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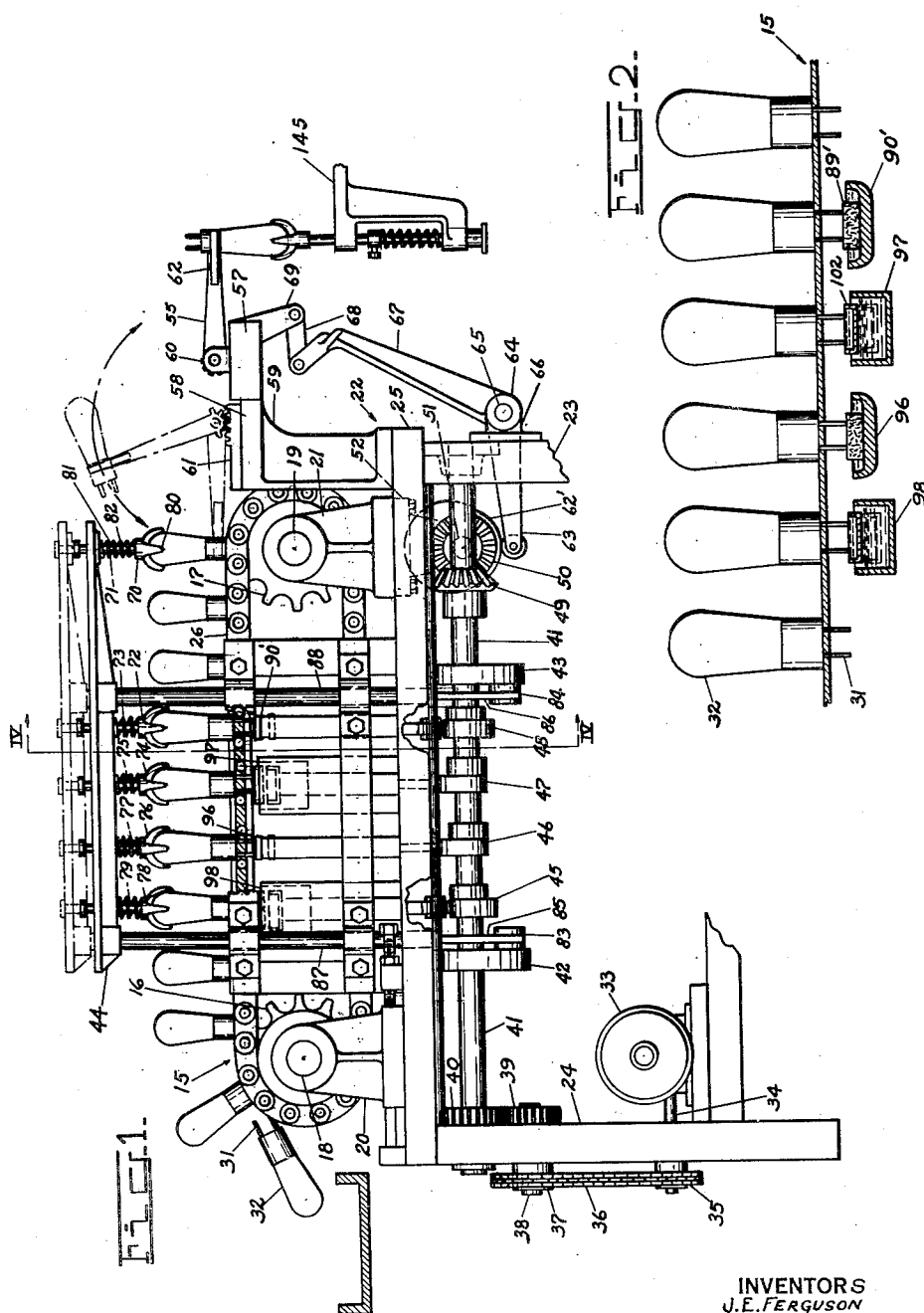
J. E. FERGUSON ET AL

