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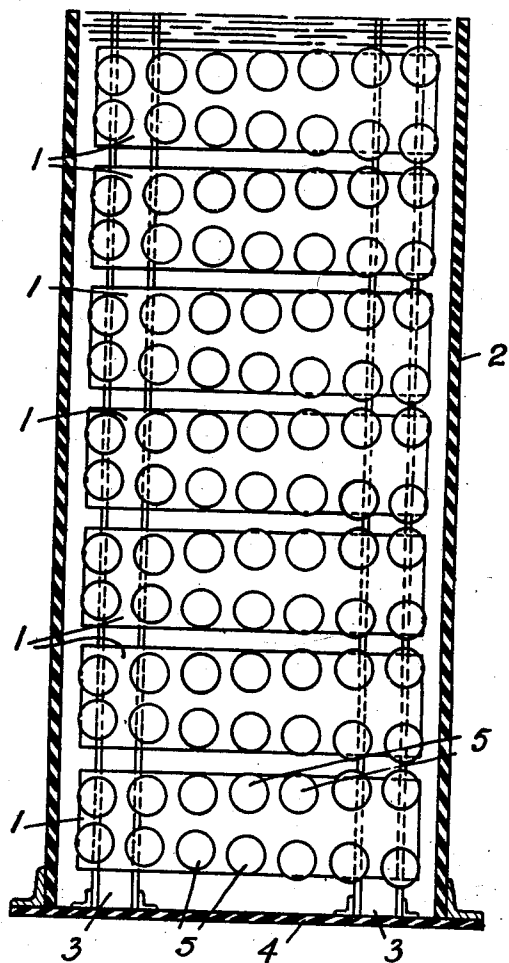
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HIGH TENSION DRY CONTACT RECTIFIER APPARATUS

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3 Sheets-Sheet 1

Fig. 1.



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Fig. 5.

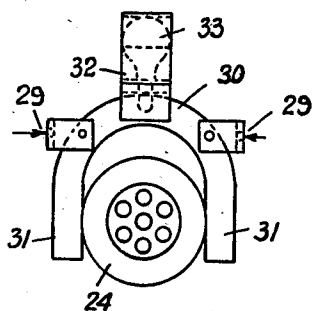


Fig. 2.

