April 18, 1933. J. M. FAGAN 1,904,214

DEVICE FOR HIGH FREQUENCY INDUCTION HEATING

Filed Jan. 22, 1930

Fig. 2.

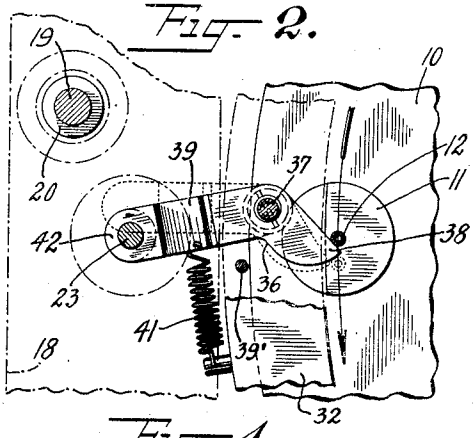


Fig. 4.

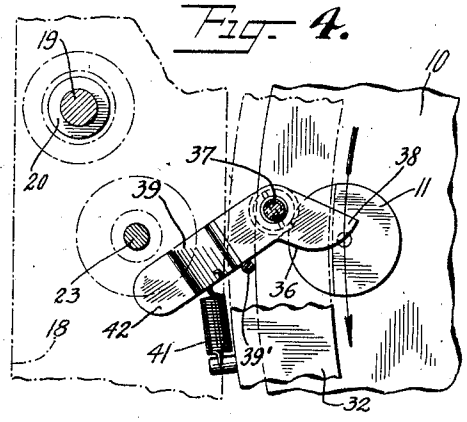


Fig. 1.

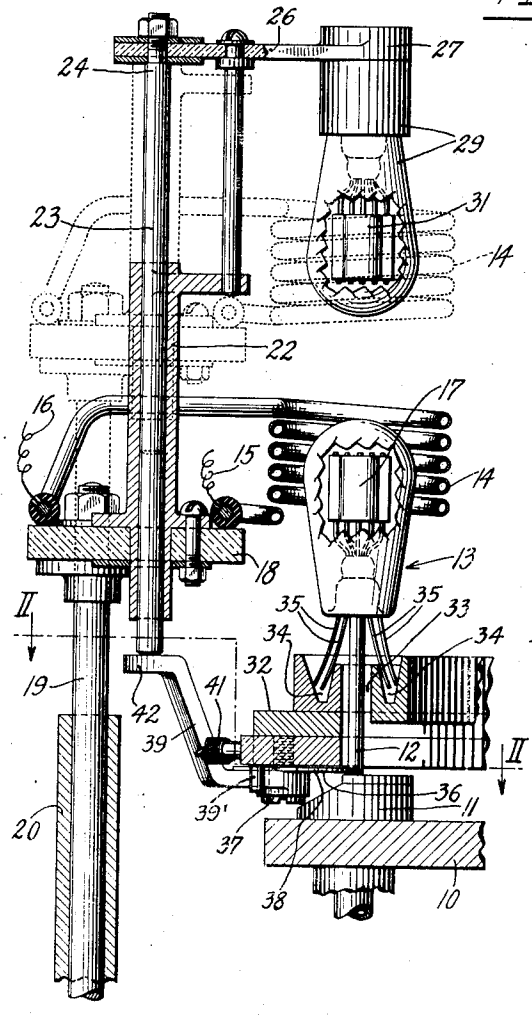


Fig. 5.