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AUTOMATIC SOLDERING MACHINE

Filed Nov. 2, 1928

3 Sheets-Sheet 1



INVENTORS
J.E. FERGUSON
R.W. CONN
W.A. HOFFMAN
BY *M. J. Reese*
ATTORNEY

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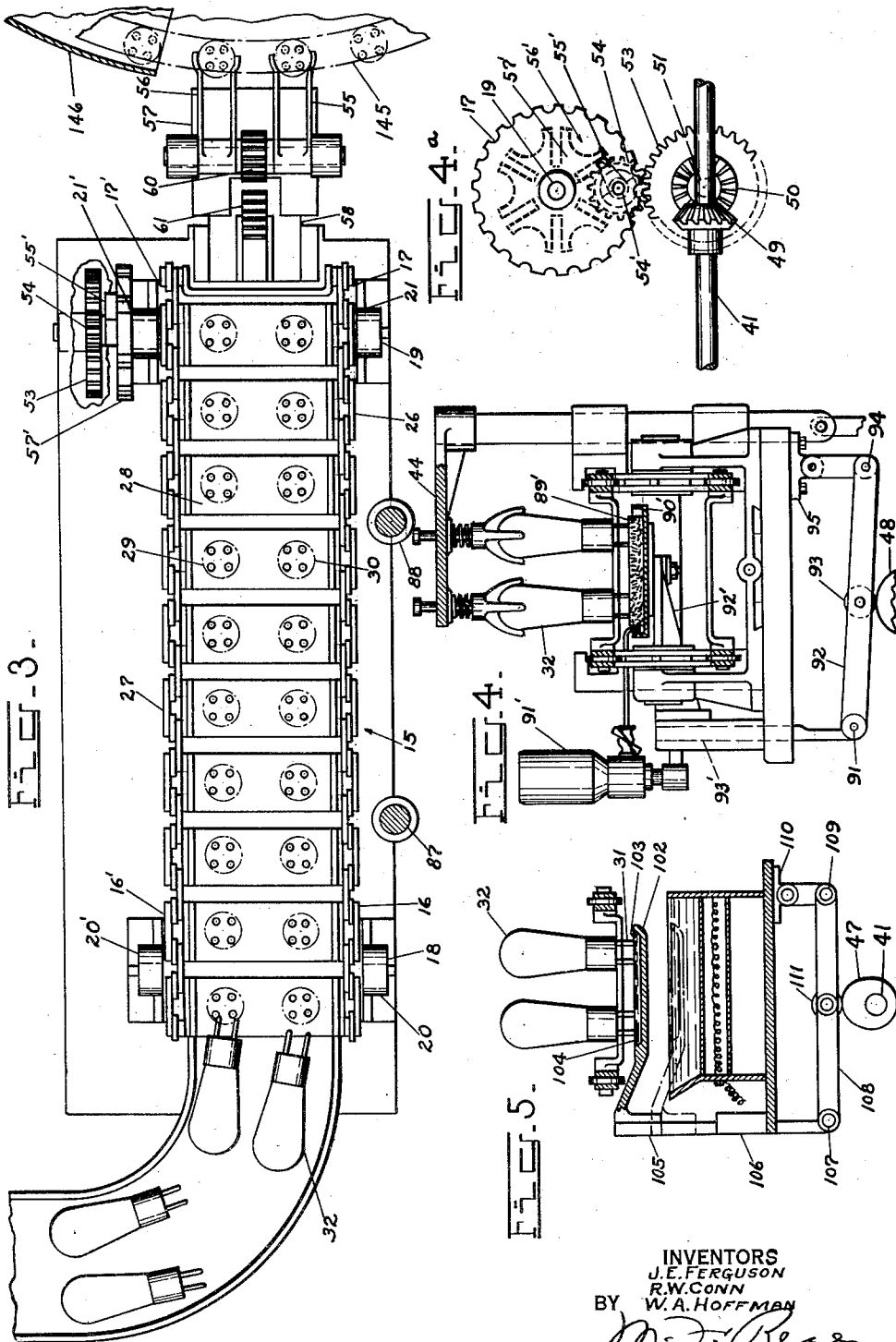
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INVENTORS
J. E. FERGUSON
R. W. CONN
BY W. A. HOFFMAN
M. J. Rege
ATTORNEY

