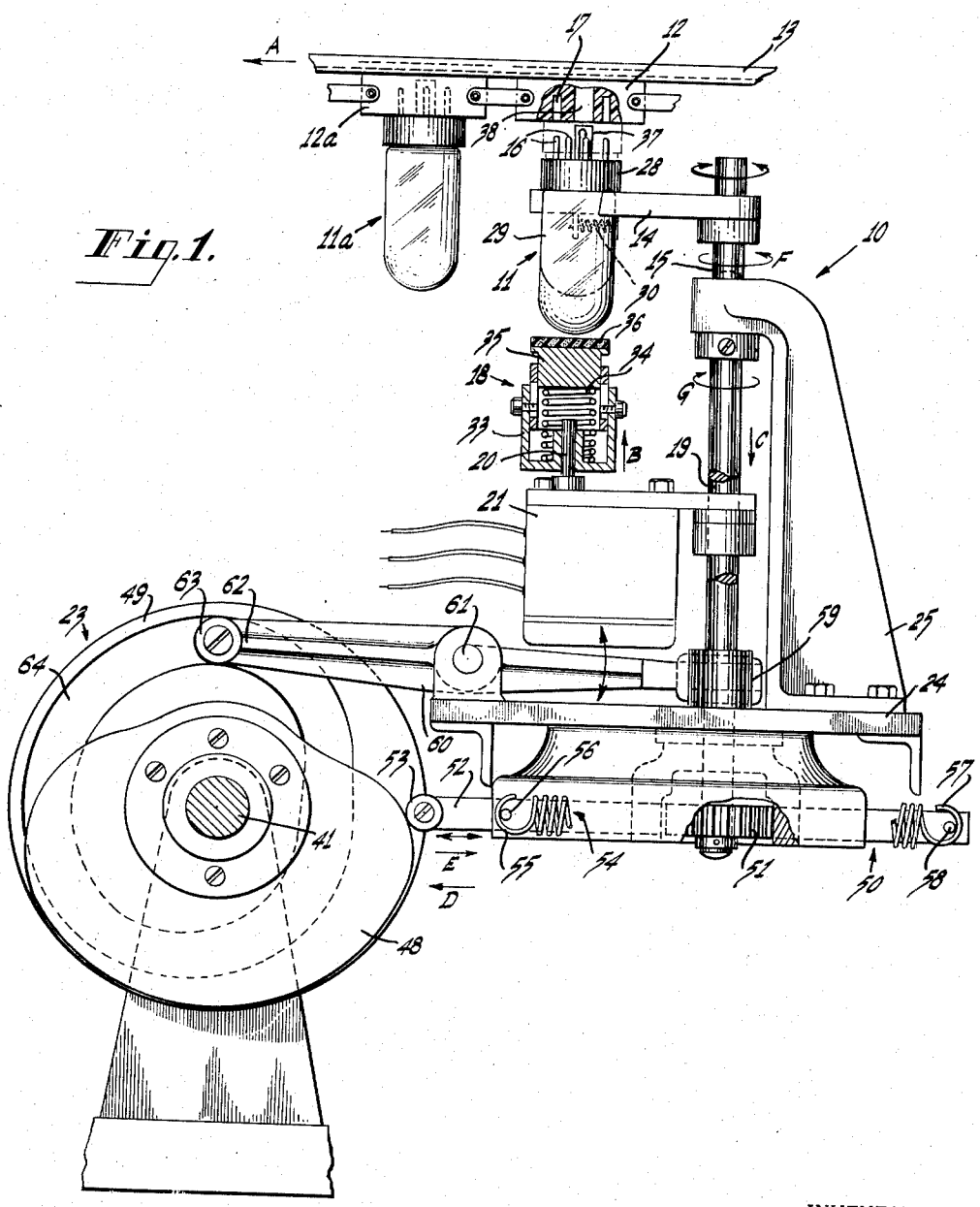
June 23, 1959 H. C. WALTKE 2,891,305

ELECTRON TUBE INSERTION APPARATUS

Filed Oct. 5, 1956

2 Sheets-Sheet 1

Fig. 1.