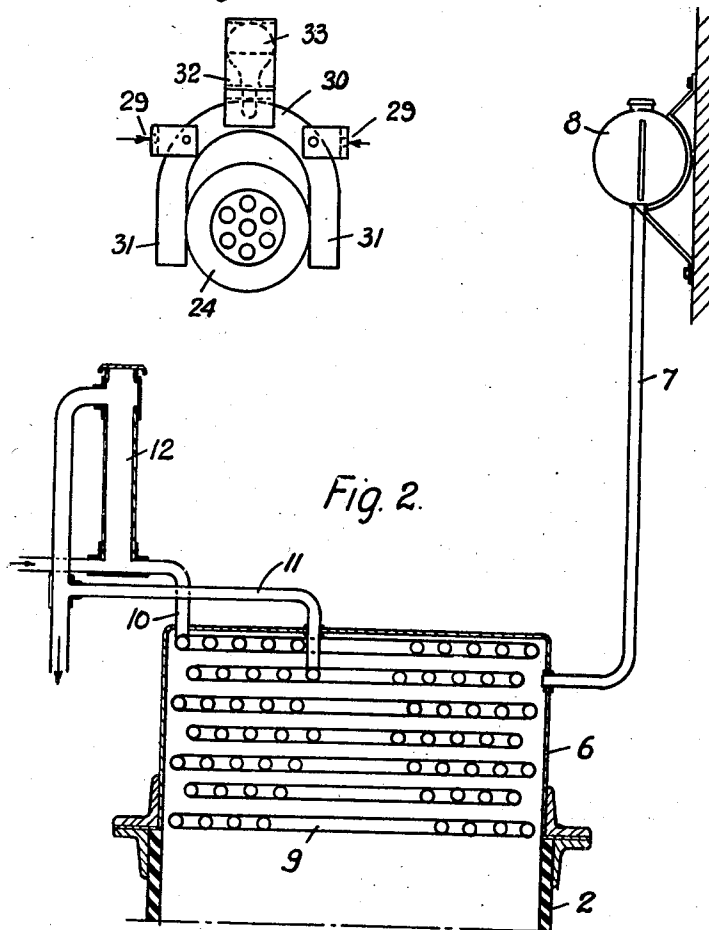


Fig. 4.

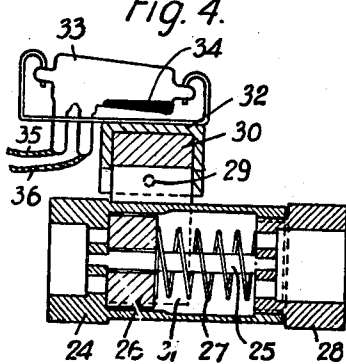
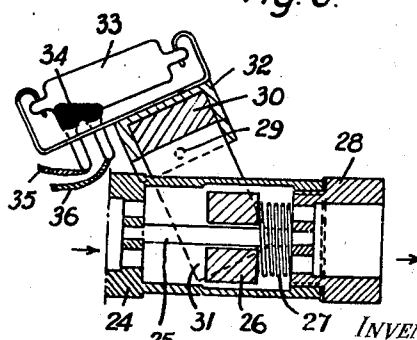


Fig. 6.



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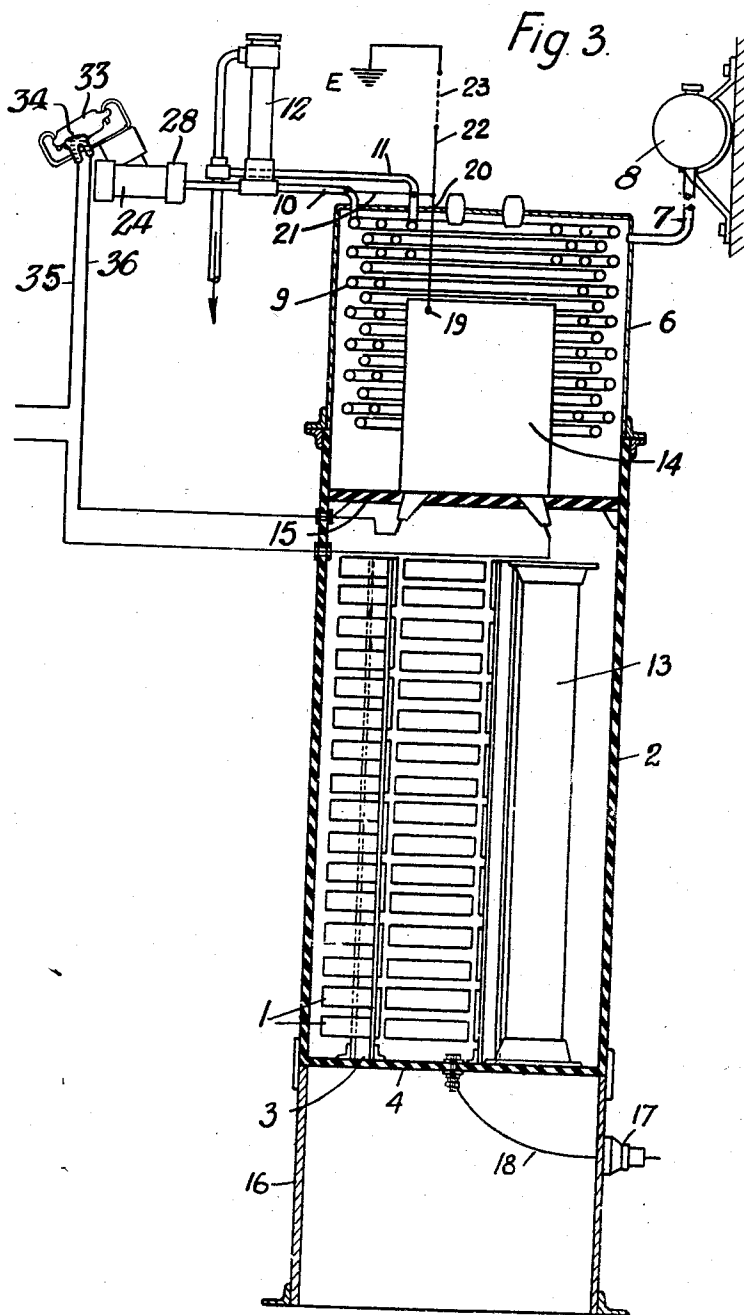
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HIGH TENSION DRY CONTACT RECTIFIER APPARATUS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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HIGH TENSION DRY CONTACT RECTIFIER
APPARATUS

