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TRAY AND TRAY UNLOAD MECHANISM

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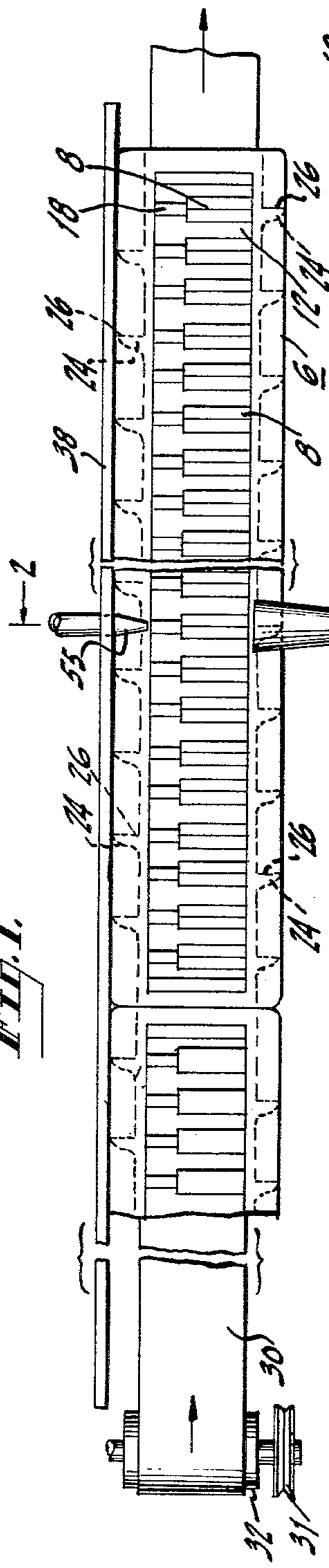

Fig. 1.

