Sept. 2, 1952 A. L. HOLCOMB ET AL 2,609,461

HIGH-SPEED CONTACTOR

Filed Dec. 13, 1950 2 SHEETS—SHEET 1

FIG. 1

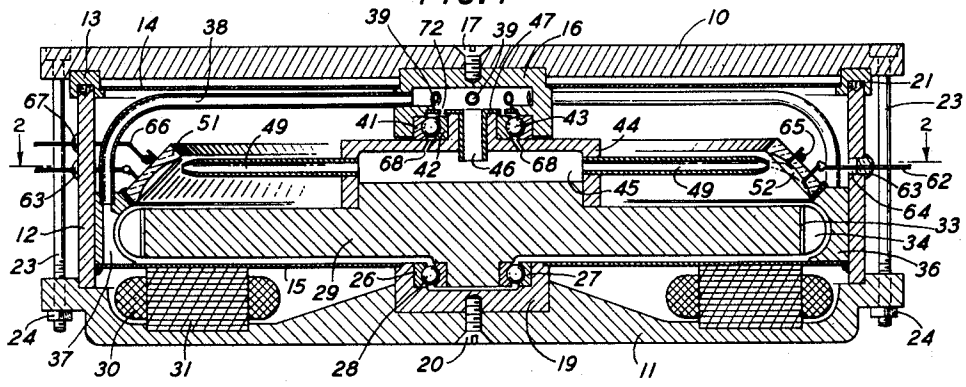


FIG. 2

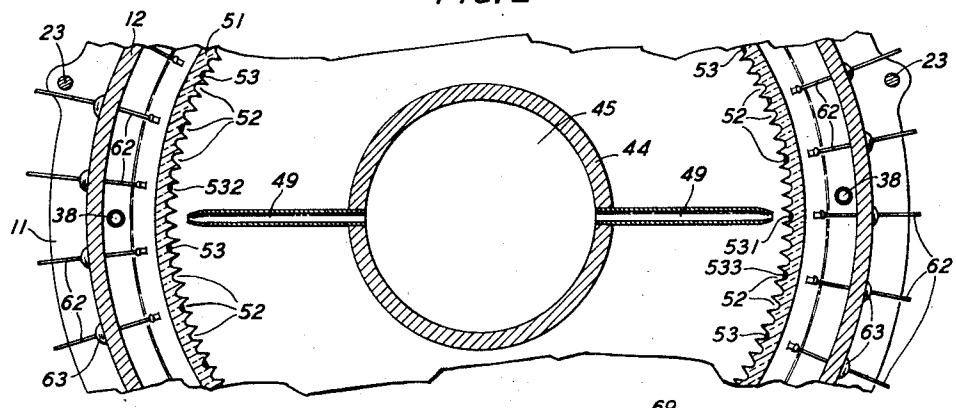


FIG. 3

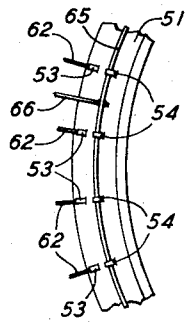


FIG. 4

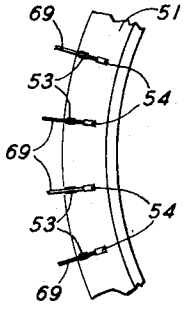
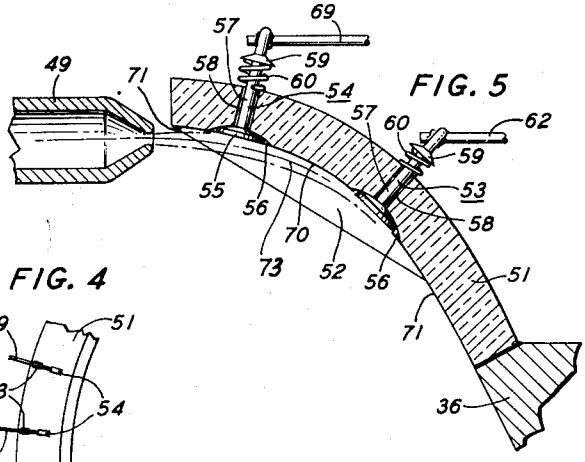


