June 6, 1967 J. W. GRIFFITH ETAL 3,324,009

MERCURY DISTILLATION APPARATUS WITH ELECTRIC HEAT CONTROL

Filed Nov. 27, 1963 2 Sheets-Sheet 1

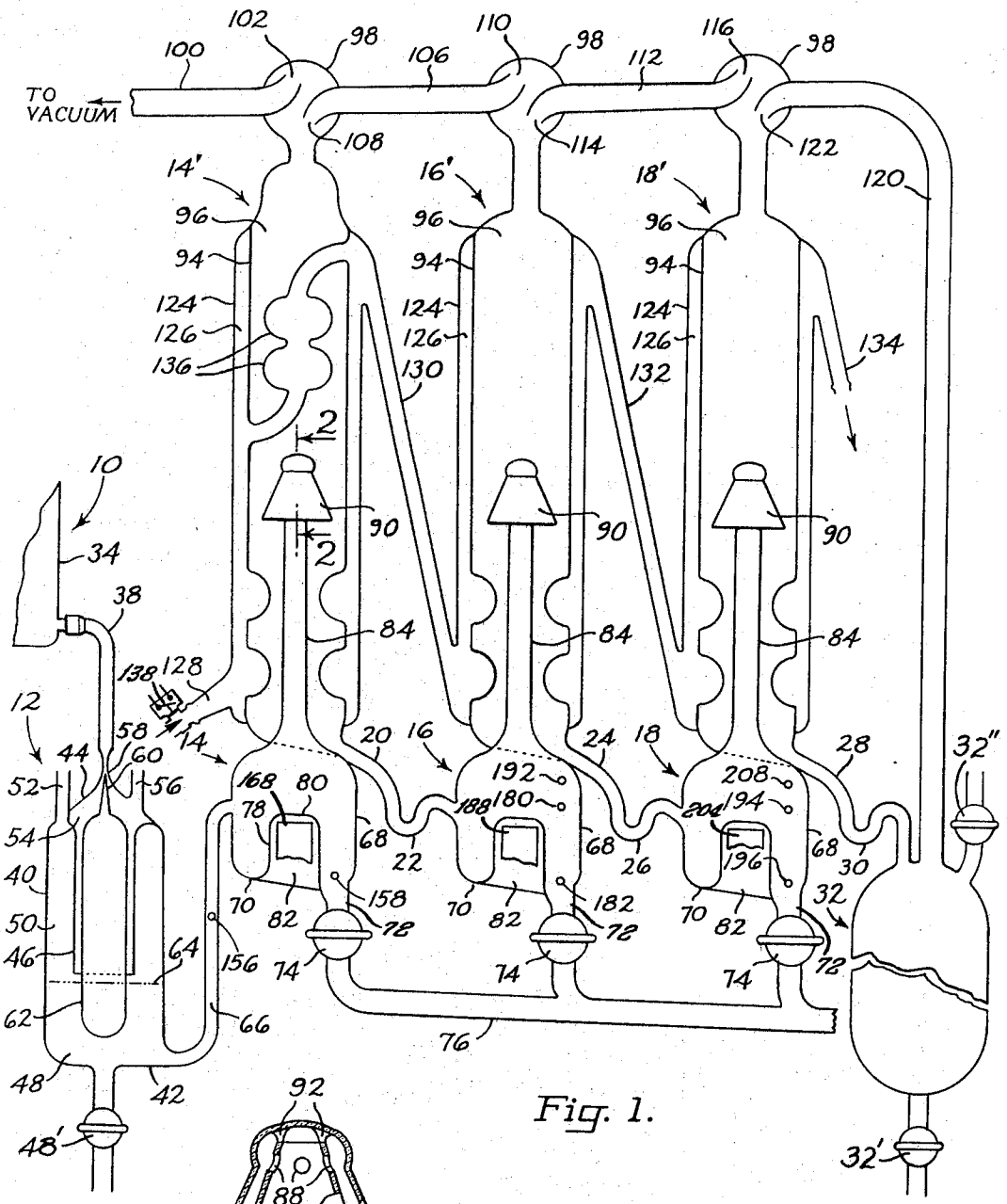



Fig. 1.

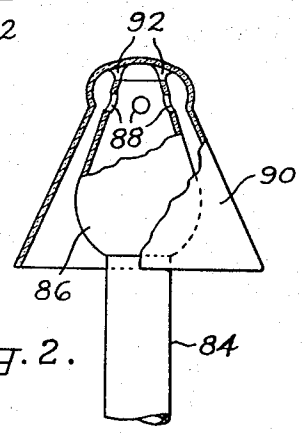



Fig. 2.