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4 Claims. (Cl. 175—366)

This invention relates to apparatus for obtaining, from a source of alternating electric current, high uni-directional or direct current potentials by means of rectifiers of the dry contact type such, for example, as copper oxide or selenium rectifiers, and has for its object to provide improved apparatus of this character.

Although theoretically it is possible by providing the required number of rectifier elements connected in series with one another to obtain any desired uni-directional or direct current potential, it is found difficult in practice to ensure that the rectifier elements shall withstand the very high potentials involved while being effectively insulated and cooled, and the invention enables these difficulties to be effectively overcome.

According to one feature of the invention, the series connected rectifying elements are arranged in groups in a hollow container, the walls of which are constructed of insulating material and which contains a bath of highly insulating fluid in which the elements are immersed, the elements being so arranged that the portions thereof adjacent to one another are as nearly as possible at the same electric potential.

According to another feature of the invention, the apparatus constructed as above described is provided with a cooling device of the circulating liquid type, this device being arranged adjacent to the low potential end of the rectifier series of groups, and is electrically connected to the corresponding terminal which is earthed.

In a modification of the arrangement above referred to, in which the cooling fluid employed in the cooling device is a good insulator such as oil, the inlet and outlet pipes for this fluid being constructed of insulating material so that the body of the cooling device is insulated from earth, the device is electrically connected as in the previous arrangement to the low potential terminal of the rectifier circuit, this terminal being, however, at a potential which is different from earth and this difference of potential being utilised for the operation of any suitable device.

According to a still further feature of the invention, arrangements are provided for automatically interrupting the supply of alternating current to the rectifier circuit in the event of failure of the circulation of the cooling liquid in the cooling device.

The invention is illustrated by way of example in the accompanying drawings of which Figure 1 is a somewhat diagrammatic view in vertical sec-

tion of the portion of apparatus constructed in accordance with the invention containing the rectifier groups, Figure 2 being a similar view of the cooling device.

5 Figure 3 is a similar view of the complete apparatus showing the arrangement of the rectifier portion, the cooling device and other parts of the apparatus.

10 Figures 4, 5 and 6 are views of one form of the automatic cut-out device above referred to, Figures 4 and 5 being views thereof in longitudinal section and end elevation respectively, while Figure 6 is a view similar to Figure 4, showing the device under different conditions of operation.

15 Referring now to Figure 1, it will be seen that the rectifier elements of the apparatus are arranged in banks 1 superposed one above another in a vertical column within a casing 2, the walls of which are constructed of electrically insulating material, the banks 1 being supported on 20 suitable vertical standards 3 mounted upon the base 4 of the casing 2.

