups 46, 47 aforementioned are spaced along said path a distance required to separate the centers of the two electrode assemblies to be assembled. This distance is equal to the magnitude of movement of carriage 34 on support 33 aforementioned as determined by the spacing between stops 38 and 45. This correlation between the length of movement of the carriage 34 on support 33 and the spacing between mandrel groups 46, 47, permits the loading of two similar parts on the mandrel groups by a fixed loading mechanism to be described.

The loading mechanism

The fixed loading mechanism 48 as shown in Fig. 3, includes a vertically oriented chute 49 mounted on a fixed support 50, which may be part of a fixed hopper, not shown. The chute is adapted to hold a plurality of parts such as anodes 17, in a vertical array. For dispensing the anodes one at a time, a tripping mechanism is provided, including a U-shaped tripping member 51 having a shank 51a pivotally mounted intermediate its ends at 52 to a support not shown, and pivotally connected at its free end to plunger 53 extending from solenoid 54. A retraction of the plunger 53 will cause the tripping member to rotate in a counterclockwise direction for releasing the lowermost anode 17 and engaging the next lowermost anode for restraining a fall thereof. Subsequent outward movement of the plunger 53 will rotate the tripping member 51 in a clockwise direction for disposing the now lowermost anode in position for release on a subsequent retraction of the plunger. The plunger 53 is urged by means not shown, to outwardly extended position. Thus, a momentary energization of solenoid 54 will cause the tripping member 51 to proceed through the cycle of movements aforementioned.

The correlating system

It is important that the several movements of the carrier, the build-up jig, and the loading mechanism take place in a predetermined order for appropriate loading of two similar parts in differently oriented positions on the jig for providing two spaced electrode assemblies.

The first established correlation is between the fixed

5

position of chute 49 of the loading mechanism and the position successively assumed by the build-up jigs 31 during periods when the chain 18 is at rest between intermittent movements thereof. To this end, the chute 49 is so positioned as to be in accurate vertical register with mandrel group 47 as each successive jig 31 is momentarily stationary, as shown in Fig. 3. The positions of the gear 22 and locking member 24 of the Geneva assembly at the beginning of a stationary period of the chain 18, is shown in Fig. 5. At this time, a build-up jig 31 is in the position shown in Fig. 3. In this position, the carriage 34 engages abutment 38 and mandrel group 47 is directly below chute 49. Also, when in this position, contacts 55, 56 depending from housing 41, engage bus members 57, 58 respectively. Bus members 57, 58 are mounted on an insulating support 59 fixed to table 60, as shown in Fig. 4. Suitable leads shown in Fig. 9 connect the bus members referred to across an appropriate power source, not shown.

Subsequent correlations involve (1) first the release of a first anode from the loading mechanism 48, (2) then movement of the carriage 34 to the left and against stop 45, as shown in Fig. 3, to dispose the second mandrel group 46 in vertical register with the chute 49, and (3) the release of a second anode by the chute referred to. The aforementioned three operations are so correlated to the operation of the Geneva assembly referred to, that they all take place during the interval that the locking member 24 engages Geneva gear 22 for locking the same. During this interval, shaft 28 rotates through an arc of approximately 180°.

The subsequent correlations referred to are controlled by three cams 61, 62, 63, fixed to shaft 28 as shown in Figs. 5, 6, 7 and 8. Cams 61, 62, 63 are provided with raised dwells 64, 65, 66 for engaging and closing normally open switches 67, 68, 69, respectively. Dwell 64 is angularly spaced from dwell 65, and dwell 65 overlaps dwell 66 for a purpose to be described. The raised dwells referred to extend angularly through an arc less than 180°, so that their functions can be performed during an interval when the chain 18 is stationary.

The first of such subsequent correlations is controlled by cam 61, which is in the position shown in Fig. 6, at the start of a stationary interval of chain 18. Further rotation of shaft 28 in a clockwise direction as viewed in Fig. 6, will cause the upper dwell 64 to close switch 67. Switch 67 is connected across a circuit including contacts 55, 56 and the solenoid 54, as shown in Fig. 9. Closure of this circuit partly effected by engagements of bus members 57, 58 by contacts 55, 56, will result from a closure of switch 67, as a consequence of which the tripping member 51 will be actuated to release the lowermost of anodes 17. The released anode will then drop onto mandrel group 47 for appropriate orientation in a first electrode assembly being built up on this group. Still further rotation of shaft 28 will result in disengagement between the raised dwell 64 and the switch 67, with a consequent opening of the switch 67 and a return of the tripping member 51 to its initial position.