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MERCURY DISTILLATION APPARATUS WITH ELECTRIC HEAT CONTROL

Filed Nov. 27, 1963 2 Sheets-Sheet 2

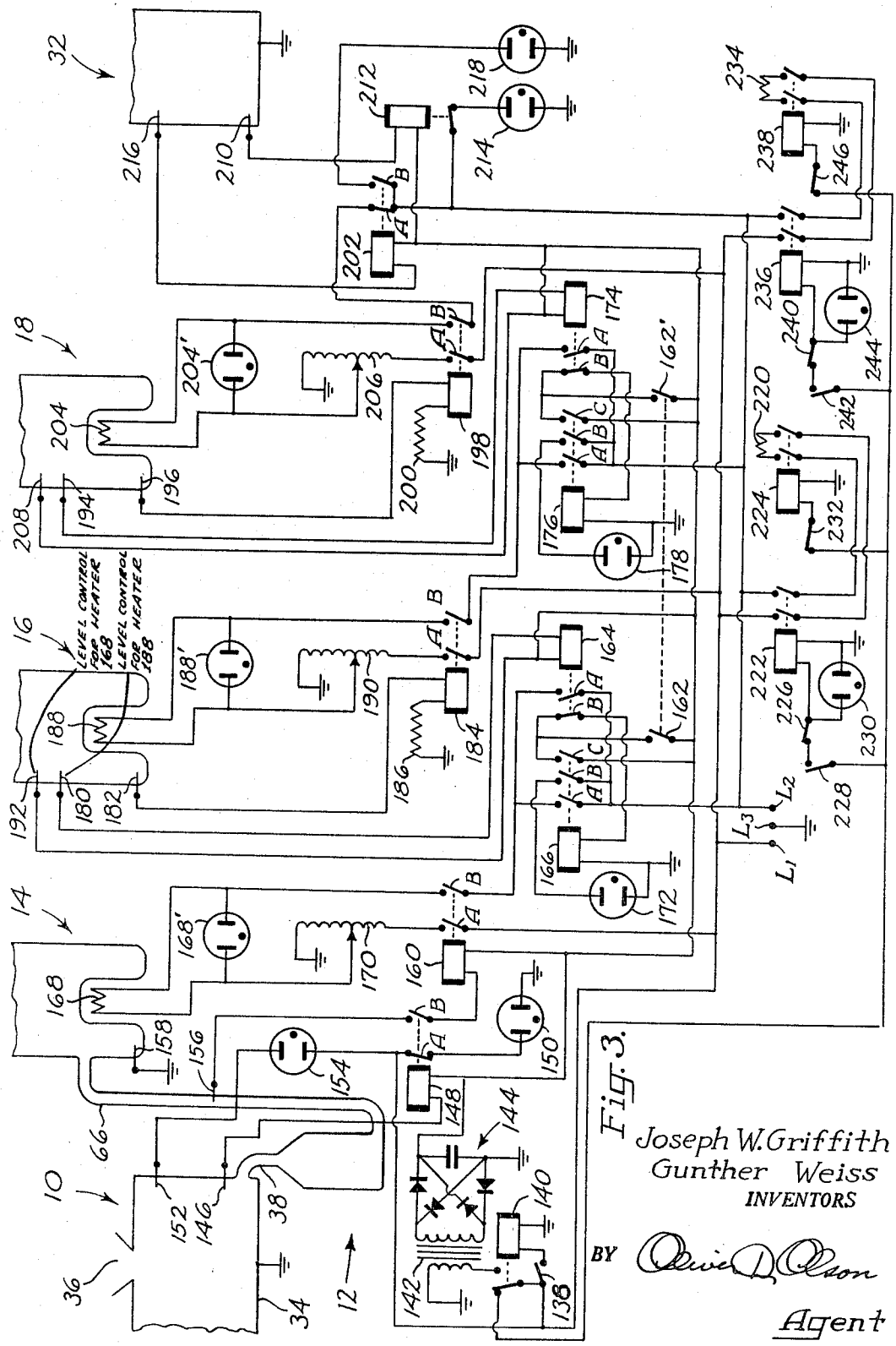



Fig. 3.

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3,324,009

# MERCURY DISTILLATION APPARATUS WITH ELECTRIC HEAT CONTROL

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This invention relates to apparatus for distilling mercury, and more particularly to automatic apparatus for the continuous multiple distillation of mercury.

Apparatus provided heretofore for the continuous distillation of mercury are characterized by being bulky assemblies which utilize an excessive amount of space, which are difficult and time consuming to clean, and which utilize complex and costly control equipment while still providing only minimum control.