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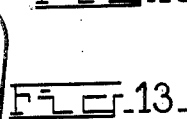
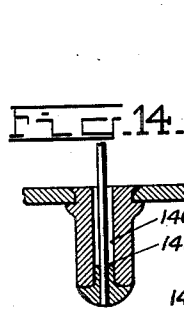
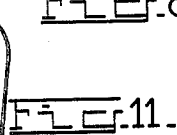
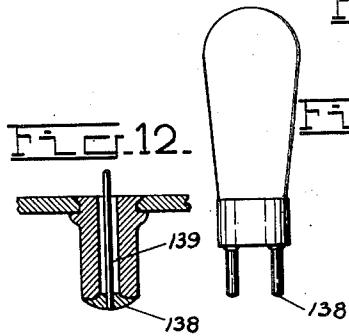
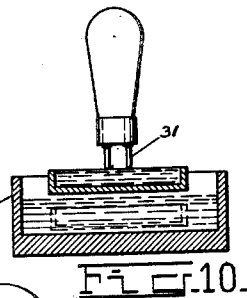
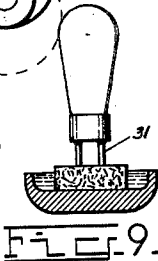
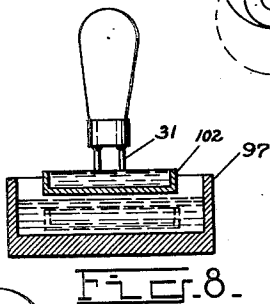
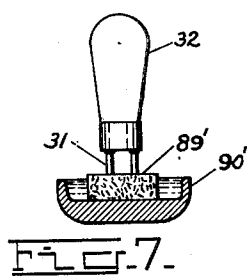
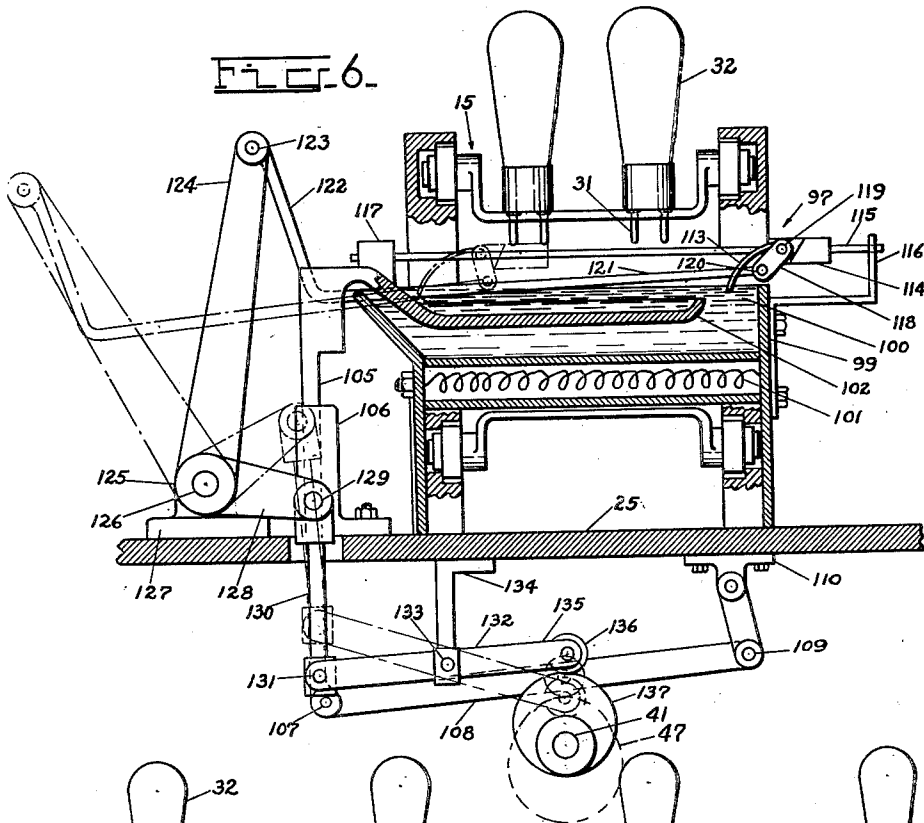
J. E. FERGUSON ET AL.