25 Each of the banks 1 comprises a number of groups 5 of rectifier elements arranged in two superposed rows, or layers and it will be noted that groups are so arranged in the bank that the groups in the upper and lower row at one end of the bank which are at substantially the same potential are more closely spaced vertically than 30 the groups at the opposite end of the bank which are at considerably different potentials. Furthermore, the group of elements at one end of the upper row in one bank is more closely adjacent to the opposite group at the end of the lower row in the next bank above than are the corresponding groups at the other ends of the two banks.

35 It will be understood that the rectifier elements of the groups are connected in series with one another, either directly or in the manner usually adopted for the so-called "voltage doubler" systems and from the arrangement above described it will be seen that in general the separation of the groups in the rows of each bank and in the adjacent rows of groups in adjacent banks is such that the greater the difference of potential between two groups, the greater is the distance by which they are separated from one another.

40 The casing 1 is filled with an insulating liquid in which the groups of rectifier elements are submerged and a cooling device shown in Figure 2 is provided at the upper end of the casing 1.

45 Referring now to Figure 2, it will be seen that the cooling device comprises a head or upper

casing 6 fitted on to the upper end of the casing 2. The casing 6 which is preferably constructed of metal is provided with suitable packing for preventing leakage of the insulating liquid which fills the whole space within the casings 2 and 6. This liquid is maintained under a suitable hydraulic head or pressure by means of the vertical pipe 7, the upper end of which terminates in an expansion chamber 8.

Mounted within the casing 6 is a tubular cooling coil 9 preferably constructed of metal and provided with an inlet pipe 10, and outlet pipe 11 and an overflow device 12 of any suitable type, the coil 9 being thereby supplied with a suitable cooling liquid preferably water, the circulation of the liquid through the coil 9 being effected by a suitable pump or otherwise.

The complete apparatus is shown diagrammatically in Figure 3, and it will be seen that the casing 2 is shown as containing, in addition to the rectifier groups 1, a condenser 13 (in the case of voltage doubler apparatus) and the transformer 14 through which the rectifier system is supplied with current the transformer 14 being mounted upon a platform 15 in the casing 2 and projecting within the upper casing 6.

The casing 2 is shown as mounted upon a pedestal or base member 16 in which is mounted an insulating sleeve or bushing 17 for the high potential conductor 18 of the rectifier circuit, the low potential terminal of this circuit as well as the corresponding terminal 19 of the transformer 14 being connected to the inlet and outlet pipes 10, 11 of the cooling coil 9 by low resistance conductors 20, 21. The conductors 20, 21 may be connected to earth at E through a conductor 22.

With this system of connection, it will be understood that the terminals of the rectifier circuit are the conductor 18 and the earthed conductor 22.

In a modified system of connection, however, in which the pipes 10, 11 are constructed of insulating material and the cooling liquid supplied to the coil 9 is also a relatively high insulator, the terminal conductor 22 may be arranged to be at a potential different from earth, so that the circuit indicated in dotted lines at 23 will be traversed by a corresponding current and may be constituted by any desired apparatus or device which is required to be operated by unidirectional current other than that to which the high voltage terminals 18 and 22 are connected.

Referring now to Figures 4, 5 and 6, a safety device is illustrated comprising a tubular member 24 preferably constructed of non-magnetic metal and interposed in the inlet pipe 10 through which cooling liquid is supplied to the cooling coil 9 shown in Figures 2 and 3.

Loosely mounted upon a suitable guide rod 25 axially arranged within the member 24 is a small piston 26 constructed of magnetisable material, a control spring 27 being interposed between the inner end of the piston 26 and the inner end of a hollow plug 28 fitted into the outlet end of the member 24.

Mounted in suitable trunnions or bearings as indicated at 29 is a permanent magnet 30, the arms 31 of which embrace the central portion of the tubular member 24 so as to be adjacent to the piston 26.