FIG. 5



INVENTORS A. L. HOLCOMB
M. A. LEAVITT

BY

ATTORNEY

Sept. 2, 1952 A. L. HOLCOMB ET AL 2,609,461

HIGH-SPEED CONTACTOR

Filed Dec. 13, 1950 2 SHEETS—SHEET 2

FIG. 6

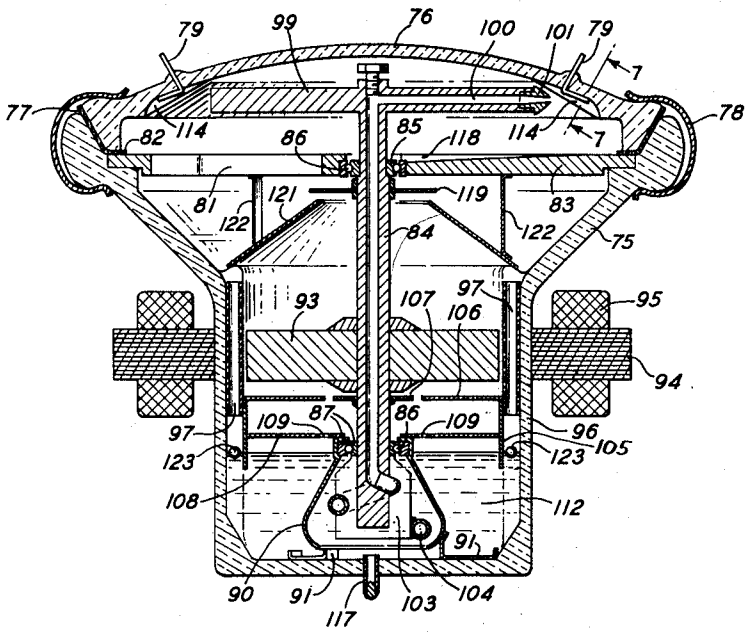
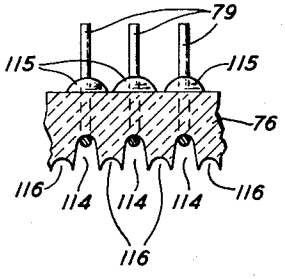


FIG. 7



INVENTORS A. L. HOLCOMB
M. A. LEAVITT

BY

ATTORNEY

Patented Sept. 2, 1952

2,609,461

UNITED STATES PATENT OFFICE

2,609,461

HIGH-SPEED CONTACTOR

Arthur L. Holcomb, Tarzana, and Minard A. Leavitt, Concord, Calif., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application December 13, 1950, Serial No. 200,668

18 Claims. (Cl. 200—32)

1

This invention relates to high speed contactors and more particularly to such contactors employing a liquid conductor.

In certain circuit applications it is desirable to connect a large number of separate circuits to a common line in rapid sequence. Such applications may be in telemetering, Sonar circuits, or pulse transmisson of speech signals. Conventional mechanical commutators when operated at high peripheral speeds have a high noise level characteristic which is prohibitive of their employment in such applications where low level circuits are involved. The sampling of the large number of low level circuits is also at a rate too high for satisfactory relay operation. And electronic switching, while feasible, becomes cumbersome and complicated due to the multiplicity of the circuits involved.

Satisfactory sampling at high rates can be obtained by high speed rotary contactors of the type employing liquid conductors, such as mercury, in which the sampling connection is made between the common line and contacts attached to the circuits to be sampled by the liquid conductor. The liquid conductor can make connection between two contacts interposed in its path or can itself serve as one terminal and make connection to only one contact. In such devices the liquid conductor stream becomes momentarily common to the contact or contacts and thus establishes the low impedance and low noise level connection.

However, where a very large number of circuits are to be sampled, requiring a similarly large number of contacts to be wiped or contacted by the liquid conductor stream, it is necessary to position the contacts closely adjacent one another. But when contacts are thus positioned closely adjacent each other the rotating stream of the liquid conductor may simultaneously make connection to two adjacent contacts in passing, thus preventing proper sampling of each circuit individually.

It is therefore one object of this invention to allow the rapid low impedance low noise level connecting of a large number of circuits sequentially to a common line or to other circuits.

It is another object of this invention to prevent improper connecting of the circuits and false information being obtained from them.

It is a further object of this invention to reduce the turbulence of a liquid conductor stream in making connection to contacts.

It is a still further object of this invention to improve the structure and operation of high speed contactors of the liquid conductor type.

2

These and other objects of this invention are accomplished in accordance with one specific embodiment of this invention by a high speed rotary contactor in which a large number of contacts are positioned in a container around the inner wall thereof and a rotating nozzle is positioned opposite them and provides a stream of a conducting liquid in contact with each in succession. In accordance with this invention, each contact is positioned in a groove in the container and separated from the neighboring contacts by at least one cut-groove. Thus the rotating stream of conducting liquid in passing from a contact to the adjacent one passes through an "off" position where it is not touching any contact. This positive definite cut-off of the conducting liquid stream prevents the conducting liquid making connection to more than one contact at a time.