As soon as dwell 64 leaves switch 67, dwell 65 on cam 62 engages and closes switch 68 in a second of the aforementioned subsequent correlations. Switch 68 is connected across a circuit including contacts 55, 56 aforementioned and the solenoid 40, as shown in Fig. 9. Closure of switch 68 results in energization of solenoid 40 so that it retracts piston or plunger 42, thereby causing the carriage 34 to move to the left as viewed in Fig. 3, until it abuts against stop 45. In this position, the mandrel group 46 is in vertical register with the chute 49.

During further rotation of shaft 28 in a clockwise direction as viewed in Figs. 7 and 8, raised dwell 66 on cam 63 will engage and close switch 69 which is connected across the circuit energizing solenoid 54 and in parallel relation to the switch 67, as shown schematically in Fig. 9. When so energized, solenoid 54 will actuate

6

tripping member 51 for releasing a second anode from chute 49 in a third of the aforementioned correlations. The released anode will drop into engagement with mandrel group 46 directly below for suitable orientation in a second electrode assembly on this mandrel group.

It will be noted that the dwell 65 on cam 62 extends through an arc that overlaps and includes the arc of raised dwell 66 on cam 63. This assures that the carriage 34 continues to be held against stop 45 and in a position to dispose the mandrel group 46 in vertical register with chute 49, during the loading of the second anode.

Any desired number of build-up jigs and loading mechanisms may be controlled by the cams 61, 62, 63 by suitable parallel energizing circuits, not shown. Thus, a plurality of electrodes may be loaded simultaneously on spaced build-up jigs by the correlating system described in the foregoing as modified by the provision of additional parallel circuits for the added loading stations.

It will be apparent from the foregoing that an improved automatic assembling apparatus and method are provided.

What is claimed is:

1. An automatic assembling apparatus comprising a fixed loading mechanism, a build-up jig comprising a support movable in a rectilinear path and a carriage movable only in said rectilinear path on said support, means connected to said support for moving the same to a given position to dispose a first portion of said carriage in parts transfer register with respect to said loading mechanism, means for locking said support in said position, and means connected to said carriage for moving the same with respect to said support and while said support is locked against movement from said position, to dispose a second portion of said carriage in parts transfer register with respect to said loading mechanism.

2. Apparatus for assembling two similar parts in spaced relation, comprising a fixed loading member having a downwardly extending chute, a tripping member mounted across said chute and adapted to release one of said parts during a predetermined cycle of movement thereof, a carrier movable in a rectilinear path below said chute, a jig comprising a support and a carriage movable only in said rectilinear path on said support, said support being fixed to said carrier, means for moving said carrier in a horizontal rectilinear path in a plane including said chute, means for locking said carrier against movement when said carrier has moved a predetermined distance to dispose a first portion of said carriage in vertical register with said chute, means including a first cam for energizing said tripping member through said cycle of movement while said carrier is locked against movement, whereby one of said parts is released to said first position of said carriage, means connecting said carriage to said support for moving said carriage in said rectilinear path with respect to said support and said chute while said carrier is locked against movement, for disposing a second portion of said carriage in vertical register with said chute, and means including a second cam operable while said second portion is in said register for energizing said tripping member through a second cycle of said movement, for loading another of said parts to said second portion of said carriage.

3. A parts build-up jig comprising a support movable in a predetermined direction in a rectilinear path, two spaced stops fixed to said support, a track of predetermined length between said stops, a carriage mounted for sliding movement on said track and only in said rectilinear path, said carriage having a surface parallel to said track, two build-up members fixed to said surface and spaced in said rectilinear path a distance equal to said predetermined length, means for moving said support in said predetermined direction in said path on said track to a predetermined position and while said

carriage is in engagement with one of said stops, whereby one of said build-up members is in a predetermined part receiving position, means for moving said carriage in the opposite direction and in said rectilinear path on said track and against the other of said stops, for disposing the other of said build-up members in said part receiving position, and means locking said support in said position during the movement of said carriage thereon.

4. Method of mounting electrodes in side by side relation to provide an electrode cage having two electrode assemblies, said method comprising carrying a jig and support therefor to a predetermined location, loading one electrode on one portion of said jig, thereafter mov-

ing said jig directly to another predetermined location while restraining movement of said support from said location, and loading another electrode on another portion of said jig while said support is restrained from said movement.

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