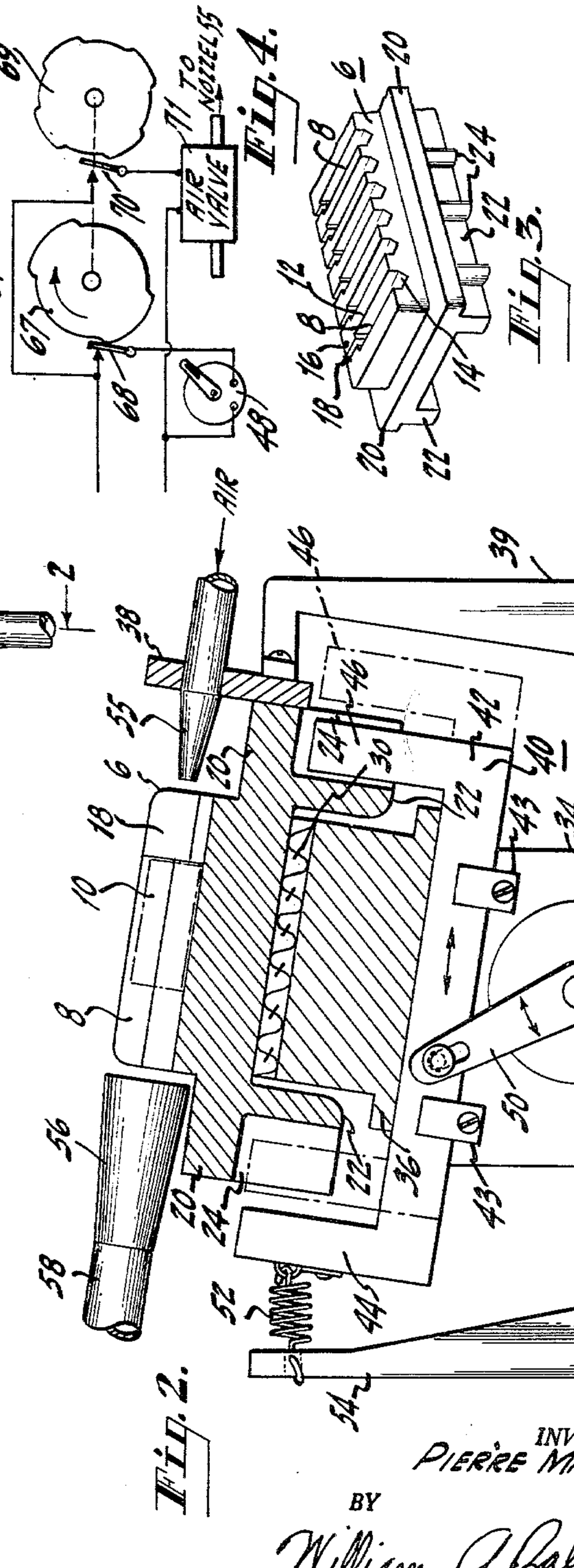

Fig. 2.

Fig. 3.

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TRAY AND TRAY UNLOAD MECHANISM

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This invention relates to apparatus for transporting, indexing and unloading compartmented trays for holding parts such as electron tube electrodes and to a tray which cooperates with such an apparatus. The invention is especially useful when applied to compartmented trays in the compartments of which electron tube parts may be stored and to apparatus having escapement means for advancing the trays one compartment at a time to a tray compartment unloading position.

In a certain type of electron tube, the electrodes thereof, comprising the anode, grid and cathode sleeve, are small hollow open-ended cylinders. The anode cylinder is about ⅜ of an inch long and about 3/16 of an inch in diameter. The grid cylinder, which is comprised of a grid lateral wire and side rods, fits inside an anode in the completed tube. The cathode support sleeve fits inside the grid. The clearances between these electrodes when assembled is critical and therefore even small distortion of the electrodes results in a defective tube.

Assembly machines have been developed for placing the anode and grid electrodes and the cathode sleeve into assembly jigs, wherein they are assembled with other elements into a mount assembly in properly spaced positions. however, the electrodes, after being made, are transported to such assembly machines. Also, since the electrode cylinders are made in large quantities, they should be stored and transported to the electrode assembly machine from the electrode making machine in such a manner as to protect the electrodes from damage. Also, having been transported to the electrode mount assembling machine, the electrodes should be fed thereinto individually and without damage.

After the electrodes are made, they are put into individual compartments of trays where they are stored. They are then transported, while in their tray compartments, to a jig loading position of the electrode assembly machine.

Prior art devices for unloading trays at an electron tube assembly position are known and involve escapement mechanisms for intermittently moving a tray past the assembly position, for stopping the tray in the assembly position while individual electrodes are unloaded successively from the compartments of the tray, and, when a first tray is emptied, for moving another tray into unloading postion.

In the usual tray, the distance between two consecutive compartments may be much smaller than the distance between the last compartment of one tray and the first compartment of a tray which follows and contacts the first tray. The prior art devices therefore have built-in mechanisms for recognizing that a tray has been emptied and that another following tray must be moved to the position where its first compartment is at the unload position thereof. Such mechanism not only recognizes that a tray has been emptied but it moves the following tray the required distance to bring its first compartment to the unload position. This required distance is different from the distance between compartments on the same tray. The recognition mechanism may be a counting mechanism which counts the number of compartments which have been brought to the unload or electrode feeding position of the assembly machine. Therefore, the tray and the counter are co-related for the escapement mechanism to recognize that a tray has been emptied. Also, if a tray having a different number of compartments is used, the counter mechanism is reset to count the different number of compartments before the escapement causes the different feed distance between trays. Or, the recognition devices may sense the end of a tray. The tray feeding mechanism is therefore complicated by the recognition device and a means for feeding a following tray a different distance from the distance between compartments in the same tray. If the escapement mechanism fails, some assembly jigs will not have an electrode fed thereto, resulting in a defective tube assembly.

In certain prior art tray-feeding devices, after a compartment along the length of a tray has been unloaded, the tray may be pushed the distance between compartments thereof by a force applied at an end of the tray. Or, the tray may be fed the distance between compartments by a continuously acting force, which, however, is intermittently prevented from moving the tray by an escapement mechanism applying a restraining force at an end of the tray.