It is one feature of this invention that each contact in a high speed rotary contactor of the liquid conductor type be positioned in a contact groove and separated from each adjacent contact by a cut-off groove.

It is a further feature of this invention that each groove be so formed as to decrease the turbulence in the conducting liquid. Specifically, each groove may be straight adjacent the nozzle and then slowly curved, the contact or contacts located therein being in depressions in the groove so that an even smooth surface is presented to the liquid stream.

It is a further feature of this invention that two or more contacts may be positioned in each groove. More specifically, it is a feature of this invention that one contact may be brought out through the container of the contactor and the other contact connected to a common internal connection.

A complete understanding of this invention and of these and other various features thereof may be gained from consideration of the following detailed description and the accompanying drawing, in which:

Fig. 1 is a sectional view of one embodiment of a high speed contactor in accordance with this invention;

Fig. 2 is a partial plan view along the line 2—2 of Fig. 1;

Fig. 3 is a partial plan view of the contact support member of Fig. 1 particularly illustrating one arrangement of contact leads;

Fig. 4 is a partial plan view of a contact support member illustrating another arrangement of contact leads;

Fig. 5 is a sectional view of the contact sup-

port member of Fig. 1 illustrating particularly the contour of the contact grooves;

Fig. 6 is a sectional view of another embodiment of a high speed contactor in accordance with this invention; and

Fig. 7 is a fragmentary sectional view along the line 7—7 of Fig. 6 illustrating particularly the grooves and contacts of the contactor of the embodiment of Fig. 6.

Referring now to the drawing, the high speed contactor illustrated in Fig. 1 comprises an upper support spider 10 and a lower support spider 11 which encompass between them the enclosed chamber of the contactor. This enclosed chamber is bounded by a long ring or sleeve 12, a short ring 13 surrounding the upper end of the long ring 12, and upper and lower plates 14 and 15. A cup-shaped member 16 is secured to the center of the upper plate 14 and to the upper spider 10, as by the screw 17, and a cup-shaped member 19 is secured to the center of the lower plate 15, as by the screw 20. The contact between the rings 12 and 13 is sealed by a gasket 21 which may advantageously be of a rubber-like silicone material known commercially as "Silastic." A plurality of bolts 23 extending between the spiders 10 and 11 and associated nuts 24 serve to maintain the rings 12 and 13 in sealed engagement.

As the spiders 11 and 12 are external to the enclosed chamber they will not come into contact with the liquid conductor, which may advantageously be mercury, though other liquid conductors known in the art may be employed. The spiders may therefore be of a light metal, such as aluminum or magnesium, to reduce the overall weight of the contactor. The rings 12 and 13 and the cup-shaped members 16 and 19 may advantageously be of steel and the plates 14 and 15 of stainless steel sheet stock, secured to the rings and cup-shaped members, as by welding thereto to hermetically seal the enclosed chamber.

The lower cup-shaped member 19 serves as a bearing housing for bearing rings 26 and 27 and bearings 28. The bearing ring 26 is secured to the member 19 while the bearing ring 27 is attached to a depending portion of a flat circular rotor 29 of relative large diameter. The rotor 29 together with a stator ring 30 and stator winding 31 comprise the drive mechanism for the high speed contactor. This drive mechanism may advantageously be, as shown, a hysteresis type synchronous motor with the rotor inside the sealed chamber and the stator outside the chamber, the stator ring 30 and stator windings 31 being supported by the lower spider 11. As stainless steel sheet is substantially non-magnetic and presents a high resistance to eddy currents, the presence of the plate 15, which is advantageously of that material, in the air gap does not produce serious shielding or losses. The stator may be wound for any desired number of poles, phases, or voltages.

At the periphery of the rotor 29 is a ring 33 cut to present vanes 34 extending radially out from the rotor. These vanes extend into a complementarily formed channel in a channel ring 36, which is secured to the ring 12 and is positioned on the plate 15. This channel ring 36 may advantageously be of cast iron and has a plurality of grooves 37 cut therethrough and extending into the channel adjacent the vanes 34. Each of these grooves receives, adjacent the top of the ring channel 36, the lower end of a return tube 38 which connects to the upper cup-shaped member 16, extending through apertures 39 in that cup-shaped member.