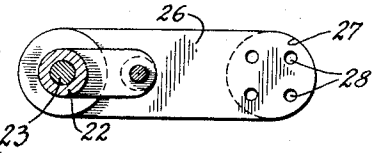
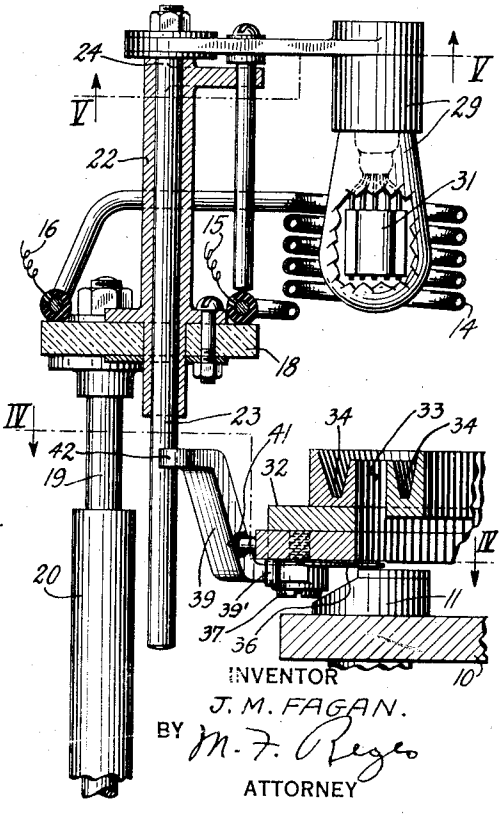


Fig. 3.



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Patented Apr. 18, 1933

1,904,214

UNITED STATES PATENT OFFICE

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DEVICE FOR HIGH FREQUENCY INDUCTION HEATING

Application filed January 22, 1930. Serial No. 422,533.

This invention relates to the manufacture of evacuated devices and relates more particularly to apparatus for controlling the operation of heat treating radio tubes or the like as set forth in my copending application Serial No. 401,743 filed October 23, 1929, now Patent #1,803,500.

In the manufacture of radio tubes which include a plurality of internal electrodes, as for example, a cathode, control element or grid and an anode or plate, it is necessary, after the device is structurally complete, to remove impurities from the electrodes particularly from the plate. The removal of impurities is accomplished by heat treatment and a convenient and practical method of heat treating is attained by disposing a coil of wire about the tube and in passing high frequency current through the coil to create a high frequency field and thus inductively heat the electrode sufficiently to drive out the gases and perform what is termed a degasifying operation.

In order to completely degasify a radio tube it is necessary to subject the tube to a plurality of successive degasifying operations while the tube is connected to an exhaust pump so that the deleterious gases will be drawn from the bulb after each heat treatment. The degasifying operation is therefore performed while the devices are on the exhaust machine and in communication with the vacuum line and in order to attain high speed production a plurality of degasifying devices are employed for simultaneous disposition over a plurality of tubes.

The exhaust machine usually consists of a spider having exhaust ports in which the exhaust tubes of radio tubes are inserted. The spider is moved intermittently and with each movement one radio tube passes from a degasifying position so that with each intermittent movement of the machine a degasified tube is ready for removal to be subjected to other manufacturing operations.

As above set forth it is essential in order to produce devices such as radio tubes at a rate of speed commensurate with other manufacturing operations, to so arrange and organize degasifying devices that they may be disposed over a plurality of tubes simultaneously.

It has been found, however, that in practice it often happens that the operator fails to insert a radio tube into an exhaust port so that when the machine moves it may happen that instead of the total number of tubes being positioned for a degasifying operation, one or more may be missing. Inasmuch as the several coils of the degasifying devices are connected in series with a constant source of high frequency current the total amount of high frequency current must be so regulated as to be sufficient to provide a high frequency field capable of heating a given mass of metal which in the present case would be the total number of plates disposed in the field. If a tube is missing at one of the high frequency positions or fields then an over-load is impressed upon the anodes or other metallic portions of the remaining tubes with the result that the temperature of the parts is elevated above that necessary for degasification and the metallic parts may be burned or rendered otherwise defective for the purpose for which they are intended.

An apparatus for practicing the above set forth degasifying operation is shown and described in copending application Serial No. 400,308 filed October 17, 1929 and assigned to the same assignee as is the present invention. In the said copending application a plurality of high frequency fields are created for treating a plurality of electrodes. The total strength of the said high frequency fields is such as to be capable of properly heat treating a given number of electrodes and in the event that one of the electrodes to be treated is missing the remaining electrodes receive an excessive heat treatment.