If the tray is unwarped, application of the moving force or the restraining force to an end of the tray provides proper indexing of the compartment being unloaded along an intermediate portion of the length of the tray. However, if a tray is warped to any substantial extent, the distance along the length of the tray from an intermediate compartment to the end portion of the tray may not be a multiple of the indexing distance. Where, as here, the work pieces or parts handled by the apparatus of this invention has a maximum diameter of about 3/16 of an inch, a slight warping of a tray may be sufficient to prevent a compartment having an electrode therein from registering with the unload position of the tray. Therefore, when using such a warped tray, the intermediate compartment thereof that is being unloaded may not register with the loading position of the assembly mechanism, resulting in non-loading of or distortion of the tube element in the intermediate compartment. While prior art metal trays, generally, do not warp, metal trays are expensive to make and, being heavy, are hard to handle. Plastic trays have a tendency to warp and therefore cause improper operation of the loading of the assembly apparatus, where a prior art escapement means is used to move plastic trays.

Many prior art escapement devices also feed a tray, or permit feeding of a tray, only predetermined equal distances. Therefore, if a tray used with the prior art escapement device has various distances between the compartments thereof, or if different trays having different compartment spacing are used with the same prior art escapement mechanism, the compartments therein do not all register with the load position of the assembly device.

It is therefore an object of this invention to provide an improved apparatus and a cooperating compartmented parts holding tray whereby a loaded tray may be indexed accurately at an unloading position.

A further object of this invention is to provide an apparatus for accurately indexing trays even though such trays may be warped, or of varying dimensions or spacing between compartments, or of different lengths.

A still further object of this invention is to provide such an apparatus having a tray escapement mechanism that requires no provision for recognizing the end of a tray.

It is another object of this invention to provide a tray so formed that it will cooperate with the indexing mechanism of this invention, even though warped.

It is an object of this invention to provide a light, easy to handle tray of material that is cheap, which tray even though warped, is so formed that it will properly cooperate with the escapement mechanism of this invention and avoid the adverse effect of warping of conventional trays.

A tray made according to this invention is provided with compartments therealong, and with escapement teeth along the length of the tray, a selected, corresponding face of each tooth being in registry with one compartment and

preferably with the center thereof. Apparatus made according to this invention for cooperating with the tray has means for continuously urging the feeding or moving forward of the tray and an escapement means for stopping the feeding of the tray, the stopping means being effective on the selected face of each tooth to stop the corresponding compartment in the unloading position.

This invention is more fully explained in the following description thereof, taken with the accompanying drawing, in which:

FIG. 1 is a plan view, partly broken away, of apparatus embodying this invention;

FIG. 2 is an enlarged sectional view of FIG. 1 taken along the line 2—2 thereof;

FIG. 3 is a perspective view of a portion of a tray of FIG. 1, and

FIG. 4 is a diagram to indicate timing of a solenoid and a blower used with the apparatus of FIG. 1.

The tray shown in each of FIGS. 1 to 3 is described first. The tray 6 preferably made of a light moldable material such as a plastic, has a plurality of spaced, laterally extending compartments 8 in the top thereof, for containing a work piece here comprising electron tube electrodes 10, one of which is shown in phantom in FIG. 2. The compartments 8 are open at the top and along one longitudinal edge of the tray 6 and they are partially closed along the other longitudinal edge of the tray 6. The lateral, transverse walls 12 of each compartment 8 are vertical. A V-shaped groove 14 is provided in the floor of each compartment, the sides of the groove slanting downwardly from the walls at an angle of about 45°. A slotted wall extends along one side of the compartments of the tray and parallel to the length thereof for partially closing the remaining end of each compartment 8. Each slot 18 in the slotted wall extends to the bottom of its compartment 8. The upper part of the slot 18 is of uniform width, while the lower part of the slot registers with the V-shaped groove 14. The center of the slot 18 coincides with the center of the compartment 8. The slots are narrow enough to prevent any electrode 10 from sliding out of the compartment 8 through the partially closed end thereof.