The upper cup-shaped member 16 also serves as a bearing housing for bearing rings 41 and 42 and bearings 43, the bearing ring 41 being secured to the member 16 and the bearing ring 42 to a hollow member 44 seated on the rotor 29 and forming therewith a large cavity 45. A short tube 46 having a flanged upper end 47 extends from the interior of the cup-shaped member 16 to the cavity 45. Two oppositely positioned nozzles 49 extend out radially from the hollow member 44, communicating with the cavity 45.

An insulating contact support member 51, which may advantageously be a pressed glass ring, is attached to the channel ring 36 and extends at an angle towards the nozzles 49. As best seen in Figs. 3 and 5, the support member 51 has a plurality of grooves 52 cut or ground into it. In the embodiment disclosed, a pair of contacts 53 and 54 are positioned in every fourth groove, the intervening grooves being empty. Referring again to Fig. 5, each of the contacts 53 and 54 comprises a contact surface 55 which fits in a slight depression 56 in the groove 52, a contact post 57 extending through an aperture 58 in the support member 51, a conical washer 59 attached to the post 57, as by being pressed on, and a retaining spring 60 between the washer 59 and the support member 51. The contacts 53 and 54 may, however, be mounted in position on the support member 51 in other ways, such as by being fused thereto.

Each of the contacts 53 advantageously has a lead 62 brought separately through the shell of the enclosed chamber by extending through insulating terminal beads 63, as of glass or "Fusite," positioned in apertures 64 in the ring 12. As shown in Figs. 1 and 3 the contacts 54 may all be internally connected together by a conducting ring 65 secured to each of the contacts 54 with only one lead 66 being brought out through a glass or other insulating terminal bead 67 as the external connection for each of the contacts 54. Or as shown in Figs. 4 and 5 each of the contacts 54 may be separately brought out through the ring 12 by means of leads 69 similar to leads 62 and similarly insulated from the ring 12.

In operation, the unit should be in a normal position prior to starting with the liquid conductor, not shown in Fig. 1, in the bottom, adjacent plate 15. The liquid conductor is preferably mercury, although other fluids and liquids may be employed, and shall be thus referred to in this description, it being understood that this invention is not to be considered as limited to any particular liquid conductor. As soon as rotation of the rotor starts the mercury is forced by centrifugal action to the periphery of the rotor 29 where the vanes 34 throw or force it into the channel in the channel ring 36 and into the grooves 37 extending through the ring 36. These grooves act as scoops to trap the mercury thrown into the channel by the rotor vanes 34. The mercury thus is actuated by a centrifugal pump and forced through the grooves 37 into the return tubes 38, the cup-shaped member 16, and through the short tube 46 into the rotor cavity 45. Small apertures 72 are provided in the flanged end 47 of the tube 46 and small apertures 68 in the hollow member 44 adjacent the bearings 43 to allow a small amount of mercury to pass through the bearing as a lubricant. Similarly a small amount

of mercury circulates around the bearings 28 as a lubricant.

The rotor cavity 45 is the main storage space for the mercury during operation and the total amount of mercury is advantageously limited to slightly less than the amount necessary to fill this space under any positional condition. The space in turn is advantageously made large enough so that the minimum amount of mercury in the cavity under any condition of position of the contactor is sufficient to cover the nozzle inlets. The mercury is propelled through the nozzle and from the nozzles with a high radial velocity which carries it past the contacts 53 and 54 and down into the rotor vanes 34, where it is immediately pumped again into the grooves 37 and the return tubes 38. Thus when operation has once started all free mercury in the contactor is quickly trapped due to the fact that the pumping volume capacity is many times greater than the volume of mercury released by the nozzles. Further due to the high velocity of the nozzle stream, the ejected mercury will return to the rotor vanes regardless of the position of the contactor. Thus, in fact, the mercury circulates in essentially a closed system.

The nozzles 49 may also advantageously have their openings adjacent the contacts angled slightly backwards with respect to the direction of rotation to produce a mercury jet with substantially no tangential component, thereby further reducing turbulence of the mercury in passing the contacts.

In normal operation and position some mercury stands in the vertical portions of the return tubes 38 and practically none in the horizontal portions nor in the upper cup-shaped member 19, since any mercury there would fall by gravity to the rotor cavity 45. Due to centrifugal action in the rotor cavity 45, the mercury will at once form a ring around the periphery and thence flow into the nozzles 49. Because of the large pumping capacity of the contactor neither tilting nor actual inversion of the contactor will affect its continued operation.

