

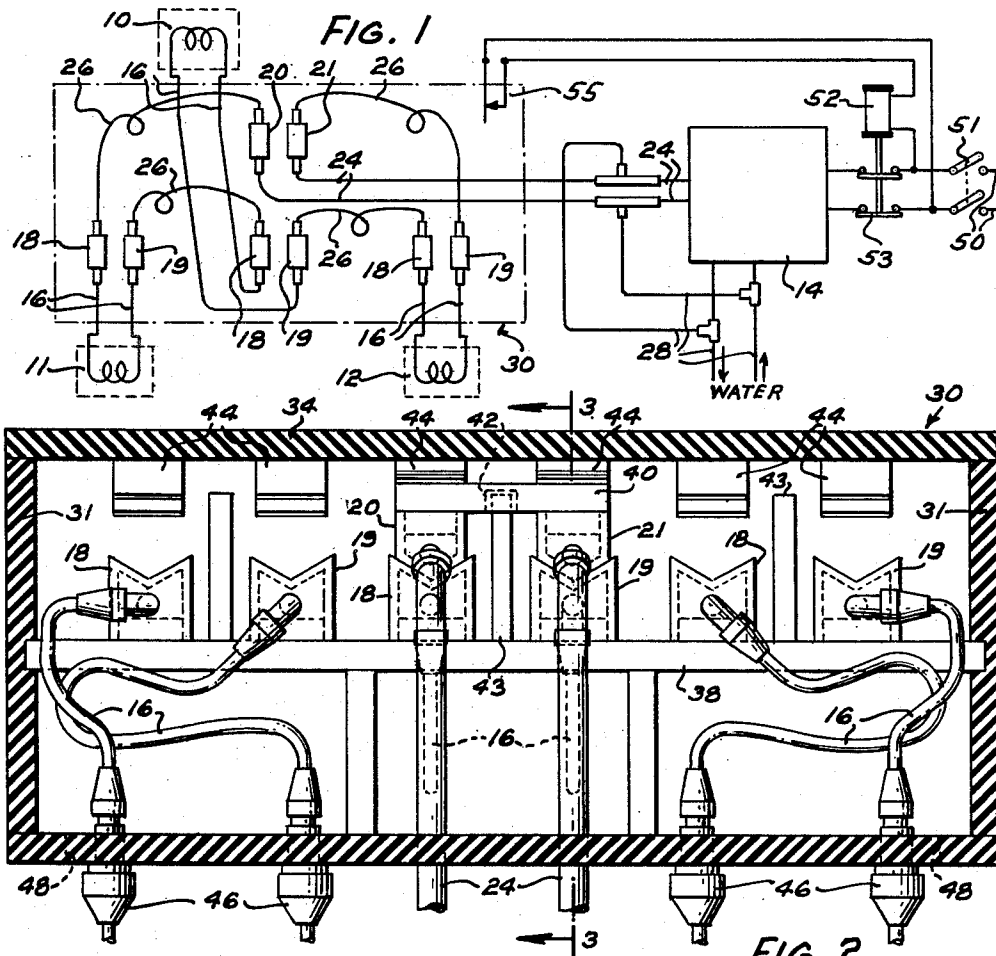
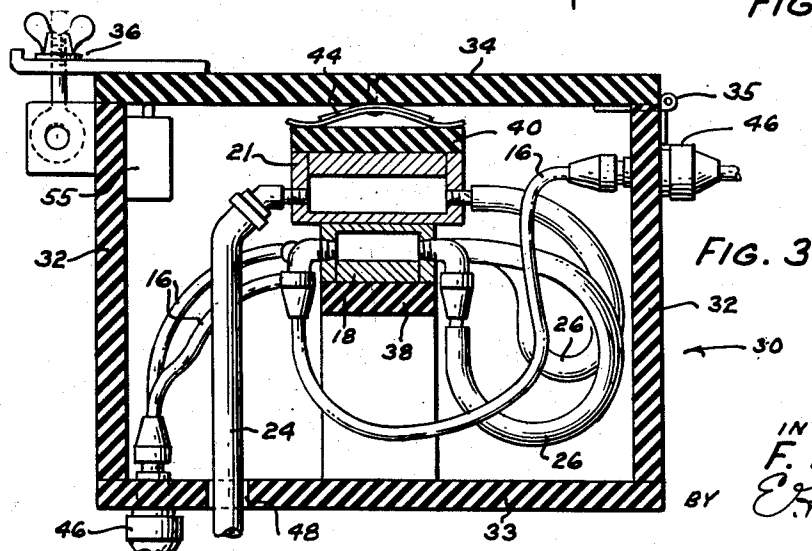
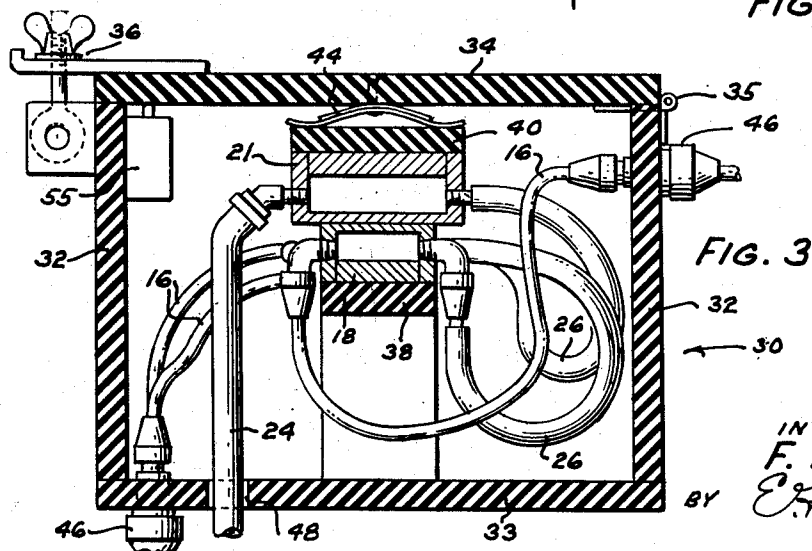
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INDUCTION HEATING APPARATUS