The base of the tray on which the compartments are supported extends outwardly beyond the compartments as shown at 20. Walls 22 extend downwardly from the base of the tray just beyond the ends of the compartments 8. The tray 6 also includes teeth 24 which extend between outwardly extending portions 20 of the base and the downwardly extending walls 22 along each side of the tray. As shown in FIG. 1, each tooth 24 has a flat face 26 thereof in line with the center line of a compartment 8. Half the teeth 24 are on each side of the tray, the teeth 24 being alternately arranged. The teeth 24 extend outwardly from their respective downwardly extending walls 22. Thereby, a flat face 26 of a tooth 24 at one side of the tray 6 registers with a compartment 8 and a flat face 26 of the next tooth 24 at the other side of the tray 6 registers with the next compartment 8 along the tray 6.

Since the first, foremost compartment 8 of a tray, viewed as it moves to the right in the figures, is at a distance away from the front or foremost end of the tray 6, which is further than the distance between compartments, the first tooth 24 of a tray 6 is further back from the front end of the tray 6 than the distance between compartments 8. The trays are made to nest when stacked. To accomplish this, the distance between the inside faces of the downwardly extending longitudinal walls 22 is made slightly greater than the width of the portions of the tray 6 comprising the compartments 8. Further, the depth of the walls 22 in a vertical direction is at least as great as the depth of the pockets in the top of the tray. Therefore, the trays can be stacked with the compartments 8 of one tray 6 between the downwardly extending walls 22 of the tray 6 above it. When so stacked, the top and the ends of the compartments 8 are closed, preventing the electrodes in the compartments from falling out.

Apparatus for moving the trays along past an unloading position is shown in FIGS. 1 and 2. This apparatus includes a continuously running flat belt 30, running over pulleys 32, only one of which is shown, mounted on any convenient support. The belt 30 may be supported along its length by a supporting plate or bed 36 mounted on support 34, which extends any convenient distance between the pulleys. Since the belt 30 moves continuously, the trays on the belt 30 will also move continuously unless restrained. As shown in FIG. 2 the belt 30 and bed plate 36 may be tipped to lower the partially closed end of the compartments 8 to make sure that an electrode 10 in a compartment 8 does not fall out of the open end of the compartment 8 while traveling along the belt. Also, since the space between the walls 22 of the tray 6 is somewhat wider than the width of the belt 30, the trays may not all be positioned uniformly with respect to the belt 30 as they move therealong. Therefore, a guide 38, supported on a base 33 by a support 39, is provided to act as a stop plate. Gravity, acting on the trays 6, cause them to contact the guide 38 thereby to make sure that each tray 6 is properly positioned with respect to the escapement means and the unloading means to be described.

The escapement apparatus 40 comprises a U-shaped member 42 of rectangular cross-section, which is mounted as by flat brackets 43 to slide with respect to support 34. However, U-shaped member 42 is prevented from rotating with respect to support 34 by brackets 43. The legs 44 and 46 of the U-shaped member 42 extend upwardly. These legs 44 and 46 are the proper distance apart so that upon sliding U-shaped member 42 with respect to the support 34, one leg of the U-shaped member obstructs a tooth 24 at one side of the tray 8 before the other leg of the U-shaped member 42 clears a tooth 24 at the other side of the tray.

The means for sliding the U-shaped member 42 comprises a rotary solenoid 48 mounted on support 34. Rotary arm 50 of the solenoid 48 moves the U-shaped member 42 in one direction and keeps it there (to the right as viewed in FIG. 2 and there shown in phantom) as long as the solenoid 48 is energized. Rotary solenoids such as 48 usually have a spring built therein to cause return of the arm 50 thereof upon de-energization of the solenoid. However, if necessary, a tension spring 52 may be provided for moving the U-shaped member to the left, to the position as shown in FIG. 2, upon de-energization of the solenoid 48. The spring 52 is stretched between a bracket 54, which is mounted on the bed or base plate 33, and the U-shaped member 42.