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AUTOMATIC SOLDERING MACHINE

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3 Sheets-Sheet 3



INVENTORS
J.E. FERGUSON
R.W. CONN
BY W.A. HOFFMAN
M.F. Regan
ATTORNEY

UNITED STATES PATENT OFFICE

JOHN E. FERGUSON, OF BLOOMFIELD, ROBERT W. CONN, OF VAUXHALL, AND WALTER ALVAH HOFFMAN, OF BLOOMFIELD, NEW JERSEY, ASSIGNORS TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA

AUTOMATIC SOLDERING MACHINE

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This invention relates to the manufacture of radio tubes or similar devices having one or more contact elements and relates more particularly to a machine for soldering electrical conductors to the contact elements of above mentioned devices.

In the manufacture of electrical devices such, for example, as a radio tube, great difficulty has heretofore been experienced in automatically connecting the contact elements or pins of the device with the internal leading-in conductors.

A radio tube which is taken as an example of one type of device to which the present invention may be applied, consists of a bulb having an internal structure including a plurality of electrodes mounted on a stem, the stem and bulb being consolidated by fusion, after which the bulb is evacuated and a base, usually of some non-conductive material such as a condensate product, is applied to the bulb and secured thereto by cement. Projecting from the lower end of the base are a plurality of tubular members which may be termed contact elements. When the bulb is applied to the base the internal conductors or leading-in wires, which in some cases are four in number, are inserted through the four provided tube contact elements in the base. The leading-in wires are then sheared off flush with the exposed ends of the contact elements, after which it becomes necessary to apply a solder to the ends of the contact elements, to electrically connect the said elements to the leading-in conductors and at the same time it is essential to provide smooth round bead-like formations on the ends of the pins, which beads serve as contacts when the device is applied to a contact of a socket for operation.

It will be appreciated that, it is of extreme importance to positively electrically connect the leading-in wires with the contact elements and, it is also important to provide the bead at the end of the pins of a uniform thickness and formation so that the contact elements will have a uniform length for effective contact with the sockets to which they are subsequently applied. Furthermore, in the manufacture of radio tubes ap-

pearance also plays an important part and it is necessary that the soldering operation be performed so as to give a symmetrical and neat appearing finish.

It will be understood that radio tubes or like devices are manufactured in volume and must consequently be produced at a high rate of speed. This makes it necessary to provide a machine which will perform the delicate soldering operation quickly and effectively and in such manner that all contacts have a uniform amount of soldering material applied thereto.

It is an object of the present invention, therefore, to provide a machine for soldering the leading-in wires of an electrical device to contact elements in an efficient and effective manner.

Another object of the invention is to provide a machine which will automatically and continuously receive electrical devices from another machine for a soldering operation.

Other objects and advantages of the invention will be more fully understood from the following description, together with the accompanying drawing, in which:

Figure 1 is a side elevational view of a machine embodying the present invention;

Figure 2 is a fragmentary view showing diagrammatically the position of bulbs to be soldered when applied to a plurality of soldering pots;

Figure 3 is a plan view of a conveyor employed in the present embodiment of the invention showing its relative position with respect to another machine from which bulbs are received;

Figure 4 is a transverse sectional view of a conveyor taken substantially on line IV—IV in Figure 1 showing the fluxing pad;

Figure 4a, is a detailed view showing Geneva driving mechanism and its relation to a main drive shaft for imparting intermittent movement to the conveyor;

Figure 5 is a detailed view of one of the soldering pots showing bulbs positioned for a soldering operation;

Figure 6 is an enlarged transverse view of the conveyor showing bulbs positioned

thereon and also showing a soldering pot with means for cleaning the surface layer;

Figures 7, 8, 9 and 10 show a bulb in position for alternate fluxing and soldering operations;

Figure 11 shows a bulb with the pins or contact elements having the first dip of solder applied thereto;

Figure 12 is an enlarged sectional view of a portion of one of the pins shown in Figure 11 to illustrate the first deposit of solder or tinning of the pin;

Figure 13 shows a bulb having the pins or contact elements with a rounded bead of solder at the ends thereof; and

Figure 14 is an enlarged sectional view of one of the pins shown in Figure 13 to illustrate the finished soldering operation.