Accordingly, it is the principal object of the present invention to provide mercury distillation apparatus in the form of a compact assembly of a minimum of components, utilizing a minimum of space, while providing for the efficient production of mercury of high purity.

Another important object of this invention is the provision of mercury distillation apparatus which is capable of being cleaned with speed and facility, without disassembly.

Still another important object of the present invention is the provision of mercury distillation apparatus in which operation is controlled automatically in accordance with predetermined conditions of coolant circulation and mercury levels.

A further important object of the present invention is the provision of mercury distillation apparatus which includes simplified automatic feed control means for maintaining precise mercury feed to the distillation component.

A still further important object of this invention is to provide mercury distillation apparatus which is of simplified construction for economical manufacture and requires a minimum of maintenance.

The foregoing and other objects and advantages of the present invention will appear from the following detailed description, taken in connection with the accompanying drawings in which:

FIG. 1 is a fragmentary schematic view in side elevation of mercury distillation apparatus embodying the features of the present invention;

FIG. 2 is a fragmentary sectional view taken along the line 2—2 in FIG. 1; and

FIG. 3 is a schematic electrical diagram of a control circuit for the distillation apparatus of the present invention.

Referring primarily to FIG. 1 of the drawings, the preferred embodiment of the apparatus illustrated includes a supply reservoir **10** from which dirty mercury to be distilled is fed by gravity to an automatically controlled constant level feed device **12**. From this device the mercury is fed to the first of three evacuated boilers **14**, **16** and **18**, respectively. The first boiler communicates with a condenser **14'** having a distillate outlet tube **20** communicating through the vapor trap **22** with the second boiler **16**. The second boiler communicates with a condenser **16'** whose distillate outlet tube **24** communicates through the vapor trap **26** to the third boiler **18**. The third boiler communicates with the condenser **18'** whose distillate outlet tube **28** communicates through the vapor trap **30** with the upper end of a distillate receiver flask **32**.

The receiver flask and the condensers are connected at their upper ends to a source of vacuum (not shown), and the boilers are connected at their lower ends through valves to a drain tube, as explained more fully hereinafter.

Considering the foregoing in greater detail, the supply



reservoir **10** comprises a tank **34** provided with an inlet opening **36** (FIG. 3) for introducing dirty mercury to be distilled. The tank also is provided with an outlet tube **38** adjacent its bottom for communication with the feed device **12**. The outlet tube preferably is flexible and is arranged for detachment from the supply reservoir, for purposes described more fully hereinafter.

The constant level feed device **12** comprises a housing having an upstanding outer wall **40**, a bottom wall **42** and a top wall **44**. An inner wall **46** is spaced inwardly from the outer wall and is joined at its upper end to the top wall. The inner wall extends downward and terminates a spaced distance above the bottom wall. Thus, there is provided a feed reservoir **48** in the space between the bottom wall and the lower end of the inner wall, and this reservoir communicates with the annular chamber **50** formed between the outer wall and the inner wall. An outlet opening **52** communicates said annular chamber with the atmosphere.

The inner wall **46** defines an inlet chamber **54** which communicates at the lower open end of the inner wall with the feed reservoir **48**. An outlet opening **56** communicates this inlet chamber with the atmosphere. The inlet chamber also communicates at its upper end with the lower end of the outlet tube **38** from the lower end of the supply reservoir.

The lower end of the outlet tube **38** is provided with a valve seat **58** which conforms to the shape of the valve head **60** provided at the upper end of the valve member **62**. The valve member is received freely within the inlet chamber **54** for vertical movement within the inner wall **46** and its lower end projects into the feed reservoir **48**. The valve member is made of a material which is of less density than the mercury. In the preferred embodiment, the valve member is made of a length of hollow glass tubing closed at its bottom end and sealed at its upper end by the valve head **60**.

In the operation of the constant level feed device **12**, mercury flows by gravity from the supply reservoir **10** downward through the outlet tube **38** and inlet chamber **54** into the feed reservoir **48**. As the level of mercury in the feed reservoir rises, the valve member **62** also rises with it until the mercury reaches a level **64** at which the valve head **60** seals against the valve seat **58** and thus shuts off further flow of mercury from the supply reservoir.

An outfeed tube **66** communicates at its bottom end with the bottom of the feed reservoir **48** and extends upwardly therefrom for communication at its upper end with the first boiler **14** intermediate the top and bottom ends of the latter.

The position of the constant level feed device **12**, and hence the length of the outfeed tube **66**, are so chosen that the differential pressure between atmosphere and the sub-atmospheric pressure within the boiler, causes the mercury in the outfeed tube to rise to the point where it just feeds into the boiler. Thus, it will be understood that the position of the constant level feed device will vary in accordance with the barometic pressure at the site of operation of the distillation apparatus. In this regard the constant level feed device may be mounted for vertical adjustment on a support and the tubes **38** and **66** may be provided as flexible tubings. Alternatively, the correct position of the constant level feed device may be ascertained for a fixed installation, and the tubes **38** and **66** then cut to proper size, if glass or other rigid tubing is employed.

