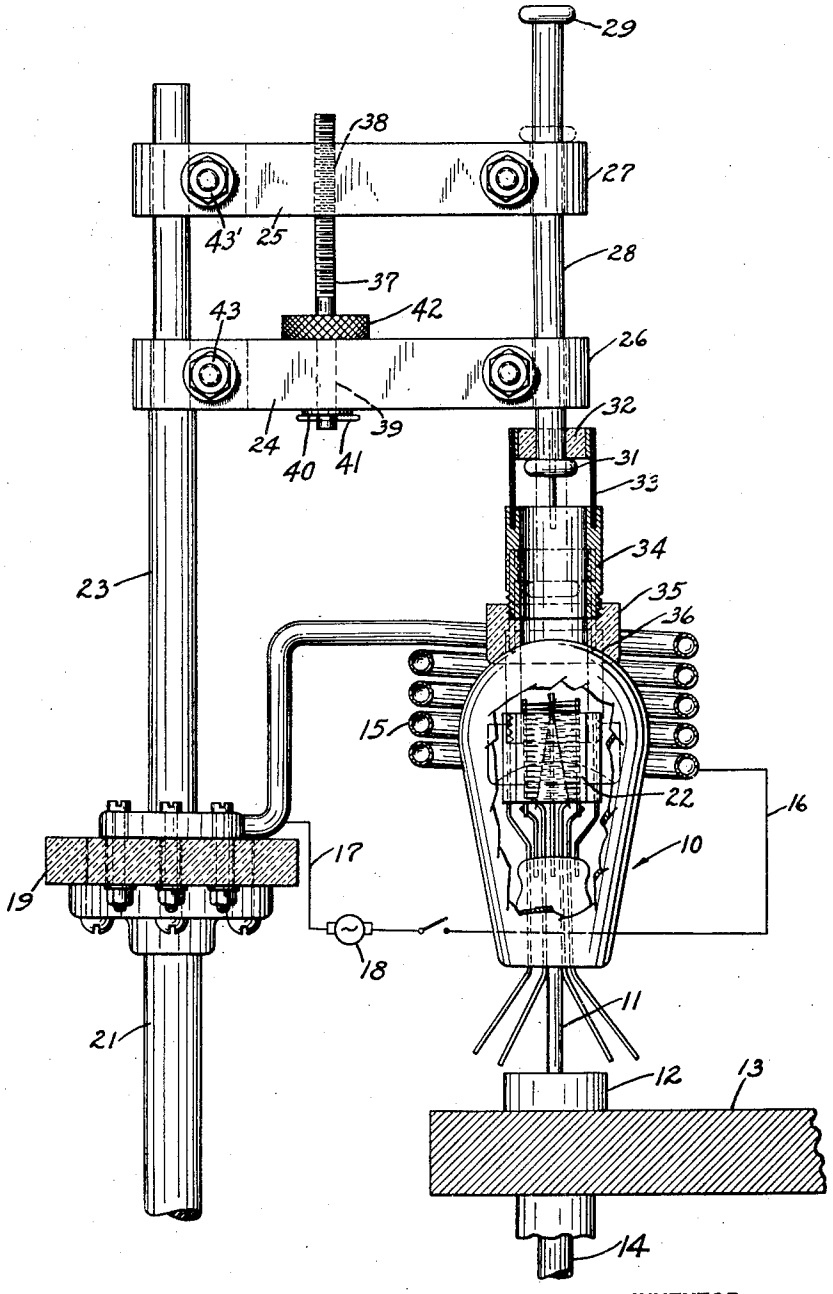
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HIGH FREQUENCY INDUCTION HEATING

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HIGH-FREQUENCY INDUCTION HEATING

Application filed October 23, 1929. Serial No. 401,743.

This invention relates to the manufacture of evacuated devices such as radio tubes or the like and relates more particularly to the operation of heat treating the electrodes within the tubes by the use of a high frequency field.

In the manufacture of radio tubes which include several 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 the plate. The removal of impurities is accomplished by a 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 filed and thus inductively heat the anode sufficiently to drive out the absorbed gases or 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 over-heating 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 and described in the said copending application wherein the electric energy absorbing member is in the form of a coil of wire and movable to a definite position within the high frequency field or to a position which would have been occupied by an electrode to be treated.