The present invention, although applicable for the deposit of a uniform amount of molten metal at the ends of contact pins or the like of radio tubes, may obviously be employed for the tinning or beading of other similar devices. As illustrated, a practical embodiment of the invention may include a conveyor 15 comprising sprockets 16, 16', 17 and 17' rotatable on shafts 18 and 19 journaled in bearings 20, 20', 21 and 21' respectively. The bearings may be supported upon a frame 22 including supporting brackets 23 and 24 and a bed plate 25. The apron of the conveyor consists of a pair of endless link chains 26 and 27. The said chains 26 and 27 are disposed upon sprockets 16 and 17 and 16' and 17' respectively. The sprocket wheels are spaced apart to receive radio tube holders 28 in the form of plates which extend between the chains in spaced relation and are secured at their opposite ends to oppositely disposed links of the chains so that each opposite pair of links of the chain carries a holder 28. Each of the holders may be formed of a non-conductive material, such as bakelite, and may be provided with two sets of apertures 29 and 30. These apertures are so proportioned as to loosely receive contact elements or pins 31 of a radio tube 32. The conveyor is driven from any suitable source, as a motor 33, (see Fig. 1) provided with suitable reduction gearing and a shaft 34. The shaft 34 is provided with a sprocket wheel 35 which transmits motion through a chain 36 to a sprocket wheel 37 mounted at one end of a stub shaft 38. The opposite end of the said stub shaft is provided with a pinion 39 in mesh with a pinion 40 on a counter-shaft 41. The said counter-shaft carries cams 42 and 43 for actuating a presser bar 44 to be later described.

The said shaft 41 is also provided with cams 45, 46, 47 and 48 which actuate means associated with a fluxing agent and the soldering pots, which means will be presently described. In addition to carrying the above mentioned cams, the shaft 41 transmits mo-

tion to the conveyor by means of a beveled gear 49 in mesh with a beveled gear 50. The beveled gear 50 is mounted on a shaft 51 journaled in a bearing 52 secured to the bed plate 25. The shaft 51, (see Fig. 4a) is provided with a spur gear 53 disposed in mesh with a gear 54 mounted on a shaft 54'. The said shaft is provided with an arm 55' of a Geneva movement 56', the slotted wheel 57' of which is secured to the shaft 19 upon which the sprocket wheels 17 and 17' are mounted. Thus, intermittent motion is transmitted to the apron of the conveyor.

As the conveyor moves means are provided for inserting the contact elements or pins of a radio tube into the apertures in the holders 28. This means in the present construction may comprise two sets of oscillatory arms 55 and 56. Each of these arms is provided with actuating mechanism of similar construction and a description of one will answer for both. Considering the arm 55, (Fig. 1) the same is mounted on a sliding head 57 movable on lateral guides 58 supported on a bracket 59 integral with the bed plate 25. The said arm 55 is provided with a pinion 60 arranged to engage with a stationary rack 61, the said rack being secured to the bracket 59 and disposed in the path of movement of the pin 60.

When the present apparatus is applied to another machine which performs other operations on the radio tube, the said oscillatory arms are moved in timed relation to the movement of the said other machine so that the arms 55 and 56 will swing outwardly and spring jaws 62 are provided at the free end of each of the arms to engage the articles such as radio bulbs by the base portion thereof.

The head 57 then moves inwardly until the rack 58 engages the pinion 60, causing the arms to carry the radio tubes toward the conveyor and as the rack 61 engages the pinion 60 the arms are swung, as indicated in dotted lines, so that the contact elements, of the radio tubes being transported, are disposed in the apertures of the radio tube holders.

The drawing shows the invention applied to a machine for securing the bases to the bulb, which machine is known as a basing machine. After the basing operation is performed it is desirable to solder the leading-in wires to the contact element which operation is performed on the present machine. Mechanisms for actuating the oscillatory arm 55, which is the same as the mechanism for the arm 56, may comprise a cam 62' secured to the shaft 51. The said cam engages an arm 63 of a bell crank member 64 pivoted at 65 in a bearing 66. The opposite arm 67 of the bell crank member is provided with a link 68 pivotally connected with an extension 69 integral with the sliding head 57. Thus, as the machine is operated and the cam 62 rotated, the said cam will cause an actuation of

the bell crank member resulting in a reciprocation of the head 57 and a consequent actuation of the oscillatory arm 55. As above mentioned, the sets of apertures 29 and 30 are proportioned to loosely fit the contact elements of the tubes so that a tube may readily be inserted therein and extreme accuracy is not required for the alignment of the pins with the apertures.