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INDUCTION HEATING APPARATUS

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This invention relates to induction heating apparatus and more particularly to induction heating apparatus having a plurality of water cooled heating coils and a switching device for selectively electrically connecting said coils to a source of high frequency current.

In the manufacturing industry, it frequently happens that there is need for a plurality of high frequency induction heating coils of various designs for various purposes to be used at different times and which may individually be connected to and energized from a common high frequency current generating unit.

It is an object of the present invention to provide a simplified arrangement for cooling a plurality of induction heating coils in a high frequency current induction heating apparatus and for selectively electrically connecting the coils to a source of high frequency current.

In accordance with one embodiment of the invention there is provided a high frequency current generator connected through a pair of tubular leads to a pair of hollow movable contact members which are movable into engagement with pairs of hollow contacts connected through tubular leads to a plurality of tubular induction heating coils for electrically connecting the coils individually to the high frequency current generator. Lengths of rubber tubing connect one hollow contact of each pair of contacts with the other of another pair of contacts and serve with the tubular leads to physically connect all coils and contacts in series and establish communication among them for the circulation of a coolant therethrough.

Other objects and advantages of the invention will become apparent by reference to the following detailed description thereof and the accompanying drawing illustrating a preferred embodiment of the invention, in which

Fig. 1 is a diagrammatic view of the high frequency induction heating apparatus;

Fig. 2 is a vertical, sectional, elevational view of the switch mechanism of the apparatus; and

Fig. 3 is a vertical, cross-sectional view of the switch taken on the line 3—3 of Fig. 2.

Referring to Fig. 1 of the drawing, there is shown three induction heating coils 10, 11 and 12, each individually connectible to a suitable source of high frequency current such as electronic high frequency generating unit indicated at 14. Individually designed for special purposes, the induction heating coils 10, 11 and 12 have shapes differing from each other for receiving and heating different parts. Each of the

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heating coils 10, 11 and 12 comprises a tubular metal coil having tubular leads 16 extending from the coil to one end of a pair of hollow stationary contact members 18 and 19.

A pair of movable hollow contacts 20 and 21 have connected thereto at one end, one end of a pair of flexible metal tubular leads 24 which at their other ends are connected to the high frequency current generator 14. By selectively engaging the contacts 20 and 21 with any pair of the stationary contacts 18 and 19 any one of the induction heating coils 10, 11 and 12 may be connected to the high frequency current generator 14 to energize the coil. Lengths of flexible tubing 26 of insulating material, such as rubber, connect one of each pair of contacts with the other of another pair of contacts, the contacts 18, 19, 20 and 21, the lengths of flexible rubber tubing 16, the tubular metal leads 24, and the coils 10, 11 and 12 being arranged as shown in Fig. 1 so that all of the contacts and the coils communicate with each other in series. Water or other coolant supplied through lines 28 to the tubular leads 24 is circulated through all of the stationary and movable contacts and the induction heating coils 10, 11 and 12.

