This invention relates in general to the manufacture of electron tubes and in particular to the automatic removal of undesirable matter from finished electron tubes.

Even under well-controlled conditions in the fabrication of electron tubes it often occurs that small particles of lint and dust are deposited on tube elements. Since the spacing of elements, especially in more recent tube types is extremely small, these particles can cause short circuits between elements and other operating difficulties.

To remove such undesirable particles and to break up leakage paths or incipient leakage paths in finished tubes it has been the practice to apply a high voltage and draw arcs between the various electrodes within the tube. The process is commonly known as "sparkling" the tubes. To do this, either the high voltage electrode or the base pins of the tubes are rotated by hand to cause the discharge to set up arcs between each pair of electrodes within the tube. Particles of lint or dust are then usually carbonized by the currents thus passed through them and leakage paths are disrupted by the currents or by the physical impact of the arcs between electrodes.

Unfortunately, however, if the discharge is not controlled in time, as is the case in hand operations, gas may be driven out of the tube elements or the electrodes or bulb may be damaged. Further, if the arcs are not drawn between each and every pair of electrodes, some leakage paths or particles will not be removed.

The fact that such treatment of the tubes to remove particles is an additional operation requiring additional handling of a finished product also must be considered. It has long been recognized that an automatic device for applying a uniform discharge to the tubes, controlled in time and positive in the sense that arcs are drawn between every pair of electrodes would fill a definite need. If such a device could be incorporated into the production line without either interfering with the flow of tubes or taking up a large amount of space, it would be of even greater value.

Therefore, it is an object of the present invention to provide an automatic high voltage discharge device for processing finished electron tubes.

It is another object to provide a discharge device which is time controlled and effective on all electrodes of a tube.

It is still another object of the present invention to provide a discharge device which adds a minimum of additional equipment to processing machinery.

It is a further object of the present invention to provide a simple, easily maintained device to accomplish the high voltage discharge function.

In general, the present invention consists in a device for turning electron tubes at a predetermined rate for a predetermined time on their longitudinal axes while simultaneously a high voltage discharge is applied to each of the base pins in turn. The device is gravity fed and is synchronized in its operation with the indexing of a finishing machine. For a better understanding of the invention, together with other and further objects, features, and advantages, reference should be made to the following description which is to be read in connection with the accompanying drawing, the single figure of which is a perspective view of a preferred embodiment of the present invention.

Referring now to the drawing, there is disclosed a finishing machine 1, from which completed tubes are passed down an inclined trough 2 into a cylindrical housing 3. At the end of housing 3 is a step 4 which is made of resilient material and is bifurcated at its end. Step 4 is normally held in position within housing 3 by means of springs 5. A solenoid 6 is mechanically connected to step 4 and is operative to retract step 4 when energized.

Housing 3 has a second upwardly facing opening formed therein, and a high voltage discharge device 7 which, for example, may be a spark coil, is positioned such that its output electrode 8 passes through that opening. The lower part of housing 3 is also cut away and accommodates rollers 9 and 10. A motor 11 supplies rotation to rollers 9 and 10 through a worm in housing 12 and gear train 13.

A time delay device 15 of conventional structure, such as an "Agastat," is mounted beneath housing 3. Thus, the device need only be capable of opening or closing switch contacts a predetermined time after it is triggered. A switch 16, actuated by finishing machine 1 at each index, is connected to timing device 15 by leads 17. Timing device 15 is connected to, and determines the operation of, spark coil 7 and solenoid 6 in a manner explained in detail hereinafter.

In operation, a completed tube is released from finishing machine 1 and passes tip first down trough 2 coming to rest against step 4 within housing 3. Step 4 may be offset or forked to prevent its contacting the tip of the tube, as may be seen in the drawing wherein the tube tip is shown as extending to the right beyond step 4. As the tube is released from finishing machine 1, switch 16 is tripped by the indexing of the machine causing initiation of the cycle of timing device 15 and energization of spark coil 7. Thus, when the tube arrives against step 4 it is resting upon rollers 9 and 10 and the discharge from electrode 8 arcs over to the uppermost base pin of the tube. Motor 11, which is running continuously, turns rollers 9 and 10 in the same direction which causes the tube to turn on its longitudinal axis at a rate of speed sufficient to insure discharge between each pair of electrodes within the tube. The rate of turning the tube is, however, fast enough to prevent overheating of any particular element or portion of the tube. At the completion of at least a full revolution of the tube, timing device 15 causes deenergization of spark coil 7 and energization of solenoid 6 simultaneously. Solenoid 6 then causes retraction of step 4 and gravity carries the tube on through the housing to a conveyor or other unloading device. The complete cycle of operation of the device is repeated when the next tube on finishing machine 1 is released into trough 2.