Although satisfactory results have been obtained by making the electrical energy absorbing member of such material and capacity as to absorb an amount of electrical energy equal to a given electrode, it is not always possible to accurately construct the electrical energy absorbing member so that it will have the desired electrical energy absorbing characteristic.

It has also been found that when it is necessary to alternately move the said member into and out from the high frequency field and consequently alternately heat and cool this member, a change in its electrical absorbing characteristic occurs so that the said member must be frequently changed in order to maintain its compensating value.

It is an object of the present invention therefore to provide a high frequency field with an electrical energy absorbing member capable of adjustment to vary the amount of absorbed electrical energy.

Another object of the invention consists in the provision of means for absorbing a given amount of electrical energy from a high frequency field.

Another object of the invention is to provide a high frequency field with an electrical absorbing member capable of being immersed in the said field to a predetermined depth for the absorption of a given amount of electrical energy.

Other objects and advantages of the invention will be evident from the following description together with the accompanying drawing which shows a side elevational view of an apparatus for inductively heating a metallic body and having the present invention applied thereto.

As illustrated a radio tube indicated as a whole by the numeral 10 may have the exhaust tube 11 thereof inserted into an exhaust port 12 and a conveyor 13 of an exhaust machine. An exhaust port 12 may lead through a conduit 14 to a vacuum pump (not shown). The conveyor 13 may be rotatable in a series of intermittent stages and may be of the type commonly used in connection with the manufacture of vacuum devices such as radio tubes or the like. A plurality of radio tubes 10 may be inserted into the exhaust ports 12 and moved to position adjacent to a plurality of heater elements or coils 15.

The coils 15 may be connected by conductors 16 and 17 with a source of high frequency current 18. It has been found preferable to employ four coils similar to the coil 15 connected in series with the source of high frequency current. The coils are secured to a cross head 19 mounted on a reciprocal rod 21. This rod may be connected by suitable mechanism (not shown) so as to move upwardly during a movement of the conveyor 13 and downwardly when the conveyor reaches a rest stage to position coils 15 about the electrodes 22 in the tubes 10 for a heat treatment. Extending from the cross head 19 is a post 23 having arms 24 and 25 extending therefrom and terminating in bearings 26 and 27 to loosely receive a slide rod 28. The slide rod 28 is provided with an enlargement or stop 29 at its upper end and the lower end 31 of the said rod is provided with a collar 32 having extensions 33 secured to a tubular electrical energy absorbing member 34. This member is preferably of low carbon steel and may be chromium coated to prevent oxidation.

The lower end of the said member 34 may be threaded and an insulative ring 35 having internal threads may be secured to the said member. The member 34 being carried at the end of the rod 28 is free to move downwardly, thus if no object such as a radio tube 10 is disposed in an exhaust port when the said port reaches the coil 15 the said electrical energy absorbing member 34 will drop into the coil and absorb its capacity of electrical energy. If a device such as a radio tube is positioned in an exhaust port it will be disposed on the axial line of the downward movement of the coil 15, thus a lower surface 36 of the insulative member would engage the top of the tube and prevent the electrical energy absorbing member 34 from entering the high frequency field.

It has been found that great accuracy in controlling the amount of electrical energy absorbed may be attained by regulating the degree of immersion of the element 34 into the high frequency field, thus means in the form of a micrometer adjustment screw 37 are provided between the extensions 24 and 25.

One end of the screw 37 extends through a threaded aperture 38 in extension 25 and the opposite end 39 is loosely journaled in the extension 24. A washer 40 and a cotter pin 41 at the lower end of the screw 37 together with a knurled thumb nut 42 hold the screw from relative movement in the extension 24. Normally the extensions 24 and 25 may be in the form of clamps and secured to the post 23 by bolts 43 and 43', thus when the extensions 24 and 25 are in a given position the slide rod 28 will drop until the stop 29 engages the upper surface of the extension 25 thus positioning the energy absorbing member 34 a given depth within the high frequency field.

In order to adjust the degree of drop of the member 34 the bolt 43′ may be loosened and the thumb nut 42 rotated causing an upward or downward movement of the extension 25, thus extending or limiting the degree of movement of the energy absorbing element 34 and permitting its adjustment to a predetermined degree in the high frequency field.

By reason of the present invention an electrical energy absorbing member may be provided and by a variation in the degree of its immersion into the high frequency field a variation in the amount of electrical energy absorbed will be attained.