The stationary and the movable contacts 18, 19, 20 and 21, the lengths of flexible rubber hose 26, and a portion of the flexible tubular leads 24 connected thereto are enclosed within a switch box 30 shown in Figs. 2 and 3. The switch box comprises end walls 31—31, side walls 32—32, a bottom wall 33, and a top wall or cover 34 hinged at 35 and provided with a latch or locking means 36 for retaining the cover in closed position. A shelf 38 of insulation within the switch box supports the stationary contact elements 18 and 19 in spaced relation to each other and the walls of the switch box to provide space and clearance for the tubular connections thereto. The hollow stationary contacts are provided with V-shaped upper walls forming grooves for receiving the movable contacts 20 and 21 having V-shaped lower surfaces conforming to the V-shaped grooves in the stationary contacts.

The movable contacts are attached to a plate 40 of insulation and may be moved as a unit from one pair of stationary contacts to another to connect the induction heating coils to the high frequency current generator 14. The plate 40 is provided with a recess 42 for receiving the upper end of pins 43 fixed to the shelf 38 between the pairs of stationary contacts 18 and 19 for locating the movable contacts 20 and 21

properly on the stationary contacts 18 and 19 and preventing lateral displacement thereof. Pairs of leaf springs 44—44 mounted on the cover 34 above each pair of stationary contacts engage the plate 40 when the cover is closed and serves to press the movable contacts 20 and 21 into firm engagement with the stationary contacts 18 and 19.

The flexible leads 16 from the heating coils 10, 11 and 12 to the stationary contacts 18 and 19 pass through apertures in the bottom and side wall of the switch box as shown in Fig. 3 and are secured thereto by suitable connections 46. Leads 24 from the movable contacts 20 and 21 to the high frequency current generator pass through a longitudinal slot 48 in the bottom 33 of the switch box, clearance being provided thereby for movement of the pair of movable contacts 20 and 21 from one position to another for engagement with the several pairs of stationary contacts 18 and 19.

The primary current to the high frequency generating unit 14 is supplied with a power line 50 under control of a switch 51. In order to insure that the high frequency current to the coils is disconnected from the coil in case the switch 51 has not been opened before the cover 30 of the switch box is opened to change the connection from one coil to another, a relay 52 is provided having normally open contacts 53 movable into closed position when the relay 52 is energized to complete the power circuit to the high frequency generator 14. A normally open microswitch 55 is located within the switch box and is actuated to its closed position when the cover 34 is closed, and serves to complete the circuit to and energize the relay 52 to close the power circuit to the high frequency generator 14, and upon the opening of the cover the switch 55 serves to deenergize the relay and disconnect the high frequency generator 14 from the power.

With the coils 10, 11 and 12 cooled by the continuous circulation of coolant therethrough, it is a relatively simple matter to operate the switch and connect any one of the coils to the high frequency current generator. For example, if it is desired to connect the induction heating coil 11 to the high frequency current unit, after switch 51 has been opened to disconnect the power from the high frequency current generator, the cover of the switch box is opened, and the movable contacts 20 and 21 are moved into engagement with the stationary contacts 18 and 19 associated with the induction heating coil 11. The cover is then closed and locked in closed position with the locking device 36 thereby closing switch 55, and the switch 51 is then closed which effects the closing of contacts 53 to supply primary power to the high frequency generator, which in turn will then supply high frequency current to the heating coil 11. Thus with this high frequency induction heating apparatus with its simplified switch and coil cooling arrangement, any one of the induction heating coils may be electrically connected to the high frequency generator without the need of making any change in the means for cooling the heating coils.

While in the embodiment of the invention disclosed herein only one induction heating coil is connected at one time to the source 14 of high frequency current it will be understood that the apparatus may be modified within the spirit of the invention to permit any two or more coils of a plurality of heating coils to be simultaneously electrically connected to the source of current.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A high frequency heating apparatus comprising a plurality of hollow heating coils having hollow leads, a pair of hollow contact members connected to the leads of each of said coils, a high frequency current generator having a plurality of flexible hollow leads connected thereto, a plurality of movable hollow contacts connected to said flexible hollow leads, said movable contacts being selectively engageable with the pairs of contacts associated with said coils to electrically connect said coils to said high frequency current generator, and flexible hollow members of electrical insulating material interconnecting the hollow contacts and cooperating with the flexible hollow leads and coils to form a single continuous conduit for circulating a coolant through all of said coils and said contacts and for maintaining said coils in insulated relation to each other.