After the tubes are positioned in a holder, means are provided for forcing the pins into the apertures to bring the bottom portions of the tubes in contact with the plates of the holders.

This means comprises the presser bar 44 upon which is mounted a plurality of sets of presser members 70, 71, 72, 73, 74, 75, 76, 77, 78 and 79. Each of these members includes a plurality of fingers 80 and a plunger 81 extending through the bar 44. A helical spring 82 normally urges each of the presser members downwardly. When the first pair of tubes are disposed in a holder the presser members 70 and 71 move with the presser bar 44 downwardly until the fingers 80 engage the top of the bulbs and force the pins thereof into the apertures.

After the holders on the conveyor become filled with radio tubes, the additional sets of presser members above mentioned engage the tubes in four different positions to hold the same rigid during the application of a fluxing agent to the ends of the pins or contact elements and during the application of solder to the said ends. Mechanism for actuating the presser bar may comprise the cams 42 and 43, which are of the internal or box type, and engage with offset portions 83 and 84 at the ends of links 85 and 86, which links are pivoted to carrier rods 87 and 88 respectively, the upper ends of the carrier rods being secured to the presser bar. The cams 42 and 43 are so formed as to cause an actuation of the presser bar to bring the tension members into engagement with the bulbs, during the intermittent stationary periods as they move with the conveyor.

After each intermittent movement when the conveyor is at a rest period the pressure bar 44 is actuated and the bulbs are moved so that the bottom portions of the bases of the bulbs are seated upon the plates 28, thus disposing the contact elements of the bulbs in operative relation to the fluxing medium or the solder.

The foregoing description gives the various operations of the machine in so far as the delivery of the radio tubes to position for fluxing and soldering is concerned. For the purpose of applying a flux to the ends of the contact elements, a fluxing pad 89' is provided. This pad is carried in a pan 90' (see Fig. 4) and a suitable container 91' is provided with a discharge nozzle for the delivery of a fluxing medium, such as an acid, to

the pan 90'. The pad 89' being disposed in the acid absorbs the same to provide a moist surface with which the contact elements of the tube engage to receive a deposit of the fluxing medium.

The pan 90' is carried on a bracket 92' extending from the upper end of a vertical reciprocable rod 93'. The opposite end of the rod is pivoted at 91 one end to a lever 92 having a roller 93 intermediate its ends. The opposite end of the lever 92 is pivoted at 94 to a depending bearing 95. The roller 93 is positioned for contact with the cam 48 secured to shaft 41. The cam 48 is so arranged and proportioned that a rotation thereof will cause an upward and downward movement of the rod 93' to bring the pad 89' to and from engagement with the contact elements of a positioned radio tube. The fluxing pad may obviously be of sufficient width to extend across the conveyor whereby a pair of radio tubes are given a fluxing operation simultaneously.

The mechanism just described for causing an operation of the flux-pad has been directed to the pad actuated by the cam 48 which is the initial fluxing operation. A second fluxing operation is, however, performed by means of a fluxing pad 96 (see Fig. 1) which pad is actuated by the cam 46. The mechanism intermediate the cam and the pad being the same as that just described for the first mentioned fluxing mechanism.

After the first fluxing operation is performed and the conveyor moves to another stage, the fluxed ends of a pair of radio tubes will be disposed in position to receive a deposit of solder. The soldering operation is performed in two stages. The first taking place after the initial fluxing operation and the second taking place after the second fluxing operation.

The first soldering pot is indicated by the numeral 97 and the second soldering pot by the numeral 98 (see Fig. 1). Inasmuch as the mechanisms for operating the respective soldering pots are similar, a description of one will answer for both.

Considering the soldering pot 97 the same consists of a container 99 having therein a quantity of solder 100 which is maintained in a molten condition by any suitable means as for example an electric heating coil 101. Although the contact elements may be dipped directly into the solder disposed in the container 99, it has been found advantageous in order to maintain a constant surface level of the solder, to provide a dip pan 102.

The dip pan 102 is arranged to be submerged in the molten solder 100 and moved upwardly therefrom so that the pan always removes a portion or increment of the solder (see Fig. 5) which obviously is always of the same depth so that the surface

thereof for contacting with the contact elements of the base, is at a predetermined level 104. The pan 102 is mounted on a vertical reciprocal rod 105 (see Fig. 5) movable in a bearing 106 secured to the bed plate 25. Pivoted at 107 to the lower end of the rod 105 is a lever 108 which is also pivotally connected at 109 to a depending bearing 110.