Advantageously the nozzles reduce the mercury to the smallest diameter jet or stream that is dependably continuous. By so doing the groove width may be lessened and the over-all dimensions of the contactor reduced. The contacts may further be positioned closely adjacent each other, in accordance with this invention, by providing at least one empty groove 52 between adjacent contacts. As the nozzle passes the contact the mercury jet will move from the contact groove into an intermediate groove which provides a positive cut-off before the jet reaches the next contact groove. The grooves 52 may be thus considered as divided into two groups, the "on" grooves in which contacts are located and the "off" grooves intermediate the "on" grooves into which the mercury must pass, thereby preventing overlapping or splashing of mercury between two adjacent contacts which might cause a shorting, bridging or an improper connection between the two. In this transition from one groove to the next, the stream is momentarily divided and flows simultaneously in two adjacent grooves. However by separating the "on" or contact grooves by "off" or non-contact grooves the mercury never flows simultaneously in two grooves in which contacts are located and thus with a stream diameter less than the width of a groove, no undesirable bridging occurs between adjacent contacts. Some spattering occurs as the stream passes the barrier wall between grooves, since the wall can not be made infinitely sharp, but very little of such spattering will reach adjacent contacts and what does is in the form of droplets incapable of providing a bridging connection.

As shown in the embodiment of Fig. 1, two nozzles 49 oppositely disposed are employed. As can be seen in Fig. 2, the contacts are so positioned that the mercury jet from only one nozzle will impinge on complementary contacts 53 and 54 at a time. Thus in considering the motion of the rotor clockwise in Fig. 2 the stream or jet emanating from the right hand nozzle 49 will first cause contact between the contact 531 and its adjacent contact 54. When the rotor rotates so that the nozzle is opposite the next adjacent groove, both nozzles 49 will be opposite non-contact or "off" grooves. A rotation to the next groove will position the right hand nozzle opposite another "off" groove, but the left hand nozzle will provide connection between contact 532 and its associated contact 54. Continuing, the next step will find the two nozzles opposite "off" grooves, thus eliminating the possibility of a bridging over between contacts in adjacent grooves, and at the next step the right hand nozzle is opposite the next contact groove, to provide connection between nozzle 533 and its associated contact 54. The closed or connected contacts will therefore be alternately on opposite sides of the contactor, a non-contact or "off" groove being between each contact connection.

If only one nozzle were employed then contacts could be positioned in alternate grooves, i. e., with one contact or "on" groove to each two grooves, rather than to each four as in the embodiment of Fig. 1. Such an arrangement is discussed further below in connection with the description of the embodiment of Fig. 6.

In addition to providing rapid connections to a large number of low noise level circuits without shorting or bridging connections between adjacent contacts, as explained above, it is also highly desirable to reduce to a minimum the possible turbulence that may be present in the conducting liquid, which is advantageously mercury. This turbulence if present can give rise to unnecessary heating, raise the noise level of the circuit, and delay the quick return of the mercury to the bottom of the contactor from whence it is pumped back to the rotor cavity 45. Referring again to Fig. 5, turbulence is reduced to a minimum in accordance with a feature of this invention by forming the portion 70 of the groove 52 between the contacts 53 and 54 to conform to the circumference of a relatively large circle and forming the portions 71 of the groove 52 on either side of the contacts 53 and 54 tangent to this circle. The contact surfaces 55 are then positioned in the depressions 56 in the groove 52 so that a smooth over-all surface is presented to the mercury stream, whose center line is indicated at 73. This smooth surface provides a smooth even deflection of the stream path around the circular portion 70 and also insures proper pressure of the mercury stream against the contact surfaces 55. Advantageously these contact surfaces are treated to provide a surface wetted by mercury. Contacts so treated retain a certain amount of mercury at all times. The passing mercury stream thus momentarily becomes common with this retained film or mercury, thereby establishing the low impedance connection between the mercury stream and the two contacts 53 and 54.

Referring now to Fig. 6 there is shown another illustrative embodiment of this invention wherein only a single nozzle is employed, the contacts are spaced in alternative grooves, the "on" and "off" grooves being of different depths however, and only a single contact is provided in each "on" groove, the connection thus established by the stream of mercury being between the contact and a lead extending into the mercury pool at the bottom of the container. As shown in Fig. 6, the contactor comprises a glass container 75 and a mating concave glass top 76, the two being sealed by a ring gasket 77, which may be of a rubber-like silicone material known commercially as "Silastic," and a steel spring 78. The adjacent surfaces of the glass container 75 and glass top 76 may be ground and lapped to provide a fit sufficiently tight, when forced together by the spring 78, that the ring gasket 77 can be dispensed with. The contacts 79 are advantageously disposed in a circle about the top 76 and fused directly thereto as described further below.