INVENTOR.
HENRY C. WALTKE
BY
William A. Zalesak
ATTORNEY

June 23, 1959 H. C. WALTKE 2,891,305

ELECTRON TUBE INSERTION APPARATUS

Filed Oct. 5, 1956

2 Sheets-Sheet 2

Fig. 2.

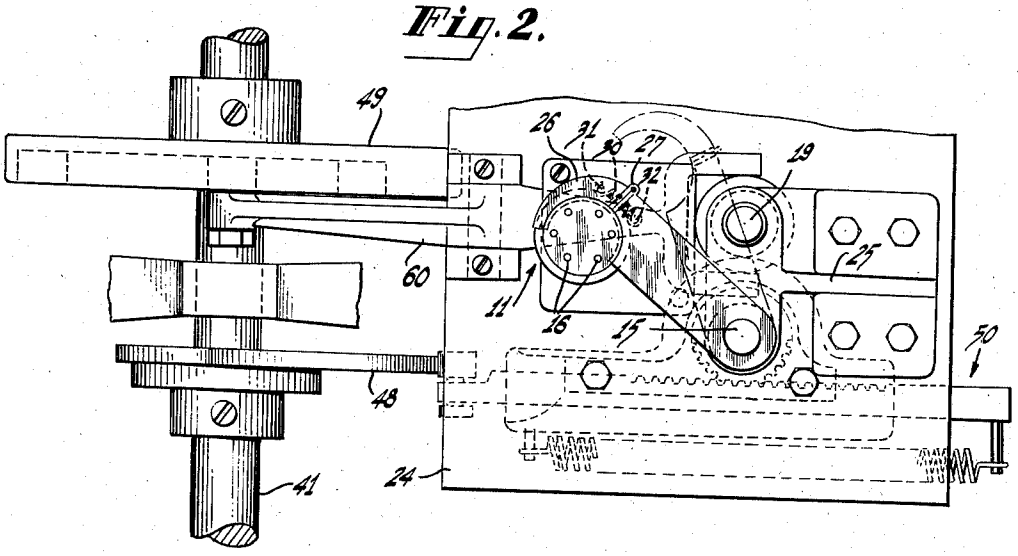
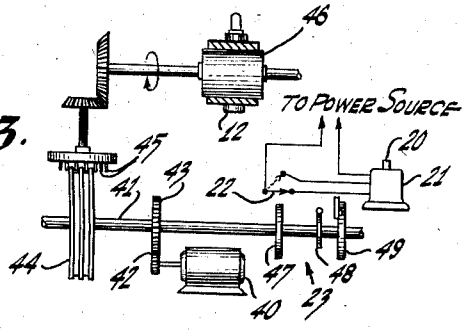


Fig. 3.



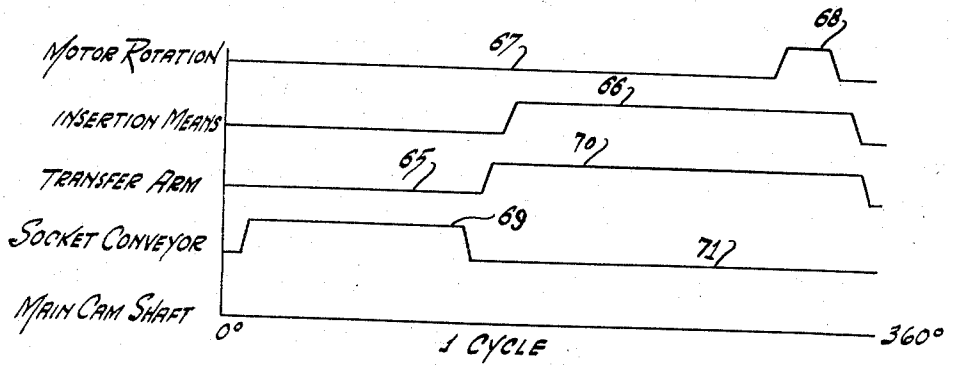


Fig. 4.