Upon energization of rotary solenoid 48, the member 42 is moved to the right, as shown in phantom in FIG. 2, stretching spring 52 and moving the right leg 46 of the U-shaped member 42 out from in front of a tooth 24 of the right hand side of tray 6. Before the right leg 46 (as viewed in FIG. 2 and facing against the direction of travel of the compartments) of the U-shaped member 42 clears the right-hand tooth 24 of the tray 26, the left leg 44 of the U-shaped member 42 obstructs the next left hand tooth 24 of the tray 6. The belt 30 carries the tray forward (to the right in FIG. 1) until the left hand tooth 24 contacts the left leg 44, and motion of the tray 6 is stopped by this contact. Upon de-energization of the solenoid, the solenoid arm 50 rotates counter-clockwise, the spring 52 contracting and helping to pull the U-shaped member 42 to the left. The left leg 44 is moved to the left to a position shown in full lines, where it does not obstruct a tooth 24, and the right leg 46 is now in position where, upon motion of the tray 6, the next right tooth 24 contacts the right leg of U-shaped member 42, stopping the tray 6 at its next indexed position. When the compartments 8 of one tray 6 have all been emptied, and a further tray 6 is moved to unload position, as a leg 44 or 46 of the U-

shaped member 42 releases the last tooth 24 on one side of one tray 6, the opposite leg 46 or 44 of the U-shaped member 42 is in position to contact the first tooth 44 on the other side of the next tray. The speed of the belt 30 that carries the trays 6 is sufficiently great to move the next tray to tooth contacting position in time to feed an electrode to the assembly machine, as will be explained. Therefore, no special provision need be made for moving the tray 6 the distance between the last compartment 8 of the one tray 6 and the next compartment 8 of the next tray 6, which distance, as noted above, is further than the distance between adjacent compartments of the same tray.

The means for unloading the compartments in the tray comprises a nozzle 55 for applying an air blast to the electrode 10 in the compartment 8 at the unload position, through the slot 18 in the end of the compartment 8. The electrode is blown out of the compartment into a funnel 56 and through a tube 58, positioned in registry with the open end of a compartment 8 and at the end thereof. The tube 58 extends to the assembly jig (not shown) that is being loaded. Since, in the present invention, the compartment 8 of a tray that is being unloaded is in registry with the tooth 24 that is in contact with a leg 44 or 46 of the U-shaped member 42, the position of this compartment 8 is not affected by any warping or change in dimension of the tray 6. Nor is the position of such a compartment 8 which is being unloaded, affected by uneven spacing of successive compartments 8 comprising a tray 6 or an uneven spacing of compartments 8 in successive trays 6. Therefore, the escapement mechanism of this invention causes registry of compartments in trays with the unload position, regardless of the usual warping of a tray, or of different sizes or spacing of compartments in a tray, and no provision is made or is necessary for recognizing the end of a tray and the beginning of the following tray.

The solenoid 48 is energized and de-energized by a timing means, diagrammatically shown in FIG. 4, controlled by the assembly machine, not shown, to which electrodes 10 are fed. Since the assembly machine is no part of this invention, no showing or description thereof is given here. Energization and deenergization of solenoid 48 permits indexed motion of the tray 6.

As noted above, the electrode 10 in a compartment 8 is blown out of the compartment into a funnel 56 at the compartment unload position. The air supply is intermittent, being turned on by a solenoid operated valve means 71, FIG. 4. The solenoid valve means 71 is also energized in timed relation to the assembly machine, the air being turned on momentarily after the solenoid 48 is either energized or de-energized.

Cams 67 and 69 of FIG. 4 rotate together as indicated by the dotted line joining them and in timed relation to the operation of the assembly machine, not shown. Upon rotation of cam 67, switch 68 is closed and solenoid 48 is energized to move the U-shaped member 42 in one direction, to permit indexing of the tray. Cam 69 causes closing of switch 70 and energization of solenoid valve 71 after the tray 6 has had time to move to its next indexed position. The air blast ceases upon de-energization of solenoid valve 71 upon further rotation of cam 69. Upon still further rotation of cam 67, the solenoid 48 is de-energized and U-shaped member 42 is moved to its opposite position by its internal spring (not shown) assisted by spring 52, permitting a further indexing of the tray 8. Shortly thereafter cam 69 energizes air valve 71 to feed a blast of air to nozzle 55 to unload the indexed compartment.