A spider support 81 having an outer ring portion 82 and arms 83 is supported in the container, the ring portion 82 being between the container 75 and the top 76. The support 81 serves to support the upper end of a hollow rotatable shaft 84 by bearing rings 85 and bearings 86 between the rings. The lower end of the shaft 84 is also supported through bearing rings 87 and bearings 88 by a conical baffle 90 which is supported from the base of the container 75 by a plurality of support members or straps 91, extending along the base and secured to the outer portions of the bottom of the conical baffle 90, and by a disc 103, identified further below.

A steel disc 93 is attached to the shaft 84 and acts as the rotor of a hysteresis type synchronous motor. The stator 94 and windings 95 are positioned outside of the sealed container adjacent the rotor 93 and separated therefrom only by the wall of the glass container 75. A plurality, such as four, teeth of the stator 94 are however removed to accommodate ribs 96 extending radially out from the outer periphery of the container 75. These ribs 96 are hollow and advantageously have tubes 97 secured therein, as discussed further below.

The upper end of the hollow shaft 84 has secured thereto, or formed integral therewith, a disc 99 having a single channel 100 drilled or otherwise provided therein communicating with the hollow shaft 84. This channel 100 is advantageously narrowed at its outer end 101 and is the single nozzle of the contactor. Of course, if desired additional channels can be provided in the disc 99 for additional nozzles. Further a single hollow shaft may be employed in place of the disc 99; however, a rotating disc provides greater rotational stability. The lower end of the shaft 84 carries a vane or impeller 103 around which is placed a spiral tube 104 having an open end and communicating with the hollow shaft 84.

The tubes 97, which may advantageously be of polyethylene or other tubing pressed into the hollow ribs 96, have secured thereto a cylindrical sleeve 105 to which is attached a planar disc baffle 106 slightly separated from coplanar disc baffles 107 carried by the shaft 84 just below the rotor 93. The sleeve 105 has also secured thereto a disc 108 secured to the conical baffle 90 and outer bearing ring 87 and thus aiding in supporting the lower end of the shaft 84. The disc 108 advantageously has a plurality of apertures 109 therethrough.

In operation, rotation of the shaft 84 and the impeller 103 in the proper direction forces the mercury 112 or other liquid conductor situated in the pool at the bottom of the container below the disc 108 into the spiral tube 104 and thus through the hollow shaft 84, the channel 100 in the disc 99, and out the nozzle 101 against the contacts 79. Each of the contacts 79 is positioned, in accordance with this invention, in a groove 114 which may advantageously be ground, as by a thin grinding wheel, in the glass top 76. The contacts 79 may advantageously be wires bent over in the grooves 114 to be substantially L-shaped, the upright portions of the L's being brought out through apertures in the top 79 and fused directly to the top, as by glass beads 115. A cut-off groove 116 is positioned between each of the contact grooves to assure definite and positive separation of the mercury stream in its rotation from one contact to the next, thus preventing short circuiting between adjacent contacts as explained above. The cut-off grooves 116 may advantageously be shallower than the contact grooves 114, the depth of the grooves being sufficient however to insure a positive cut-off of the mercury stream.

The end portions of the contacts 79 in the contact grooves 114 are advantageously treated to provide a surface wetted by mercury so that the passing mercury stream can become momentarily common with the retained mercury on the contact and thus with the contact. While an L-shaped wire has been shown as the contact in the grooves 114 it is to be understood that contacts similar to contacts 53 and 54 of the embodiment of Fig. 1 or other contacts can be employed. Similarly contactors in accordance with this invention are not to be considered as limited in the relative proportions of the contact and cut-off grooves.

The mercury stream on being momentarily joined to the contact 79 establishes contact between the upper portion of the wire external to the contactor and a metallic lead 117 extending centrally through the base of the container 75 and at all times in contact with the mercury pool 112 and thus with the mercury stream emitted from the nozzle. The lead 117 may advantageously be connected to a central or common circuit and each of the contact wires 79 to separate circuits which it is desired to connect to the central circuit in succession in a rapid sequence.