While what has been disclosed is a preferred embodiment of the invention, various other modifications within the concepts of the invention will suggest themselves to those skilled in the art. The invention should be limited only by the spirit and scope of the appended claims.

What is claimed is:

1. Apparatus for automatically sparking electron tubes comprising, a timer, a high voltage discharge device, gravity responsive means for placing said tubes in proximity to said discharge device for a period determined by said timer, and means for rotating said tubes to apply the discharge from said discharge device to the leads of said tubes.
2. Apparatus for automatically sparking the leads of an electron tube comprising, a timer, a high voltage discharge device gravity responsive means for placing said tube with its leads in proximity to said device for a period determined by said timer, and means for rotating said tube substantially on its longitudinal axis to apply the discharge from said device to each of said leads.

3. Apparatus for automatically sparking electron tubes as they are released from a finishing machine comprising, a motor, a pair of rollers continuously driven by said motor at a predetermined speed, means for conveying said electron tubes to said rollers, a timing device actuated by said finishing machine, retaining means for holding each of said tubes on said rollers for a period determined by said timing device, a normally deenergized high voltage discharge device disposed adjacent said rollers, said device being connected to said timing device and operative during said period determined by said timing device, and means for withdrawing said retaining means at the end of said period.

4. Apparatus for automatically sparking electron tubes as they are released from an indexing finishing machine comprising, a conveying device for receiving one of said tubes at each index of said finishing machine, a timing device responsive to each index of said machine, a retractable stop for holding each of said tubes in a predetermined position on said conveying device, a high voltage discharge device disposed adjacent said predetermined position, a device for rotating said tubes in said predetermined position, a solenoid connected to said stop, said discharge device and said solenoid being energized through said timing device such that each of said tubes is held in rotation for at least one revolution during which said discharge device is energized.

5. Apparatus for automatically sparking electron tubes as they are released periodically from a finishing machine comprising, an inclined trough having its upper end adjacent said finishing machine for receiving said electron tubes, a similarly inclined cylindrical housing at the lower end of said trough, a forked stop spring biased into said housing for engaging the shoulders of said tube and halting its progress within said housing, a solenoid for periodically retracting said stop from said housing, a pair of rollers in the bottom of said housing adjacent said stop for supporting said tube, an electric motor and gear train for rotating said rollers to turn said tube on its longitudinal axis, a spark coil disposed above said housing and having its output electrode within said housing spaced approximately the length of one of said tubes from said stop, a timing device synchronized with said finishing machine for actuating said spark coil as a tube reaches said housing, and for actuating said solenoid to retract said stop after a predetermined time, whereby the discharge from said output electrode is applied to the base pins of each of said tubes in sequence, said device being adapted to energize said spark coil and said solenoid in sequence during a predetermined period, and switching means, said switching means being synchronized with said finishing machine and coating with said timing device to initiate the operation of said timing device.

6. Apparatus for automatically sparking the leads of electron tubes as they are released from an indexing finishing machine comprising, an inclined trough for receiving one of said tubes at each index of said finishing machine, said trough having an opening in its lower surface, a pair of rollers disposed in parallel relationship in said opening, a motor and gear train for continuously rotating said rollers, a retractable stop for holding each of said tubes on said rollers for a predetermined time, a high voltage discharge device disposed adjacent and above said rollers, said trough having an upwardly facing opening for accommodating said device, means for energizing said device for a period sufficient for each of said tubes to make at least one complete revolution on said rollers, and means for retracting said stop at the end of said period to permit each of said tubes to continue its movement in said trough beyond said rollers.

7. Apparatus for automatically sparking electron tubes after ejection thereof from a finishing machine comprising, a conveyor, a high voltage discharge device and an electrical control system, said conveyor consisting of an inclined trough having its upper end adjacent the finishing machine for receiving said electron tubes, a similarly inclined cylindrical housing at the lower end of said trough, a forked stop spring biased into said housing for engaging the shoulders of said tube and halting its progress within said housing, a pair of rollers in the bottom of said housing adjacent said stop for supporting said tube, and means for continuously rotating said rollers to turn said tube on its longitudinal axis, said high voltage discharge device consisting of a spark coil disposed above said housing and having its output electrode within said housing spaced approximately the length of one of said tubes from said stop and means for applying a predetermined voltage to said spark coil, and said electrical control consisting of a switch, said switch being mounted adjacent said finishing machine and responsive to indexing thereof, a timing device, means connecting said switch to said timing device to initiate the operation thereof, a solenoid, said solenoid being disposed adjacent the outer end of said forked stop to center therewith and means connecting said timing device, said spark coil and said solenoid, respectively, in sequence, to energize said spark coil for a first predetermined period and to energize said solenoid for a second predetermined period to move said forked stop out of said housing.

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