A roller 111 is mounted on the lever 108 and arranged to engage with a cam 47 on the shaft 41 so that a rotation of the said shaft will cause an oscillation of the lever with a consequent up and down movement of the dip pan 102. It has been found that when employing molten solder, the surface thereof becomes covered with a filament or layer of dross which is detrimental to the soldering operation. Since it is obviously preferable to bring the contact elements into contact with a clean surface of the soldering material, means are employed whereby the surface of the material in the container is cleaned while the dip pan is in its lower position beneath the surface of the solder material. The means for cleaning the surface of the solder may, as shown in Figure 6, comprise a scraper 113 mounted on a head 114 slidable on rods 115 disposed in support members 116 and 117 at opposite sides of the container 99. The scraper 113 is attached to a link 118, the link being pivoted at 119 to the head 114 and at 120 to an end 121 of an actuating rod 122. The opposite end of the said rod is pivoted at 123 to an arm 124 of a bell-crank 125, the said bell-crank being pivotally supported at 126 in a bearing 127 secured to the bed plate 25. An opposite arm 128 of the bell-crank is pivotally attached at 129 to one end of a rod 130, the opposite end of the rod being pivoted at 131 to an arm 132 fulcrumed at 133 in a bearing 134 secured to the bed plate 25. An end 135 of the arm 132 is provided with a roller 136 arranged to engage with a cam 137 secured to the shaft 41 so that upon a rotation of the shaft the cam 137 will cause an actuation of the scraper 113 to move it across the surface of the molten material to position indicated in dotted lines.

The operative elements of the machine are so arranged that while the dip pan 102 is positioned below the surface of the molten material, the scraper is actuated to cleanse said surface so that when the dip pan moves upwardly it carries a portion of the material, the surface of which is free from foreign matter or substance detrimental to the effective deposit of the solder upon the contact elements. After the contact elements of a pair of tubes have been dipped into the solder the pan is again submerged by a rotation of the shaft 41 which also causes the subsequent movement of the scraper to its

initial position to scrape the surface of the molten metal.

The operation of soldering as accomplished by the present machine includes the transfer of an article to be soldered, as a radio tube, from another machine for deposit into the conveyor 15. The conveyor then moves the tube so that the contact elements thereof travel through a predetermined path. Adjacent to the path of travel of the contact elements as above described are disposed a plurality of means for alternately fluxing and applying solder to the contact elements. As shown in Figures 7 to 10 the contact elements of a radio tube are first brought in contact with the pad 89' so that a quantity of flux adheres to the contact elements. As the conveyor is moved to the next stage of its travel, a dip pan 102 moves upwardly to bring a portion of the solder in contact with the fluxed ends of the contact elements. This operation, which may be termed the initial soldering operation, causes a relatively thin deposit of solder 138 as shown in Figure 12, which operation is in the nature of a tinning step and the relatively small deposit of solder serves to connect a lead wire 139 with the contact element which in many cases is satisfactory from a manufacturing standpoint.

It has been found, however, that a more effective and practical result is obtained by repeating the soldering operation, and the present machine, therefore, provides the second fluxing pad for the application of the fluxing medium to the contact elements which already have solder applied to their ends. The conveyor then moves the tube to position for the second soldering operation and the dip pan of the solder pot or container 98 is actuated to bring the ends of the contact elements in contact with the surface of the solder. This second soldering operation results in a more complete contact between the lead 139 and the pin, since as shown in Figure 14, a portion of the solder by reason of the capillary attraction in the aperture 140 of the pin, causes the solder to extend as at 141 into the pan and surrounding the lead, thus making an effective electrical connection between the lead and the pin and the contact element.

An important feature of the present invention is the cooperation of the present machine with a machine in which the articles and consequently the contact elements are heated. As shown in the drawing (Figs. 1 and 3) a portion of a basing machine employing a conveyor 145 is shown. This conveyor may be part of any suitable basing machine as used in the lamp industry in which bases are provided with the usual cement disposed about the necks of bulbs. The conveyor carries the bases and bulbs through

an oven for a heat treatment of the basing cement.