Each of the three boilers illustrated comprises a hollow housing having an upstanding peripheral wall **68** and an annular bottom wall **70** joined thereto. The bottom wall slopes to one side of the boiler, and a drain conduit

72 communicates through the lowermost portion of said bottom wall with the interior of the boiler. A shut-off valve 74 in each drain conduit controls communication of the latter with a common drain tube 76.

Joined to the inner edge of the annular bottom wall 70 and extending upwardly therefrom into the boiler is an inner peripheral wall 78 which is closed at its upper end by the top wall 80. Thus, there is formed a downwardly open wall 82 centrally of each boiler for the removable reception of an electrical heater element, for heating mercury therein to its boiling point.

The upper end of each boiler housing wall 68 is open and is joined to the lower end of an elongated, upwardly extending condensing tube 84. The upper end of the tube is open from communication with the condensing chamber in which the tube is contained. In the preferred embodiment best illustrated in FIG. 2, the upper end of the tube is formed in the shape of a bowl 86 which is open at its upper end and is provided with a plurality of circumferentially spaced lateral openings 88 adjacent the upper end. A mantle 90 is mounted over this open upper end of the tube, being secured thereto by welding or otherwise joining the circumferentially spaced downwardly projecting fingers 92 to the upper edge of the bowl. The mantle diverges downward in outwardly spaced relation to the bowl, to direct mercury vapors from the upper end of the tube downward toward the bottom end of the condensing chamber, i.e. in the direction opposite the source of vacuum.

Each of the condensers is formed by a hollow tube 94 defining a condensing chamber 96 therein. Each tube 94 is sealed at its bottom end to the lower, flared end of the associated condensing tube 84. In the preferred embodiment illustrated, this joining seal is provided in such manner that the bottom end of the condensing chamber slopes downward to the side which communicates with the distillate outlet tube. This arrangement insures complete removal of mercury distillate from the condensing chambers.

The upper end of each condensing chamber tube is connected to a common source of vacuum. In the preferred embodiment illustrated, the upper end of each tube communicates with a hollow bowl 98. An inlet conduit 100 from the vacuum source projects into the bowl of the first condenser assembly 14' and terminates in an upwardly directed opening 102. A connecting conduit 106 terminates at one end in said bowl in a downwardly directed opening 108 and terminates at its opposite end within the bowl of the second condensing unit 16' in an upwardly directed opening 110. A second connecting conduit 112 terminates within said bowl in a downwardly directed opening 114 and at its opposite end in an upwardly directed opening 116 within the bowl of the third condensing unit 18'. The conduit 120 from the receiver flask 32 terminates within said bowl in a downwardly directed opening 122.

It is by virtue of the oppositely directed openings within the bowls 98 associated with the condensing units, that mercury vapor is prevented from being drawn into the vacuum supply. In this regard the connecting conduits 106 and 108 are arranged to slope downward toward the preceding condensing unit so that any mercury vapor which might enter these conduits will condense and be returned to the next preceding condensing unit.

The tube 94 defining each condensing chamber 96 is enclosed in an outwardly spaced wall 124 which is sealed to the tube at its top and bottom ends. There is thus formed between the tube and outer wall an annular space 126 for the circulation of coolant liquid. In this regard a coolant inlet tube 128 communicates with the bottom end of the space 126 associated with the first condensing unit 14', the connecting tube 130 communicates the upper end of said space with the lower end of the space associated with the second condensing unit 16', the connecting tube 132 communicates the upper end of said space with the lower end of the space associated with the third condensing unit 18', and the outlet tube 134 communicates the upper end of said space with a drain.



Since maximum vaporization of mercury occurs in the first boiler 14, additional condensing surface preferably is provided in the associated condensing unit 14'. In the embodiment illustrated, this additional condensing surface is provided by the multiple hollow bowls 136 positioned within the condensing chamber 96 above the condensing tube mantle 90 and communicating at its opposite ends with the coolant space 126.

Interposed between the coolant inlet tube 128 and the source of coolant, such as water, is an electric switch 138 (FIG. 3) which is actuated to closed position when coolant is being circulated through the condensing units. The purpose of this switch is explained in detail hereinafter, and it may be of any conventional type such as the well known fluid pressure operated diaphragm actuated switch illustrated schematically in FIG. 1.