The stream after passing the contacts 79 is diverted downward by the end of the grooves 114. A small amount of the mercury falls onto the arms 83 of the spider support 81 which have channels 118 on their upper surfaces to conduct this small amount of mercury to the ball bearings 85 and 86 to serve as a lubricant therefor. This small amount of mercury is then thrown back to the outer walls of the container 75 by a slinger 119 carried by the rotating shaft 84 just below the spider support 81. The greater part of the mercury however falls against a conical baffle 121 which is supported by straps 122 from the spider support arms 83. This conical baffle 121 prevents the mercury from falling onto the motor rotor 93 and conducts it instead to the hollow ribs 96 of the container 75 and through the tubes 97 positioned therein back to the common pool at the base of the container. The tubes 97 form seats for steel balls 123 which float in the mercury pool and serve as check valves on tilting of the container. The balls 123 are

retained adjacent the tubes 97 in the hollow ribs 96 by the sleeve 105. Thus if a contactor in accordance with this embodiment of this invention is employed aboard a ship, sudden positional changes due to the pitch and roll of the ship will not cause the mercury to be thrown out of the lower pool. Additionally, the disc 108 defines a chamber for the mercury pool, serving both to prevent mercury from the pool splashing onto the rotor and also as a trap for long periods of inclinations, the apertures 109 being at the center of the disc adjacent the shaft 84. The lower conical baffle 90 acts as a shroud completely surrounding the lower end of the shaft 84 and the impeller 103 to prevent motion of the impeller 103 being transmitted to the main body of mercury. The shroud or baffle 90 is advantageously shaped so that as the mercury is accelerated by the rotation of the impeller the centrifugal action tends to hold it in the scoop path of the open tube 104. The shroud or baffle 90 thereby avoids undesirable turbulence and centrifugal action in the main pool of mercury.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A high speed contactor comprising a vessel, a liquid conductor within said vessel, means insulatingly supporting a plurality of closely spaced electrical contacts within said vessel, means for propelling said liquid conductor against said contacts sequentially, and barrier means within said vessel and projecting between adjacent contacts, preventing said liquid conductor from contacting any two adjacent sequential electrical contacts at the same time.

2. A high speed contactor comprising a vessel, a liquid conductor within said vessel, support means having a surface within said vessel having a plurality of ridges and grooves therein, electrical contacts positioned in some of said grooves and insulated from each other, and means for propelling said liquid conductor along said surface and against said contacts sequentially, each of said contacts being separated from the adjacent contact in sequence by at least one of said grooves.

3. A high speed contactor comprising a vessel, insulating means having a surface within said vessel, a plurality of closely spaced contacts supported by said surface, a liquid conductor within said vessel, means within said vessel for propelling said liquid conductor against the exposed inner face of said contacts sequentially, and cut-off means between said contacts preventing said liquid conductor making connection to two adjacent sequential contacts, said cut-off means comprising grooves in said insulating means intermediate said adjacent contacts.

4. A high speed contactor comprising a vessel, a liquid conductor within said vessel, insulating means having a surface within said vessel and having a plurality of closely spaced grooves in a circular boundary in said surface, electrical contacts supported by said insulating means and positioned in some of said grooves, and means for propelling said liquid conductor against said contacts sequentially in the form of a jet, said jet, contacts and grooves being of comparable width, each of said contacts being separated from the adjacent sequential contact by at least one of said grooves.

5. A high speed contactor comprising a vessel, support means within said vessel and having a plurality of closely spaced grooves aligned in a circular row therein, electrical contacts supported by said support means and positioned in some of said grooves, said contacts being insulated from each other, a liquid conductor within said vessel, and means within said vessel for ejecting said fluid along said circular row of contacts and substantially perpendicular thereto and directly against the exposed face of each contact, each of said contacts being separated from the adjacent contact along said row by at least one of said grooves.

6. A high speed contactor comprising a vessel, a liquid conductor therein, support means having a circular inner periphery within said vessel and a plurality of closely spaced grooves in said inner periphery and perpendicular to the plane thereof, electrical contacts mounted in a row by said support means and positioned in some of said grooves, a rotatable nozzle within said vessel and having an orifice adjacent said inner periphery, and means for ejecting said liquid conductor from said nozzle in the form of a jet parallel to the plane of rotation of said nozzle and against the exposed face of said contacts, each of said contacts being separated from the adjacent contact along said row by at least one of said grooves.

7. A high speed contactor in accordance with claim 6 wherein said contacts are located in said some grooves in pairs whereby connection is made by said ejected liquid conductor between each pair of contacts.

8. A high speed contactor in accordance with claim 7 wherein a lead extends from each of said contacts through said vessel.

9. A high speed contactor in accordance with claim 7 wherein a conducting ring is positioned behind said support means and connected to one of each pair of contacts.