Thus the degree of compensation may be accurately controlled and if the immersed portion of the electrical energy absorbing element loses its electrical absorbing characteristic the said member may be quickly and conveniently adjusted so that a new surface will be subjected to the field and the proper degree of energy will be absorbed.

By reason of the present invention a more accurate and durable device is provided and the operation of heat treating electrical devices without danger of subjecting them to excessive heat is attained in a simple and convenient manner.

Although a preferred embodiment of the invention is 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 degasifying metallic bodies comprising means for creating a high frequency field to inductively heat an electrode capable of absorbing a given amount of electrical energy, a body capable of absorbing electrical energy, means for moving said body into said field and means for regulating the degree of movement of said body into said field for the absorption of a given amount of electrical energy.

2. An apparatus for degasifying metallic bodies comprising means for creating a high frequency field capable of heating a given number of bodies, an electrical energy absorbing element, means for introducing said element into said field in the absence of one of said bodies and means for regulating the degree of immersion of said body into said field to effect an absorption of energy equal to the electrical energy absorption characteristics of the missing body.

3. An apparatus for degasifying a metallic body comprising means for creating a high frequency field, means for moving into said field a body capable of absorbing a given amount of electrical energy, a member capable of absorbing a greater amount of electrical energy than said body and means for moving said member to dispose a portion thereof into said field capable of absorbing an amount of electrical energy substantially equal to that absorbed by said body.

4. An apparatus for degasifying vacuum devices comprising a conveyor having a plurality of holders for said devices, means for creating a given number of high frequency fields, means for moving said conveyor to position a device into each of said fields to inductively heat the conductive structures in said devices for degasification, means for connecting each device with an exhaust pump to remove gases therefrom, electrical energy absorbing members, means for moving said members into said fields in the absence of said devices, and means for regulating the degree of immersion of said members into said fields to compensate for missing devices.

5. An apparatus for degasifying metallic bodies capable of absorbing a given total amount of electrical energy, a plurality of members, each of said members being capable of absorbing a greater amount of electrical energy than one of said bodies, means for creating a high frequency field for inductively heating said bodies to degasifying temperature and means for immersing portions of said members into said field in the absence of bodies to be degasified.

6. An apparatus for degasifying metallic bodies capable of absorbing a given total amount of electrical energy comprising a plurality of members, each of said members be capable of absorbing a greater amount of electrical energy than one of said bodies, means for creating a high frequency field for inductively heating said bodies to degasifying temperature, means for immersing portions of said members into said field in the absence of bodies to be degasified and means for varying the depth of immersion of said members.

7. An apparatus for degasifying metallic bodies comprising means for creating a high frequency field capable of heating a given number of bodies, an electrical energy absorbing element capable of absorbing a greater amount of electrical energy than one of said bodies, and means for moving said element a predetermined depth into said field in the absence of one of said bodies to absorb energy sufficient to compensate for the missing body.

8. An apparatus for degasifying metallic bodies comprising means for creating a plurality of high frequency fields of a combined given strength, an electrical energy absorbing element disposed adjacent to each of said fields, means for moving said elements into said fields in the absence of said bodies and adjustable means for limiting the degree of movement of said elements into said fields.

9. An apparatus for degasifying metallic bodies comprising means for creating a high frequency field for inductively heating said bodies, a tubular member of low carbon steel

capable of absorbing a greater amount of electrical energy than one of said bodies and means for immersing said member into said field to a depth sufficient to compensate for the missing body.

10. An apparatus for degasifying metallic bodies comprising means for creating a high frequency field for inductively heating said bodies, a member capable of absorbing electrical energy, means for protecting said member against oxidation and means for moving said member into said field in the absence of one of said bodies.

11. An apparatus for degasifying metallic bodies comprising means for creating a high frequency field for inductively heating said bodies, a member formed from low carbon steel capable of absorbing a given amount of electrical energy, a coating of chromium on said member and means for moving said member into said field in the absence of one of said bodies.

12. An apparatus for degasifying metallic bodies comprising means for creating a high frequency field for inductively heating said bodies, a tubular member formed from low carbon steel capable of absorbing a given amount of electrical energy and means for moving said member into said field in the absence of one of said bodies.

In testimony whereof, I have hereunto subscribed my name this 18th day of October, 1929.

JAMES M. FAGAN.