INVENTOR.
HENRY C. WALTKE
BY
William A. Zalesak
ATTORNEY

United States Patent Office 2,891,305
Patented June 23, 1959

2,891,305

ELECTRON TUBE INSERTION APPARATUS

Henry C. Waltke, New Providence, N.J., assignor to Radio Corporation of America, a corporation of Delaware

Application October 5, 1956, Serial No. 614,253

3 Claims. (Cl. 29—206)

This invention relates to apparatus for inserting pronged workpieces, such as electron tubes, into sockets and, while not limited thereto, is herein described as embodied in apparatus for inserting tubes of the keyed, octal base variety into test set sockets.

Such apparatus includes sockets having prong receiving apertures or passageways equal in number and similar in array to prongs extending from one end of an electron tube and a further aperture for receiving a locating prong also extending from the tube end referred to. Usually the locating prong is positioned in coaxial relation with the tube. Heretofore the insertion of such prongs into the socket apertures has involved application to the tubes of rotation on its major axis, in one direction only, while the tube was positioned to cause an end portion of the locating prong to coincide with or partly enter the further aperture referred to. At the same time a force was applied axially of the tube to urge further entrance of the locating prong into the further aperture. This procedure, however, did not always result in a desired entrance of the prongs into the apertures and, consequently, an improper test result was often obtained; in some cases the apparatus was also damaged.

An object of the invention is to provide improved electron tube insertion apparatus for fully seating electron tubes in sockets.

Another object of the invention is to provide improved apparatus for reducing frictional engagement of a tube prong with a prong receiving passageway in a socket, during the seating of the tube in the socket, for ensuring a complete engagement of the tube with the socket.

The foregoing and related objects are realized in accordance with the invention by the provision of improved apparatus for automatically inserting electron tubes into sockets therefor. The apparatus comprises (*a*) electron tube holding means adapted to be positioned adjacent to a socket into which a tube held by the means is to be inserted, (*b*) tube seating means mounted adjacent to the holding means for rotational movement and for movement in a direction toward the socket and adapted to engage a portion of the tube for disposing the tube in seatable relation with the socket, and (*c*) means connected to the tube seating means for rotating the same, successively, in opposite directions and for applying to the seating means a force in a direction urging the tube toward and into seated relation with the socket. Consequently, when a prong of the tube engages a portion of a socket passageway, and fails to desirably enter the passageway in response to rotation in one direction, the reversal in direction of rotation according to the invention will free the prong of engagement with the passageway portion referred to and will allow the tube to be completely seated in the socket.

In the drawing, wherein like numerals refer to like parts:

Figure 1 is a side elevational view of electron tube insertion apparatus according to the invention;

Figure 2 is a top plan view of a portion of the apparatus illustrated in Figure 1;

Figure 3 is a schematic illustration of portions of the driving mechanisms of the apparatus of Figure 1; and

Figure 4 is a chart illustrating the relative timing of the operation of various movable elements of the apparatus of Figure 1.

Referring to Figure 1, there is illustrated electron insertion apparatus **10** embodying the invention. Described generally, the apparatus **10** is adapted to insert tubes **11** into sockets **12** of testing apparatus of which there is shown only the tracks **13** along which the sockets **12** are moved, the sockets being moved along the tracks in direction A in conveyor-belt fashion. The testing apparatus may be any of the well known tube testing apparatus used in the art in which a plurality of the sockets **12** are connected for travel past a predetermined location in an endless path.

The apparatus includes electron tube holding means in the form of a tube transfer arm **14** fixed to a first shaft **15** (Figures 1 and 2) which is adapted to hold a tube **11** with the array of prongs **16** thereof in a position in axial register with the array of prong receiving passageways or apertures **17** of the socket into which the tube is to be inserted.

The apparatus also includes tube insertion or seating means **18**, fixed to a second shaft **19**, and mounted for rectilinear movement in direction B toward the socket **12**. The seating means **18** is also mounted for rotational movement by virtue of its being fixed to the motor shaft **20** of a reversible electric motor **21**.

The apparatus also includes rotating means. This means includes the motor **21** which is connected (Figure 3) to a cam actuated motor reversing switch **22** for causing the motor shaft **20** to rotate, successively, in opposite directions.