Inasmuch as the basing temperature is held constant the contact elements of the devices have uniform temperature. This is an advantage in soldering since when the contacts are cold or partly warm the action of the flux and the applied solder varies and it is difficult to obtain a uniform deposit. By coupling the present machine with a machine wherein the contact elements are preheated as in an oven 146 of a basing machine, a fixed condition is attained and the desired uniformity in soldering is made possible.

The present invention therefore not only provides a rapid and efficient mechanism for applying solder to contact elements but performs this operation in combination with a machine which aids materially in obtaining better quality, giving a new and desirable result.

The present invention makes it possible to rapidly and effectively perform the delicate operation of applying solder to the contact elements of a radio tube in such manner as to electrically connect the lead-in wires with the contact elements, and at the same time apply the solder in the form of a bead of uniform thickness.

Although a preferred embodiment of the invention is shown and described herein, it is to be understood that modifications may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A machine for applying solder to the contact elements of radio tubes or the like comprising a container, molten metal in said container, means for removing the surface layer from said molten metal, a dipper, means for moving said dipper into said molten material after the surface layer thereof has been removed, means for removing said dipper to bring a portion of clean material adjacent to a radio tube and means for moving said tube to insert the ends of the contact elements thereof into the molten material in said dipper.

2. A machine of the class described comprising a conveyor, a plurality of tube supporting means on said conveyor, means for applying tubes to said supporting means, a container having a flux therein, a container having molten solder therein, means for moving tubes successively under said flux, means for changing the relative positions of said flux and said tube to apply the flux to the ends of the contact elements of said tubes, means for moving said tubes adjacent to said molten metal, means for changing the relative position of said metal and said tube to apply the flux ends of said contact elements to said molten metal and means for discharging the said tubes.

3. A soldering machine comprising a container for molten solder, means for supporting an article to be soldered above said container, a dipper member, means for immersing said member in said solder, means for cleaning the surface of said solder and means for raising said dipper member to move solder having a clean surface into contact with said article.

4. A soldering machine comprising a container for molten solder, a dipper member, means for immersing the dipper member in said solder, a surface scraper, means for actuating said scraper to clean the surface of said solder and means for raising the dipper member to remove solder having a clean surface.

5. A machine for applying beads of solder to the ends of contact elements of radio tubes or the like comprising a conveyor, a plurality of holders on said conveyor for holding tubes with the contact elements exposed, fluxing means and soldering means disposed adjacent to the path of movement of said conveyor, means for actuating said conveyor to successively position said tubes with the ends of said contact elements in operative relation to said fluxing and soldering means and means for moving said fluxing and soldering means for the application of a flux and solder to the ends of said contact elements to apply beads of solder to said ends.

6. A machine for applying beads of solder to the ends of contact elements of radio tubes or the like comprising a conveyor, a plurality of holders on said conveyor for holding tubes with the ends of the contact elements thereof exposed, fluxing means and soldering means disposed adjacent to the path of movement of said conveyor, means for actuating said conveyor to successively position said tubes with the ends of said contact elements in given position with respect to said fluxing and soldering means and means for moving said fluxing and soldering means for the application of flux and solder to the ends of said contact elements to apply beads of solder to said ends.

7. A machine for applying solder to the contact elements of radio tubes or the like comprising a container, molten metal in said container, means for removing the surface layer from said molten metal, a dipper, means for moving said dipper into said molten material after the surface layer thereof has been removed, means for removing said dipper to bring a portion of metal with a clean surface adjacent to a radio tube and means for moving dipper to insert the ends of the contact elements thereof into the molten metal in said dipper.

8. A machine for applying solder to the ends of contact elements of radio tubes or the like comprising a fluxing means, a soldering means, means for supporting tubes with

the ends of contact elements positioned above said fluxing and soldering means, means for moving said fluxing means and said soldering means to simultaneously apply flux to the ends of the contact elements of one tube and solder to the ends of contact elements of another tube and means for moving tubes progressively for a fluxing and soldering operation.

10 In testimony whereof, we have hereunto subscribed our names this 31st day of October, 1928.

JOHN E. FERGUSON.
ROBERT W. CONN.
WALTER A. HOFFMAN.

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