Automatic control of operation of the apparatus is achieved by utilizing the electrical conductivity of mercury in the various units of the assembly, in association with the electrical circuitry illustrated in FIG. 3, as follows:

In preparation for operation of the apparatus, the terminals $L_1$, $L_2$ and $L_3$ are connected to a suitable source of electric supply. In this regard it is to be understood that the terminal $L_3$ represents a common ground to which all of the ground connections indicated in FIG. 3 are connected. When coolant water is admitted from a tap to flow through the spaces 126 of the condensing units, the electric switch 138 is closed, thereby energizing relay 140 and effecting transfer of its associated contact from the position indicated and completing the electric circuit of the primary winding of the transformer 142 associated with the rectifier power supply 144.

Mercury to be distilled then is filled into the supply reservoir 10. When the level of mercury rises to the level of the electrical contact 146 positioned adjacent the bottom of the reservoir (and insulated electrically therefrom), the electric circuit of the relay 148 is completed from the power supply 144, through said relay and contact 146, thence through the mercury to the common ground of the grounded housing 34 of the supply reservoir. Contact A of relay 148 thereupon transfers from the closed position illustrated, to open the electric circuit of the neon lamp 150 which previously was energized to indicate that the supply reservoir was empty.

When the level of mercury in the supply reservoir reaches the electrical contact 152 positioned adjacent the top of the reservoir, the electric circuit of the neon lamp 154 is completed, to give visible indication that the supply reservoir is full.

Mercury to be distilled flows by gravity from the supply reservoir through the tube 38 and inlet chamber 54 into the constant level feed reservoir 48 until it reaches the level 64 at which the valve member 62 elevates the valve head 60 into sealing engegement with the seat 58. The supply of mercury from the reservoir 10 thus is shut off.

With the source of vacuum connected to the conduit 100, the assembly of boilers, condensers, and receiving flask are evacuated (the shut off valves 74 being closed). Accordingly, mercury from the reservoir 48 is forced upward through the outfeed tube 66 and into the first boiler 14. As the level 64 of mercury in the feed reservoir 48 drops slightly, for example about two millimeters, the valve member 62 drops to open the valve and admit more mercury from reservoir 10 to restore the level 64.

When the mercury in the first boiler rises to the level of the inlet of tube 66, it interconnects electrically the electrical contact 156 which projects into the tube 66 and the electrical contact 158 which projects into the first boiler below the inlet level of the tube 66. This completes the

electric circuit of the relay **160**, through the closed contact B of activated relay **148**.

If desired, the contact **156** may be positioned in the boiler **14** just above the inlet of tube **66**, where it will be connected electrically to contact **158** through the electrically conducting mercury in the boiler.

Activation of relay **160** effects transfer of its associated contacts A and B from the open positions illustrated.

The manual start switch **162** then is closed momentarily to complete an electric circuit from the power supply **144** through said switch **162** and the normally closed contact B of inactivated relay **164**, thence through relay **166** to the common ground. Activation of relay **166** transfers its associated contacts from the position illustrated, closure of contact C forming a holding circuit for said relay to permit release of the manual start switch.

Closure of contact A of relay **166** completes the electric circuit from terminal $L_2$ through said contact and the closed contact B of activated relay **160**, through the electric heater element **168** associated with the first boiler **14**, thence through the adjustable heater control transformer **170** and the closed contact A of activated relay **160** to terminal $L_1$. The heater thus is activated to heat the mercury in the first boiler to its boiling point. The neon lamp **168'** in parallel with heater **168** also is activated with the latter to give visible indication that the first boiler is in operation.

Closure of contact B of activated relay **166** completes the electric circuit of the neon lamp **172** to provide visible indication that the first boiler **14** is in automatic operation.

Simultaneously with the momentary closing of the manual start switch **162**, a second manual start switch **162'** (coupled mechanically thereto as indicated by the dash line) also closes to complete the electric circuit from the power supply **144** through said switch **162'** and the normally closed contact B of inactivated relay **174**, thence through relay **176** to the common ground. Activation of this relay **176** transfers its associated contacts from the positions illustrated, contact C forming a holding circuit therefor, and closure of contact B completes the electric circuit of the neon lamp **178** to indicate that the second boiler **16** is ready for automatic operation.

Mercury is vaporized in the first boiler **14** and condensed in the associated condensing chamber **14'** whereupon it passes into the second boiler **16**. When the mercury in the second boiler rises to the level of the electrical contact **180** located therein above the inlet level from the vapor trap **22**, the mercury connects said contact **180** electrically to the contact **182** located in the second boiler below the contact **180**. There is thus completed an electric circuit from the power supply **144** through the relay **164** and the mercury-bridged contacts **180** and **182**, thence through the relay **184** and the resistance **186** to the common ground.