The foregoing holding means **16**, seating means **18**, and rotating means are connected to power transfer means **23** (Figure 3) to be described, for imparting to the holding means and the seating means desired movements during operation of the apparatus. The power transfer means engages the switch **22** for governing the direction of rotation of the rotating means aforementioned. The foregoing elements of the invention will be described in greater detail in the following.

As illustrated in detail in Figures 1 and 2 the apparatus includes a table **24** having an arm **25** fixed thereto. The first shaft **15** (to which the tube holding arm **14** is fixed) is journaled in one portion of the arm **25** and in a portion of the table **24** for rotational movement. The second shaft **19** (on which the seating means **18** is mounted) is journaled in another portion of the arm **25** for axial movement. The arm **14** aforementioned is fixed to the upper portion of the first shaft **15**. The arm **14** has a spring biased, hinged jaw **26** (Figure 2) mounted on a hinge **27** for yieldably gripping a tube **11** therein. The jaw **26** supports a tube in a prongs-up position by engaging a lowermost edge of a base **28** of the tube **11** as shown in Figure 1, the base **28** of the tube having a larger diameter than that of the glass envelope portion **29** of the tube. A spring **30** (Figure 2) is secured to pins **31** and **32** on opposite sides of the hinge **27** for biasing the jaw to support a tube therein without the necessity for adjusting the jaw to small differences in tube diameter. Another advantage of the hinged jaw arrangement is that it allows a tube to be slippingly moved in the jaw both upwardly (in Figure 1) and rotationally, a further advantage is that the jaw opens against the force of the spring **30** by the pressure of the tube against the jaw when the tube **11** is carried to a successive position along the conveyor tracks **13**. In one angular position of the first shaft **15**, for example, the position of the arm **14**

and the shaft 15 shown in full in Figure 2, the arm 14 is disposed in a position such that the axis of a tube supported in the jaw is positioned in axial alignment with the tube seating means 18 and in axial alignment with the center of the array of apertures 17 in the socket 12 (Figure 1) into which a tube 11 held by the arm 14 is to be inserted. In another angular position of the arm 14 and the shaft 15, illustrated in phantom in Figure 2, the arm is disposed out of axial alignment with the tube seating means 18 and is in a position to receive a tube to be inserted into a socket. The tube to be inserted into a socket may be placed in the arm 14 (while the arm is in the phantom position of Figure 2) either manually or automatically as by being dropped into the jaw 26 from a suitably positioned chute (not shown).

The tube seating means 18 is comprised of a cup-shaped frame 33 fixed to the motor shaft 20. The frame 33 houses a compression spring 34 fixed at its lower end (in Figure 1) to the frame and free of the frame at its upper end. The spring 34 supports a generally cylindrical block 35. The block 35 is, consequently, floatingly supported by the spring 34 for movement in directions B and C. There is fixed to the top of the block 35 a resilient member 36, which may for example be a rubber pad, adapted to engage a portion of the tube 11 for urging the tube into seated relation with the socket 12 when the seating means is actuated.

The tube seating means 18, as described above, is mounted on the motor shaft 20. The motor 21 is mounted on the second shaft 19 for axial movement in directions B and C for applying to the seating means 18 a force in a direction urging the tube 11 toward the socket 12 while causing the tube to rotate. Consequently, when the first shaft 15 has been rotated in direction F into a position where the arm 14 has received a tube 11 to be inserted into the socket 12, the resilient member 36 is positioned below and in axial register with the tube supported by the arm 14. Also, when the second shaft 19 moves upwardly in direction B the tube seating means 18 is also moved upwardly urging the member 36 against the end of the tube 11 remote from the prongs 16 thereof. If, as is the usual case, the prongs of the tube 11 are not radially aligned wtih the apertures 17 of the socket 12, the tube 11 will be moved upwardly for a distance sufficient to allow a locating prong 37 of the tube to enter a further aperture 38 of the socket. The continued upward movement of the tube seating means 18 causes the spring 34 to be compressed providing potential energy for urging the tube completely into the socket (into the position illustrated in phantom in Figure 1) when the prongs are aligned with the apertures 17 in the socket.