For the purpose of avoiding the overheating of less than a given number of electrodes the above mentioned copending application discloses an electrical energy absorbing member which is automatically disposed in the field upon the omission of one of the electrodes as a compensating medium, so that an amount of electrical energy equal to that of the missing electrode will be absorbed, thus preventing an over-heating of the remaining electrodes.

The present invention is in the nature of an improvement over the apparatus shown in the above mentioned copending applications and whereas in the above copending applications an electric energy absorbing member is provided either in the form of a solid body or in the form of a coil of wire arranged to be displaced by a device to be heat treated, the present invention provides mechanism capable of lateral engagement with a portion of a positioned device to prevent the movement of an electric energy absorbing member into a high frequency field when a device to be treated is present.

It is an object of the present invention therefore to provide mechanism disposed adjacent to a high frequency field capable of cooperating with a positioned device to prevent the movement of an electric energy absorbing member.

Other objects and advantages of the invention will be evident from the following description together with the accompanying drawing, in which

Fig. 1 is a side elevational view in cross section showing a portion of a conveyor and adjacent mechanism for controlling the movement of an electric energy absorbing member.

Fig. 2 is a view taken on line 11—11 in Fig. 1;

Fig. 3 is a fragmentary view similar to Fig. 1 but showing the mechanism upon which the electric energy absorbing member is mounted, in a raised position.

Fig. 4 is a view taken on line IV—IV in Fig. 3, and

Fig. 5 is a view taken on line V—V in Fig. 3.

A practical embodiment of the invention may, as illustrated, comprise a conveyor 10 constituting a rotary spider of an exhaust machine having exhaust ports 11 to receive exhaust tubes 12 of an electrical device 13 such as a radio tube or the like.

The conveyor 10 may be rotatable in a series of intermittent movements in the usual manner by mechanism (not shown) so as to bring a device 13 to position beneath a helical conductor 14 when in its upper position as shown in Fig. 3.

The conductor 14 may be connected by conductors 15 and 16 to any suitable source of high frequency current. When the conductor is moved downwardly as shown in Fig. 1 the coil 14 will surround the device so as to enclose the electrodes 17 in a high frequency field and subject them to a heat treatment. Means for moving the coil 14 over a device may comprise a cross head 18 to which the coil is secured. The cross head is provided with a reciprocal lifter rod 19 slidable in a guide bearing 20 extending upwardly from and through the cross head 18, a vertical guide 22 having a slide rod 23 disposed therein. The upper end 24 of the slide rod is provided with an etxending arm 26 having a socket 27 provided with apertures 28 to receive contact pins of a radio tube 29.

In the present construction the electric energy absorbing member is in the form of a device similar to the device being heat treated so that the electrodes 31 of the electric energy absorbing member will absorb the same amount of energy as have been absorbed by a device to be treated. It is to be understood, however, that in place of the dummy tube 29 a metallic body or coil of wire such as set forth in the above mentioned copending applications, may be employed.

Mechanism actuated by the conveyor mechanism lifts the lifter rod 19 to raise the cross head and hence the coil 14, to the position shown in dotted lines in Fig. 1 to permit the movement of a device to be treated beneath the said coil. The mechanism for actuating the lifter rod 19 may operate through a definite cycle so that the lifter rod 19 is actuated each time. It is necessary therefore to provide mechanism which will, in the absence of a device beneath the coil, permit the tube 29 to travel downwardly and occupy the position of the absent device to be treated.

The mechanism above described, therefore, normally operates to carry the tube 29 to the position to be occupied by a device to be treated. Cooperating mechanism is, however, provided to prevent the downward movement of the tube 29 if a device to be treated is in position. This cooperating mechanism may comprise a stationary guide bracket 32 positioned above the conveyor and having a slot 33 for the passage of the exhaust tube 12. Grooves 34 may be provided to receive lead wires 35 of the device 13. The present invention takes advantage of the positioned exhaust tube and utilizes the same to actuate mechanisms to prevent the downward movement of the tube 29 when a device to be treated is in its proper position.