Activation of relay **164** transfers its associated contacts from the positions illustrated, the opening of contact B effecting deactivation of relay **166** and the closing of contact A forming a bypass for the now opened contact A of inactivated relay **166**, to maintain energized the heater **168** associated with the first boiler **14**.

Activation of relay **184** and the consequent transfer of its associated contacts A and B from the positions illustrated, completes an electric circuit from terminal $L_2$ through the closed contact A of activated relay **176** and the closed contact B of activated relay **184**, thence through the electric heater element **188** associated with the second boiler **16**, through the adjustable heater control transformer **190** and the closed contact A of activated relay **184** to terminal $L_1$. The neon lamp **188'** in parallel with the heater element **188** also is energized to give visible indication that the second boiler is in operation.

In the event the volume of mercury distillate from the first boiler **14** is greater than the volume of mercury distillate from the second boiler **16**, the level of mercury in the second boiler ultimately will rise to the level of the electrical contact **192** positioned above the contact **180**. When this occurs, the mercury will have interconnected said contacts electrically, thus creating an electrical shunt across the relay **164**. The latter thus becomes deenergized, returning its associated contacts to the positions illustrated. Thus, with the opening of its associated contact A the electrical circuit of the heater **168** for the first boiler **14** is broken, as evidenced by deactivation of the associated neon lamp **168'**. The heater **168** thus is deenergized to prevent further distillation of mercury to the second boiler, until the level of mercury in the second boiler drops below the contact **192**. When this occurs, relay **164** again becomes activated and the closure of its associated contact A completes the electric circuit of the heater **168** in the first boiler.



In similar manner, when sufficient mercury has distilled over into the third boiler **18** to electrically interconnect the contacts **194** and **196** the electrical circuit from the power supply **144** is completed through the relay **174** and said contacts, thence through the relay **198** and the resistance **200** to the common ground. Activation of relay **174** causes transfer of its associated contacts, the opening of contact B deenergizing relay **176** and the closing of contact A maintaining the record boiler heater **188** activated.

Activation of relay **198** and consequent transfer of its associated contacts from the open positions illustrated, completes the electric circuit from terminal $L_2$ through the normally closed contact A of relay **202** and the closed contact B of activated relay **198**, thence through the electric heater element **204** associated with the third boiler **18**, through the adjustable heater control transformer **206** and the closed contact A of activated relay **198** to the terminal $L_1$. Activation of the neon lamp **204'** gives visible indication that the third boiler is in operation.

If the volume of distillate from the second boiler **16** exceeds the output of the third boiler **18**, mercury in the latter ultimately will rise to the level of the contact **208**, thereby shunting the relay **174** and opening its associated contact A to deactivate the heater **188** in the second boiler **16** until such time as the mercury in the third boiler drops to a level below the contact **208**.

The triple distilled mercury leaving the third condenser unit **18'** through the outlet tube **28** is deposited in the receiver flask **32**. As the level reaches the electrical contact **210** adjacent the bottom of the flask, it completes the electric circuit from the power supply **144** through the relay **212**, thence through the contact **210** and the mercury to the common ground of the grounded flask. Activation of relay **212** results in the opening of its associated contact and consequent deactivation of the neon lamp **214** which previously had been activated to indicate that the receiver flask was empty.

When the mercury in the received flask rises to the level of the electrical contact **216** positioned adjacent the top of the flask, it completes the electric circuit of the relay **202**. Transfer of the associated contact B from the open position illustrated completes the electric circuit of the neon lamp **218** to give visible indication that the receiver flask is full.

Concurrently therewith, opening of the contact A of the activated relay **202** breaks the electric circuit of the heater element **204** associated with the third boiler **18**, to prevent further distillation of mercury therefrom. Accordingly, continued distillation of mercury from the second boiler **16** will cease when the level of mercury in the third boiler **18** reaches the contact **208**. Thereupon relay **174** will be deactivated and its associated contact A will open to deenergize the heater element **188** in the second boiler. In similar manner, further distillation of mercury from the first boiler **14** will cease when the level of mercury in the second boiler **16** reaches the contact **192**.

Cleaning of the components of the apparatus may be accomplished with disassembly. Preparatory to cleaning, the outlet tube **38** is disconnected from the supply reservoir **10** and the tube **100** is disconnected from the source of vacuum. The drain valves **74**, as well as the drain valves **48'** and **32'** at the bottom of the feed reservoir **48** and receiver flask **32**, respectively, then are opened to drain all of the mercury from the system. Thereafter the drain valves are closed, the atmosphere openings **52** and **56** and the open end of the vacuum tube **100** are plugged, and the source of vacuum is connected to the top of the receiver flask **32** through the valve connection **32''**. The source of coolant water is shut off, thereby opening switch **138**.