The power transfer means 23 of the apparatus described is illustrated in Figures 1, 2, and 3. A main motor 40 (Figure 3) is geared to a power take-off shaft 41 as by gears 42 and 43. There is also mounted on the power take-off shaft 41 an intermittent drive cam 44 which engages drive pins 45 of conveyor apparatus 46 for intermittently moving an endless array of sockets 12 successively into tube receiving register with the tube seating means 18 (Figure 1). The power take-off shaft 41 also has three other cams 47, 48, and 49 mounted thereon for rotational movement with the shaft 41. The first cam 47 controls the actuation of the cam actuated motor reversing switch 22, the second cam 48 controls the rotational movement of the first shaft 15 (to which is fixed the tube holding arm 14), and the third cam 49 controls the axial movement of the second shaft 19 (to which is fixed the tube seating means 18).

The first cam 47, which controls the direction of rotation of the motor shaft 20 by exercising control over the motor reversing switch 22, connects the motor 21 (as is conventional in a reversable motor) for rotation of the shaft in one direction in one position of the switch and in the opposite direction in another position of the switch.

The second cam 48 (Figs. 1, 2, and 3), which controls the rotational movement of the first shaft 15, is connected to a rack 50 to transmit to the rack rectilinear movement in directions D and E, the rack meshing with a pinion 51 keyed to the first shaft 15. The end portion 52 of the rack adjacent to the second cam 48 is terminated in a cam follower 53 which rides on the cam surface of the second cam. The cam follower 53 is maintained in contact with the cam surface of the second cam 48 by virtue of a tension spring 54. The tension spring 54 has an end portion 55, adjacent to the second cam 48, fixed to an extension portion 56 of the table 24. The end portion 57 of the spring remote from the follower 53 is fixed to another end portion 58 of the rack 50. When the second cam 48 rotates, the rack 50 moves back and forth in directions D and E. This back and forth movement causes the pinion 51 and the first shaft 15 to rotate in directions F and G. This rotational motion, in turn, causes the arm 14 to move successively from one to the other of the two positions of the arm illustrated in Figure 2.

The third cam 49 controls the axial movement of the second shaft 19 which has a collar 59 fixed to one end portion thereof. The collar 59 is connected to an end of a lever 60 pivoted at a central portion thereof at a pivot 61 supported at a portion of the table 24 adjacent to the third cam 49. The other end 62 of the lever 60 supports a cam follower 63 which follows a groove 64 in the third cam 49. Consequently, when the third cam 49 rotates, the lever 60 oscillates about the pivot 61 causing the second shaft 19 to move up and down in directions B and C. This up and down movement of the shaft 19 causes the seating means 18 to move up and down.

The graphs shown in Fig. 4 are representations of various conditions of movement and rest of several elements of the apparatus described. A graph line in Fig. 4 is associated with each of these elements. The graph line associated with the main cam shaft 41 is indicative of constant rotation of this cam shaft through a cycle of operation depicted in Fig. 4. The graph lines entitled "Socket conveyor," "Transfer arm," "Insertion means," and "Motor rotation" each have raised and base portions indicating different conditions of the elements referred to by these titles.

The operation of the apparatus described will be appreciated from a consideration of Figures 1, 3, and 4. The cams 44, 47, 48, and 49 (Figures 1 and 3) are oriented relative to each other so that a socket 12 is first moved into register with the tube seating means 18 (another socket 12*a*, which has been previously loaded with a tube 11*a*, being moved in direction A away from the tube holding arm 14). The movement of the socket 12, in relation to the movement of the other elements of the insertion apparatus, is illustrated by the graph line entitled "Socket conveyor," the raised portion 69 of the graph line being indicative of the portion of a cycle of revolution of the main cam shaft during which the socket is moved from one position to the next. After a socket has come to rest in its position of adjacency to the seating means (as illustrated in Figure 1) the tube holding or transfer arm 14 is moved from its out-of-the-way position (the phantom position in Fig. 2, indicated by base portion 71 of the graph line entitled "Transfer arm" of Fig. 4) and into register with the tube seating means 18. The position of the tube holding or transfer arm in register with the tube seating means 18 is illustrated by the raised portion 70 of the transfer arm graph line. Next, while the arm 14 is maintained in register with the socket, the seating or insertion means 18 is moved upwardly, moving the tube supported in the arm up and into contact with the socket. This upward movement is indicated by the raised portion 66 of the graph line entitled "Insertion means." The rotation of the motor shaft 20 is in one rotational direction (this one rotational direc-