A bracket 32 is secured to the magnet 30 and carries a mercury switch 33 of the well known type comprising a bulb containing a body of mercury 34 and conductors sealed into the wall

of the bulb and connected to flexible external conductors 35, 36. The conductors 35, 36, are connected either in the supply circuit of the primary or low tension winding of the transformer 14 or in the operating circuit of a suitable contactor device controlling this transformer circuit, the operation of the safety device being as follows:

So long as the cooling fluid is properly circulating in the cooling coil 9, this fluid flows through the tubular member 24 in the direction of the arrows shown in Figure 6 and acting upon the piston 26 maintains this piston in its right-hand position as shown in Figure 6 compressing the spring 27.

The magnetic attraction between the arms 31 of the magnet 30 and the magnetisable piston 26, under these conditions maintains the magnet 30 in its deflected or operative position in which the mercury switch 33 is in such a position that the body of mercury 34 electrically connects the conductors 35, 36, thereby closing the circuit of the primary winding of the transformer 14 or causing this circuit to be closed through the contactor device above referred to.

The rectifier apparatus is accordingly rendered operative as will be apparent without further explanation.

In the event, however, of the flow or circulation of cooling fluid in the cooler coil 9 failing for any reason, the cessation or substantial reduction of the flow of cooling liquid through the tubular member 24 will permit the spring 27 to displace the piston 26 to its inoperative position shown in Figure 4. The magnet 30 is correspondingly displaced, carrying with it the mercury switch 33 so that the body of mercury 34 (as shown in Figure 4) no longer effects electrical connection between the conductors 35, 36.

The supply of alternating current to the primary winding of the transformer 14 is thus interrupted either directly or through the contactor device, and the rectifier apparatus is thus rendered inoperative until the circulation of cooling fluid is restored. Damage to the rectifier apparatus, owing to failure of the cooling system, is thus automatically prevented.

The invention is evidently not limited to the particular arrangement and construction above described and illustrated by way of example, which may be varied in many respects without exceeding the scope of the invention.

The casing 2, for example, may be arranged also to contain any other accessory apparatus or devices other than those above described and the cooling device which may be of any preferred type may be arranged within the casing in any manner adapted to ensure the effective circulation of the cooling fluid in which the rectifier and other elements of the apparatus are immersed.

I claim:

1. In high tension rectifier apparatus in which rectifier elements of the dry contact type are immersed in a bath of highly insulating fluid within a hollow container in such manner that the portions of the individual rectifier elements adjacent to one another are as nearly as possible at the same potential and in which the low potential terminal is insulated from earth, the combination of a cooling device of the circulating liquid type disposed in said bath and having inlet and outlet pipes of insulating material and containing a circulating liquid which is a good insulator, the body of the cooling device being

connected to the low potential terminal of the rectifying apparatus and the difference of potential between this terminal and earth being utilized to supply unidirectional current for operating any desired apparatus or device.

2. In high tension rectifier apparatus in which rectifier elements are immersed in a bath of highly insulating material which is kept cool by a cooling device of the circulating liquid type immersed in the bath, the combination of a piston adapted to be displaced by the flow of cooling liquid, and switch means for controlling the supply of current to the rectifying apparatus operatively connected with said piston.

3. In high tension rectifier apparatus in which rectifier elements are immersed in a bath of highly insulating material which is kept cool by a cooling device of the circulating liquid type immersed in the bath, the combination of a safety device comprising a piston adapted to be displaced by the flow of cooling liquid, and when

thus displaced to effect the operation of a switch to close either directly or through a contactor device the circuit through which alternating current is supplied to the rectifying apparatus, the piston being biased to automatically return to an initial position in which the supply of current is cut off in the event of failure in the flow of the circulating cooling liquid.

4. In high tension rectifier apparatus in which rectifier elements are immersed in a bath of highly insulating material which is kept cool by a cooling device of the circulating liquid type immersed in the bath, the combination of a safety device comprising a magnetizable piston adapted to be displaced by the flow of cooling liquid, a permanent magnet disposed to follow the movement of said piston, and a switch controlling the supply of current to the rectifying apparatus operated by the movement of said permanent magnet.

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