10. A high speed contactor comprising a vessel, insulating means having a circular inner periphery, said inner periphery having a plurality of closely spaced grooves therein perpendicular to the plane thereof, electrical contacts supported in a row by said insulating means and positioned in some of said grooves, a liquid conductor within said vessel, and means within said vessel for propelling said fluid along the row of said contacts and substantially perpendicular thereto, each of said contacts being separated from the adjacent contact along said row by at least one of said grooves, and each of said grooves having contacts therein, said grooves and contacts being contoured to present cooperatively a smooth surface to said propelled liquid.

11. A high speed contactor comprising a vessel, a liquid conductor within said vessel, a flat disc defining a rotor rotatably supported within said vessel, a cooperating stator external to said vessel, an insulating ring within said vessel having a plurality of closely spaced grooves therein, electrical contacts positioned in some of said grooves, a nozzle rotatable with said rotor, and means including said rotor and said stator for circulating said liquid conductor in said vessel and for ejecting said liquid conductor against said contacts, each of said contacts being separated from said adjacent contact along said ring by at least one of said grooves.

12. A high speed contactor in accordance with claim 11 wherein each of said grooves having a

contact therein has a depression therein, said contact fitting into said depression, said contact and said groove presenting a smooth surface to said ejected liquid conductor.

13. A high speed contactor in accordance with claim 11 wherein said contacts are located in said grooves in pairs, and an electrically conducting ring encompasses said insulating ring on the other side thereof from said grooves, one of each of said pairs of contacts being connected to said ring and the other of each of said pairs of contacts having a lead brought out through said enclosed vessel.

14. A high speed rotary contactor comprising a vessel, a liquid conductor within said vessel, a rotatable flat rotor within said vessel, a plurality of vanes extending radially from the periphery of said rotor, a complementary stator external to said rotor and defining therewith a motor for rotating said rotor, a hollow member affixed to said rotor and defining a rotor cavity therewith, a nozzle communicating wtih said cavity and extending radially therefrom, an insulating ring coaxial with said rotor and adjacent the path of said nozzle, said ring having therein a plurality of grooves adjacent said nozzle, and electrical contacts in some of said grooves, each of said contacts being separated from the adjacent contact around said ring by at least one of said grooves, a channel ring adjacent said vanes and complementary therewith, said insulating ring being supported on said channel ring, said channel ring having grooves therein, and a plurality of return tubes extending into said channel ring grooves and adapted to return said liquid conductor from said channel ring to said cavity after it has been ejected from said nozzle against said contacts.

15. A high speed contactor comprising a vessel, said vessel having an insulating top, said top having therein a plurality of closely spaced grooves situated in a circle around the periphery of said top within said vessel, electrical contacts situated in some of said grooves, a liquid conductor within said vessel, and means for propelling said liquid conductor against said contacts, each of said contacts being separated from the adjacent contact around said circle by at least one of said grooves.

16. A high speed contactor comprising a vessel, said vessel having an insulating top, said top having therein a plurality of closely spaced deep grooves situated in a circle around the periphery of said top within said vessel, electrical contacts situated in said deep grooves, a shallow groove situated in said top between each of said deep grooves, a liquid conductor within said vessel, and means for propelling said liquid conductor against said electrical contacts.

17. A high speed contactor comprising a vessel, said vessel having a glass top, said top having therein a plurality of closely spaced grooves situated in a circle around the periphery of said top within said vessel, electrical contacts within said grooves and having leads extending through said top, said leads being fused to said top, a liquid conductor within said vessel, a hollow shaft rotatably supported within said vessel, a nozzle communicating with said hollow shaft, and means for rotating said hollow shaft and ejecting said liquid conductor from said nozzle against said contacts, each of said contacts being separated from the adjacent contact around said circle by at least one of said grooves.

18. A high speed contactor comprising a container, a glass top for said container, said top having therein a plurality of grooves located in a circle, electrical contacts in some of said grooves, adjacent electrical contacts being separated by at least one of said grooves, a support spider in said container, a hollow shaft supported by said spider, said spider having channels therein leading towards said shaft, a nozzle connected to said hollow shaft and extending adjacent said contacts, a first conical baffle supported from said spider, a plurality of tubes extending from said baffle towards the base of said container, a liquid conductor in said container, an impeller and open spiral tube at the base of said hollow shaft, said tube communicating with said hollow shaft, a second conical baffle surrounding said impeller and spiral tube, and motor means for rotating said shaft to cause said liquid conductor to be ejected from said nozzle.

ARTHUR L. HOLCOMB.
MINARD A. LEAVITT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,444,687	Widakowich	July 6, 1948