tion is indicated by the base portion 67 of the graph line entitled "Motor rotation") during all of the foregoing. After the seating or insertion means has been moved upwardly (graph line portion 66) the direction of rotation of the motor shaft 20 is reversed (by virtue of the actuation of the switch 22 in Figure 3 to its phantom position). The period of rotation of the motor shaft in the reversed direction is indicated by the raised portion 68 of the graph line entitled "Motor rotation." As indicated above, this reversal of rotation momentarily frees the prongs of the tube from engagement with the prong receiving apertures or passageways of the socket. When the tube is freed of such engagement the potential energy in the spring 34, produced by a compression of the spring during the upward movement of the seating means, will cause the tube to be completely seated in the socket.

From the foregoing it is seen that the insertion apparatus of the invention provides improved means for ensuring the complete seating of pronged electron tubes into sockets thereof.

What is claimed is:

1. Inserting apparatus comprising a frame; an electric motor having a reversibly rotatable shaft and mounted on said frame for movement with respect thereto in a substantially rectilinear path, said shaft extending along said path; motor reversing means connected to said motor and adapted to control the direction of rotation of said shaft; a housing mounted on said shaft; a compression spring mounted within said housing and having a substantially free end portion; a resilient element mounted on said end portion and adapted to engage an end of a pronged electron tube remote from prongs thereof whereby said tube is in coaxial relation with respect to said shaft when engaged by said resilient element; a transfer arm having a tube engaging portion and mounted for rotation about an axis substantially parallel to said path and with said tube engaging portion axially closely spaced from said resilient element, said tube engaging portion having a path of travel including a path portion normal to said rectilinear path; and common drive means connected to said transfer arm, to said motor, and to said reversing means for moving said arm portion into said rectilinear path while actuating said reversing means for rotating said shaft in one direction, said drive means moving said motor in a direction along said rectilinear path toward said arm until said resilient element is in tube engageable relation with said arm portion and while actuating said motor reversing means for reversing the rotation of said shaft.

2. In a tube inserting apparatus, a seating device comprising a support movable rectilinearly in a given path, a motor fixed to said support and having a rotatable shaft extending in a direction parallel to said path, a seating assembly fixed to said shaft, said assembly including a tube engaging member movable with respect to said shaft in a direction opposite to said direction under resilient restraint and adapted to urge said tube towards a desired seatable position, said tube engaging member being adapted to dispose said tube in coaxial relation with respect to said shaft, and means for actuating said motor in successively opposite directions, whereby said motor when energized is adapted to rotate said seating assembly for angularly orienting said tube into said seatable position.

3. In a pronged tube inserting apparatus, a seating device comprising a support movable rectilinearly and rotationally about a predetermined axis extending therethrough, a tube engaging member resiliently mounted on said support and adapted to support a tube with its axis coincident with said predetermined axis, means for moving said support rectilinearly and adapted to dispose a tube engaged by said tube engaging member in a predetermined first position, and means for rotating said support in successive opposite directions about said axis and adapted to dispose said tube in a predetermined second position, whereby a socket having openings for receiving prongs of said tube in said second position is adapted to receive said tube in fully seated relation therewith.

References Cited in the file of this patent

UNITED STATES PATENTS

1,832,677	Wildeboer	Nov. 17, 1931
2,069,086	Donovan	Jan. 26, 1937
2,120,877	Uber	June 14, 1938
2,518,009	Hess	Aug. 8, 1950
2,767,465	McCain	Oct. 23, 1956
2,784,830	Thorson	Mar. 12, 1957