Acid or other cleaning solution then is drawn in from a supply through the tube **38**, to completely fill the feed device **12**, flask **32**, boilers and condensing chambers **96**, completely to the bowls **98**. The vacuum source then is disconnected, by closing valve **32''**, to retain the cleaning solution in the assembly. After the solution has remained in the system for a predetermined time, suitably about ten minutes, the drain valves are opened to drain the solution from the system.

The foregoing operation is repeated a number of times with water, to flush the system, then with a volatile solvent such as alcohol, acetone or other suitable liquid to remove all traces of water. Thereafter dry air is pumped through the system to assist in the removal of the solvent. Finally, the system is evacuated, by again opening valve **32''**, and heated to insure complete vaporization of the solvent, the latter being removed through the vacuum system.

For the purposes of heating the system, the assembly of feed device **12** and distilling units is contained within an oven which is capable of being heated by the electric heater element **220**. This heater element is connected across the terminals $L_1$ and $L_2$ releasably through the contacts of the relays **222** and **224**. The electrical circuit for relay **222** extends from the common ground through said relay, thence through a thermostat switch **226** controlled by the thermostat in the oven, thence through the manual on-off switch **228** and the normally closed contact of relay **140** (when the latter is deenergized), to the terminal $L_1$. Thus, it will be apparent that the heater element **220** cannot be activated until the source of coolant liquid for the condensing units is shut off and the coolant controlled switch **138** is opened to deenergized the relay **140**.

The neon lamp **230** in parallel with the relay **222** is activated with the latter to give visible indication that the heater element **220** is activated.

Relay **224** is in an electric circuit which extends from a common ground through said relay and the thermostat controlled switch **232** controlled by a second thermostat in the oven, thence through the contact of relay **140** to terminal $L_1$. The switch **232** and associated relay **224** serves merely as a safety in the event of malfunction of the primary thermostat switch **226** and its associated relay **222**. The primary thermostat switch **226** is set to open when the oven reaches a predetermined elevated temperature, and the thermostat switch **232** is set to open at a slightly higher temperature.

The receiver flask **32** is contained within a second oven capable of being heated by the electric heater element **234**. In manner similar to the heater element **220**, the element **234** is connected across the terminals $L_1$ and $L_2$ releasably through the contacts of the relays **236** and **238**. The electrical circuit for relay **236** extends from the common ground through said relay and the primary thermostat controlled switch **240**, thence through the manual on-off switch **242** and the contact of relay **140**, to terminal $L_1$. The neon lamp **244**, in parallel with relay **236**, is activated with the latter to give visible indication that the heater element **234** is activated.

The electric circuit for the safety relay **238** extends from the common ground through said relay and the safety thermostat controlled switch **246**, through the contact of relay **140** to terminal $L_1$.

It will be appreciated from the foregoing that the present invention provides mercury distillation apparatus which is of simplified and compact construction, utilizing a minimum of space, provides for the continuous distillation of mercury under conditions controlled automatically by predetermined levels of mercury in the various components of the system, and is capable of being cleaned with speed and facility and without disassembly of the components.

It will be apparent to those skilled in the art that various changes may be made in the details of construction, the numbers and arrangements of parts, and the electrical circuitry, without departing from the spirit of this invention and the scope of the appended claims.

Having now described our invention and the manner in which it may be used, what we claim as new and desire to secure by Letters Patent is:

**1.** Mercury distillation apparatus, comprising

(a) a mercury supply reservoir,

(b) a plurality of distilling units each having a boiler and a condenser,

(c) outfeed means communicating the supply reservoir with the first boiler,

(d) conduit means communicating each condenser with the next succeeding boiler,

(e) a distillate container,

(f) conduit means communicating the last condenser with the distillate container,

(g) conduit means communicating the distillate container and distilling units with a source of vacuum,

(h) an electric heater associated with each boiler and having an electric circuit, and

(i) electric control means in the electric circuit of each heater, each control means having an electric circuit,

(j) a pair of vertically spaced electrical contact means associated with each boiler and arranged in the electric circuit of the control means for the heater of said boiler, said contact means being operable upon the attainment of a predetermined minimum level of mercury in the boiler to be interconnected electrically by the mercury in the boiler, whereby to operate the heater control means to activate the heater of said boiler, and

(k) a pair of vertically spaced electrical contact means in each boiler succeeding the first and arranged in the electric circuit of the control means for the heater of the next preceding boiler, said contact means being operable upon the attainment of a predetermined maximum level of mercury in the boiler to be interconnected electrically by the mercury in the boiler, whereby to operate the heater control means to inactivate the heater of the next preceding boiler.