Operation of this apparatus is as follows:

A first tray 6 containing electrodes in each compartment thereof, is put on the conveyor belt 30 by hand or by a suitable mechanical device (not shown). The belt 30 moves the tray until the first tooth 24 thereof contacts an upstanding leg of U-shaped member 42. Since the U-shaped member is in registry with the funnel 56 and

the air nozzle 55, the contacted tooth 24 and therefore the compartment 8 to be unloaded is also in registry with funnel 56 and nozzle 55. Compresed air is supplied to the air nozzle 55 and the electrode 10 in a compartment 8 is blown out of the compartment 8 into the funnel 56. The U-shaped member 42 is moved to its opposite extreme position. At this position, the right leg 46 releases a tooth 24 and the left leg 44 obstructs the next tooth 24 along the tray and the belt 30 moves the tray until the next tooth 24 of the tray is in contact with the left leg 44. Another compartment 8 is in unload position. Another air blast is directed into this compartment 8 to blow the electrode therein into the funnel 56. This process is repeated continuously. The speed of the belt 30, the timing of the escapement and the timing of the air blasts are so correlated that a compartment is at the tray unload position when the blast is turned on.

What is claimed is:

1. The combination of a tray and indexing means therefor, said tray having compartments therein along one surface thereof, a series of teeth spaced from each other along said tray, wtih successive teeth projecting alternately from different surfaces of said tray, there being a one to one registry of successive teeth and successive compartments, said indexing means comprising a tooth obstructing means, means for moving said obstructing means between positions where it obstructs successive alternately arranged teeth and means for yieldingly moving said tray in a direction to be obstructed by said obstructing means.

2. Apparatus for indexing and unloading a tray having a plurality of compartments and a like plurality of stop means each registered with a different one of said compartments, said apparatus including a conveyor belt, means for continuously driving said belt along a path, an escapement means positioned along the path of said belt, said escapement means comprising a member having portions that are alternately engageable with successive ones of said stop means to successively obstruct the motion of a tray on said belt, means for unloading a compartment in said tray, said unloading means and said obstructing portions being in substantial registry.

3. In combination, a tray, a tray indexing apparatus, and an unloading means, said tray comprising a plurality of compartments along a surface thereof and a plurality of teeth along said tray, successive ones of said teeth projecting alternately from different surfaces of said tray, said teeth and said compartments having a one to one correspondence, with a face of each tooth in predetermined relationship with a compartment, said tray indexing apparatus comprising a continuously moving belt and an intermittently movable tray obstructing means, said tray obstructing means being movable between positions where it obstructs successive alternately arranged teeth on said tray, said compartment unloading means being positioned along said belt, said tray obstructing means and said compartment unloading means being substantially in registry.

4. The combination of a tray, an indexing means therefor and a tray unloading means, said tray comprising compartments along the upper surface thereof, said compartments being open at the top and at one end and partially closed at the other end thereof, said tray further comprising teeth extending from sides thereof, in alternately arranged rows, there being a one to one relationship between said teeth and said compartments, said indexing means comprising a tray tooth obstructing means, means for moving said obstructing means from a position where it obstructs a tooth in one row and clears teeth in another row to a position where it obstructs teeth in said other row and clears teeth in said one row, means for yieldingly moving said tray in a direction to be obstructed by said obstructing means, said tray unloading means comprising an air jet directed towards the partially closed end of a compartment, said obstructing means and said air jet being substantially in registry, whereby a compartment corresponding to an obstructed tooth is unloaded by said air jet.

5. A tray comprising a plurality of compartments formed therein along a surface thereof for receiving work pieces, a plurality of teeth formed along surfaces of said tray, there being a one to one relationship of said teeth and said compartments, alternate ones of said teeth extending in opposite directions.

6. A tray having compartments along a surface thereof for receiving work pieces, said tray comprising a toothed structure along one side thereof and a further toothed structure along the other side thereof, said teeth in said toothed structure being staggered with respect to the teeth in said other toothed structure, there being a one to one correspondence of said teeth and said compartments.

7. A tray comprising an elongated structure, a plurality of compartments being formed in one surface of said structure and extending laterally thereof, said compartments being open at one side of said structure and being partially closed at the opposite side thereof, a plurality of teeth being formed in the sides of said tray structure, there being a one to one relationship of said compartments and said tray, said teeth being arranged alternately in a plurality of rows.

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