The means for preventing the downward movement of the tube 29 may comprise lever member 36 pivotally connected to the stationary bracket 32 at 37. The lever member 36 may be in the form of a bell crank having a short arm 38 and a long arm 39. A spring 41 connected with the long arm 39 normally operates to engage the arm 39 with a stop pin 39′ and holds the short arm 38 with one end

in the path of movement of the exhaust tube 12. If a device 13 is in position as the conveyor 10 moves to bring the device beneath the coil 14 the arm 38 will be engaged by the exhaust tube 12 moving the offset portion or stop 42 on the long arm 39 beneath the slide rod 23, thus as the cross head is lowered to bring the coil 14 about the positioned device the tube 29 will remain in its elevated position and thus holding the electric energy absorbing member inoperative.

As the conveyor moves, mechanism operates to again raise the lifter rod 19 so that the guide bearing 22 takes the position as shown in dotted lines in Fig. 1 thus retaining the energy absorbing member 29 in place and as the conveyor 10 moves the lever 36 which may be termed a trigger member is moved to permit the exhaust tube 12 to pass and then by reason of the spring 41 the stop 42 is positioned out of alignment with the slide rod 23. This leaves the energy absorbing member in position to descend with the cross head if at the next index of the conveyor no device to be treated is in position to actuate the trigger member 36.

In constructing the present device it is desirable to employ non-magnetic material for the operating parts which are adjacent to the high frequency coil. The present construction provides a positive and effective mechanism for preventing the overloading of a given number of devices when in a high frequency field of a definite value.

It is to be understood that although only one mechanism is shown and described herein that the present construction is to be used in connection with a plurality of high frequency coils so that in the event that less than the proper number of devices are to be heat treated, the present mechanism will operate to position electric energy absorbing elements in the high frequency field to compensate for the absent devices.

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 inductively heating a body comprising means for supporting a body, a high frequency coil, means for moving the body through a horizontal path adjacent to said coil, a second body movable adjacent to said coil and means in the path of movement of said first mentioned body and engageable therewith to prevent movement of said second mentioned body.

2. A machine for inductively heating radio tube parts or the like comprising a conveyor for moving tubes through a horizontal path, holders on said conveyor for supporting radio tubes, a helical conductor disposed adjacent to the path of movement of said conveyor, means for moving said helical conductor about a tube supported on said conveyor, an electrical energy absorbing element movable toward a supported tube and means in the path of movement of and engageable with a supported tube to prevent movement of said element.

3. A machine for inductively heating metal parts of vacuum devices or the like comprising a conveyor, means on said conveyor to receive exhaust tubes of devices, a heater element, a plurality of members movable to position to be heated by said element in the absence of devices and means engageable with the exhaust tubes of positioned devices to prevent movement of said members.

4. In combination with an exhaust machine having ports to receive the exhaust tubes of electrical devices, means for inductively heating said devices, members movable to position to be inductively heated in the absence of devices and means engageable with said exhaust tubes for preventing movement of said members when devices are in position to be heated.

5. In combination with an exhaust machine having a conveyor with ports to receive the exhaust tubes of electrical devices for movement through a horizontal path, a plurality of helical conductors, a plurality of electrical energy absorbing elements, means for moving said elements to position to be heated by said conductors in the absence of electrical devices and means in the path of movement of said devices and engageable therewith for preventing a movement of said elements.

6. In combination with an exhaust machine having a conveyor with ports to receive the exhaust tubes of electrical devices for movement through a horizontal path a plurality of helical heater elements, means for retaining said heater elements above the path of movement of said devices, means for moving said heater elements over said devices, a plurality of heat absorbing members, means for moving said members to be heated by said elements and means in the path of movement of said devices and engageable therewith for preventing a movement of said members.

In testimony whereof, I have hereunto subscribed my name this 16th day of January 1930.

JAMES M. FAGAN.