**2.** The apparatus of claim **1** wherein the outfeed means includes

(a) a feed reservoir having an upper annular portion and provided with an upwardly converging conical top, the top and annular portion having atmosphere-communicating openings therethrough,

(b) infeed conduit means communicating the supply reservoir with the feed reservoir through an opening in the apex of said conical top,

(c) a float member extending through the annular portion of the feed reservoir and having valve means at its upper end for releasably sealing the apex opening of the conical top, the float member extending into the bottom portion of the feed reservoir for floating upon mercury contained therein and to close the valve means upon attainment of a predetermined elevated level of mercury in the feed reservoir whereby to maintain a substantially constant level of mercury in the feed reservoir, and

(d) outfeed conduit means communicating the feed reservoir with the first boiler.

3. The apparatus of claim 1 wherein the condensers include interconnected coolant liquid passages arranged to receive a coolant liquid therethrough, and the apparatus includes an electric switch in the electric circuits of the heater control means, the switch having an operator disposed to intercept the path of coolant liquid travel and being operable by the passage of coolant liquid through the condenser passages to enable operation of the heater control means to activate the heaters.

4. Mercury distillation apparatus, comprising

(a) a mercury supply reservoir,

(b) a feed reservoir,

(c) infeed conduit means communicating the top of the feed reservoir with the mercury supply reservoir,

(d) valve means adjacent the top of the feed reservoir adapted to releasably close the infeed conduit means from the feed reservoir,

(e) the valve means including a float member extending into the feed reservoir for engagement with mercury contained therein, the float member being operable to float upon the mercury and to close the valve means upon attainment of a predetermined elevated level of mercury in the feed reservoir,

(f) a plurality of distilling units each having a boiler and a condenser,

(g) outfeed conduit means communicating the bottom of the feed reservoir with the first boiler for feeding mercury from the reservoir to said boiler,

(h) conduit means communicating each condenser with the next succeeding boiler,

(i) a distillate container,

(j) conduit means communicating the last condenser with the distillate container,

(k) conduit means communicating the distillate container and condensers with a source of vacuum,

(l) an electric heater associated with each boiler and having an electric circuit,

(m) electric control means in the electric circuit of each heater each control means having an electric circuit,

(n) a pair of vertically spaced electrical contact means associated with each boiler and arranged in the electric circuit of the control means for the heater of said boiler, said contact means being operable upon the attainment of a predetermined minimum level of mercury in the boiler to be interconnected electrically by the mercury in the boiler, whereby to operate the heater control means to activate the heater of said boiler,

(o) a pair of vertically spaced electrical contact means in each boiler succeeding the first and arranged in the electric circuit of the control means for the heater of the next preceding boiler, said contact means being operable upon the attainment of a predetermined maximum level of mercury in the boiler to be interconnected electrically by the mercury in the boiler, whereby to operate the heater control means to inactivate the heater of the next preceding boiler,

(p) the condensers including interconnected coolant liquid passages arranged to receive a coolant liquid therethrough, and

(q) switch means in the electric circuits of the heater control means, the switch having an operator disposed to intercept the path of coolant liquid travel and being operable by the passage of coolant liquid through the condenser passages to enable operation of the heater control means to activate the heaters.



5. The apparatus of claim 4 including a pair of vertically spaced electrical contact means in the distillate container and arranged in the electric circuit of the electric control means for the heater of the last boiler, said contact means being operable upon the attainment of a predetermined maximum level of mercury in the distillate container to be interconnected electrically by the mercury therein, whereby to operate the heater control means to inactivate the heater of the last boiler.

6. Mercury distillation apparatus, comprising

(a) a mercury supply reservoir,

(b) a plurality of distilling units each having a boiler and a condenser,

(c) outfeed means communicating the supply reservoir with the first boiler,

(d) conduit means communicating each condenser with the next succeeding boiler,

(e) a distillate container,

(f) conduit means communicating the last condenser with the distillate container,

(g) conduit means communicating the distillate container and distilling units with a source of vacuum,

(h) an electric heater associated with each boiler and having an electric circuit,

(i) electrical safety control means in the electric circuit of each heater and operable upon the attainment of a predetermined maximum level of mercury in the boilers succeeding the first to deactivate the heater associated with the next preceding boiler,

(j) the condensers including interconnected coolant liquid passages arranged to receive a coolant liquid therethrough, and

(k) an electric switch in the electric circuits of the heater control means, the switch having an operator disposed to intercept the path of coolant liquid travel and being operable by the passage of coolant liquid through the condenser passages to enable operation of the heater control means to activate the heaters.


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