2. An induction heating apparatus comprising a plurality of hollow heating coils having hollow leads, a pair of hollow contact members connected to the leads of each of said coils, a high frequency current generator having a pair of flexible hollow leads connected thereto, a pair of movable hollow contacts on said leads, said movable contacts being selectively engageable with the pairs of contacts associated with said coils to electrically connect said coils to said high frequency current generator, and flexible conduits of electrical insulation interconnecting the hollow contacts and cooperating with the flexible hollow leads and coils to form a single continuous conduit for circulating a coolant through all of said coils and said contacts and for maintaining said coils in insulated relation one to another.

3. In an induction heating apparatus, the combination of a plurality of tubular metal heating coils having tubular leads extending therefrom, a pair of hollow first contact members connected to the leads from each of said coils, a pair of hollow second contact members having tubular leads connectible to a source of high frequency current, said second contact members being movable into engagement with the first contact members to selectively connect said coils to said source of current, and a plurality of hollow electrical insulating members connected to said contact members, each of said hollow insulating members establishing communication between two of said contact members and cooperating with said tubular leads to form a conduit establishing communication in series with all of said coils for the circulation of a coolant therethrough.

4. In an induction heating apparatus, the combination of a plurality of tubular metal heating coils having tubular leads extending therefrom, a pair of hollow first contact members connected to the leads from each of said coils, a plurality of hollow second contact members having tubular leads connectible to a source of high frequency current, said second contact members being movable into engagement with the first contact members to selectively connect said coils to said source of current, a plurality of hollow insulating members connected to said contact members, each of said hollow insulating members establishing com-

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munication between two of said contact members and cooperating with said tubular leads to form a conduit establishing communication in series with all of said coils, and means for directing coolant into said conduit.

5. An induction heating apparatus comprising a plurality of tubular heating coils having tubular leads extending therefrom, a pair of hollow first contact members connected to the leads from each of said coils, a first means supporting said first contact members in predetermined fixed relation to each other, a plurality of second hollow contact members having tubular leads connectible to a source of high frequency current, a second means supporting said second contact members in predetermined fixed relation to each other, one of said supporting means being movable relative to the other to permit the engagement of said first contact members with said second contact members to selectively connect said coils to said source of current, and a plurality of insulating conduits connected to said hollow contacts and cooperating with said tubular leads to form a continuous conduit establishing communication in series with all of said coils for the passage of coolant therethrough and for maintaining said coils in insulated relation one to another.

6. An induction heating apparatus comprising a source of high frequency current, a plurality of tubular heating coils having tubular leads extending therefrom, a pair of hollow first contact members connected to the leads from each of said coils, a first means supporting said first contact members in predetermined fixed relation to each other, a pair of second hollow contact members having tubular leads connected to said source of high frequency current, a second means supporting said second contact members in predetermined fixed relation to each other, one of said supporting means being movable relative to the other to permit the engagement of said first contact members with said second contact members to selectively connect said coils to said source of current, and a plurality of hollow insulating members connected to said hollow contacts, each of said insulating members establishing communication between two of said contact members and cooperating with said tubular leads to form a continuous conduit establishing communication in series with all of said coils for the passage of coolant therethrough.

7. An induction heating apparatus comprising

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a plurality of hollow heating coils each having a pair of hollow leads extending therefrom, a pair of hollow stationary contact members connected to the pair of leads from each of said coils, a plurality of movable hollow contact members having hollow leads connectible to a source of high frequency current, said movable contact members being movable into engagement with the stationary contact members to selectively connect said coils to said source of current, a plurality of hollow insulating members connected to said contact members, each of said insulating members establishing communication between the two of said contact members and in cooperation with said hollow leads forming a continuous conduit means establishing communication in series with all of said coils for the passage of a coolant therethrough, and means for directing coolant into said conduit means.

8. An induction heating apparatus comprising a source of high frequency current, a plurality of hollow heating coils each having a pair of hollow leads extending therefrom, a pair of hollow stationary contact members connected to the pair of leads from each of said coils, a plurality of movable hollow contact members having hollow leads connectible to a source of high frequency current, said movable contact members being movable into engagement with the stationary contact members to selectively connect said coils to said source of current, a plurality of hollow insulating members connected to said contact members, and cooperating with said hollow leads and coils to form a single continuous conduit means establishing communication in series with all of said coils for the passage of a coolant therethrough and for maintaining said coils in insulated relation one to another, and means for directing coolant into said conduit means.

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