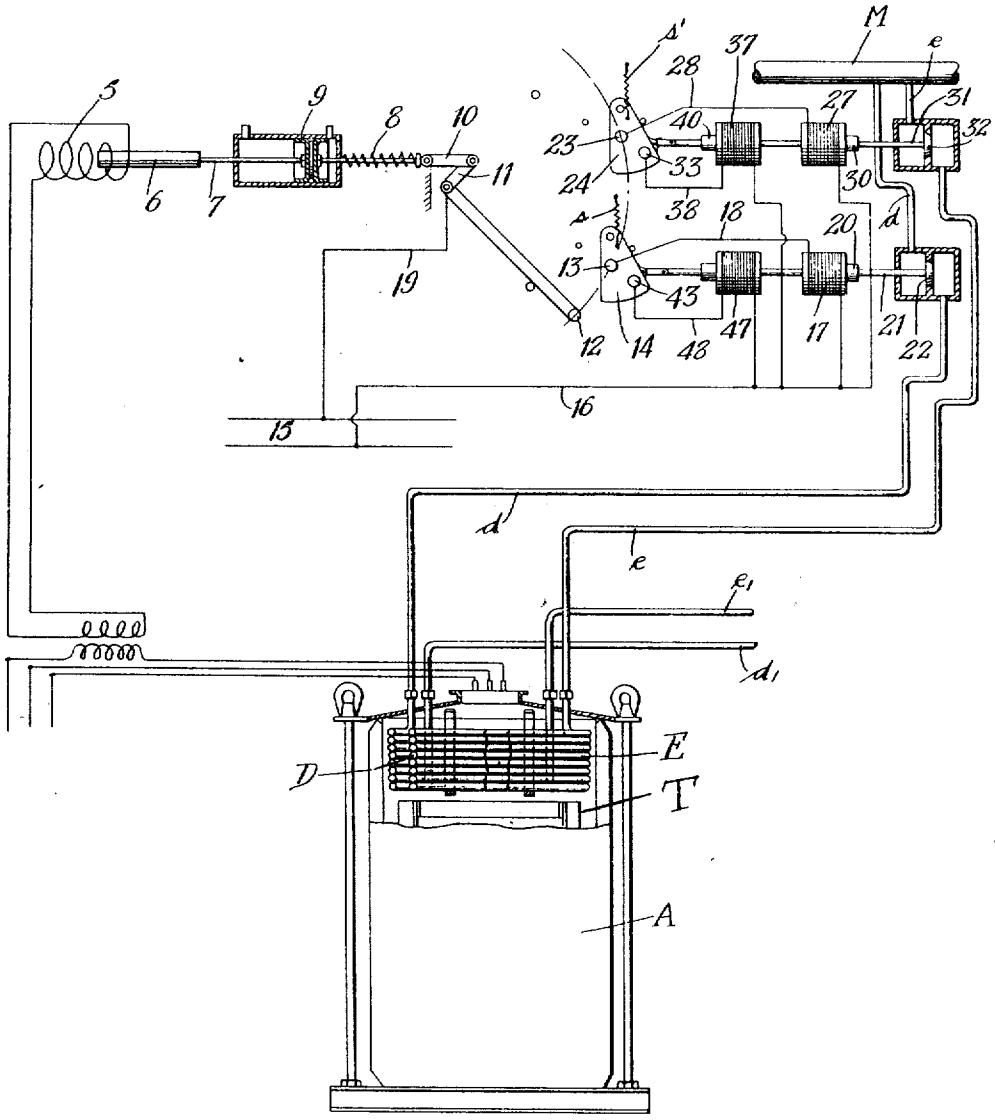
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R. V. BINGAY

WATER COOLED TRANSFORMER

Filed Nov. 27, 1920



Inventor

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By his Attorneys

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UNITED STATES PATENT OFFICE.

ROBERT V. BINGAY, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO PITTSBURGH TRANSFORMER COMPANY, A CORPORATION OF PENNSYLVANIA.

WATER-COOLED TRANSFORMER.

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To all whom it may concern:

Be it known that I, ROBERT V. BINGAY, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Water-Cooled Transformers, of which the following is a specification.

This invention relates to electrical apparatus which is cooled by the circulation of a fluid such as oil and particularly to water-cooled apparatus such, for instance, as a transformer submerged in cooling oil which in turn is cooled by water circulation. The object of the invention is to provide automatic control means which will regulate the water circulation according to the load on the transformer so as to protect the transformer against an excessive temperature rise and at the same time to avoid waste of the water.

In the accompanying drawing illustrating the invention by a specific embodiment thereof a control system is shown by diagram of circuits adapting the system for use in connection with a transformer.

In the system shown in the drawings a transformer tank A contains oil in which the transformer T is submerged. Cooling coils D and E are provided surrounding or above the transformer and are in the oil; the inner coil D receives its supply of cooling water through the supply pipe d and the outer coil E receives a separate supply of cooling water through the pipe e. The respective outlets d_1 and e_1 from the coils D and E, may be connected to a waste conduit or have their flows returned through cooling means to the supply main M.

The inner coil D will be sufficient to cool the circulating oil when the transformer is under light loads up to 70% for instance of the rated capacity; beyond this point additional cooling will be required to prevent the transformer from overheating. In the system of this invention the control of the cooling water is effected by the variations in the load on the transformer so that the water cooling will change simultaneously with the load. In the specific embodiment of the invention illustrated in the drawings one of the load circuits is carried in series through the primary of a transformer which supplies current to the solenoid 5 exerting a variable pull upon core 6, the pull being proportionate to the load on the transformer. This pull is transmitted to a rod 7 and is opposed by a light spring 8 and by a dash pot piston 9 so that only a very slight resistance is exerted against a gradual movement of the core but a higher resistance to quick fluctuations. In this way the core will be substantially unmovable by temporary load variations but will respond readily to changes which persist.

The movements of the rod 7 are transferred through link 10 to a bell crank 11 carrying the contact 12 at its end. Spring 8 will normally press this bell crank 11 clockwise holding its arm in lowermost position for low load condition of the transformer. As the load increases the contact 12 will be raised and will finally make contact with the point 13 of oscillating segment 14. The line wires 15 are supplied from any suitable source of electricity and may be the usual 110 volt supply lines. This contact between 12 and 13 will establish a circuit from one of the line wires 15, wire 16 to solenoid 17, wire 18, contacts 13 and 12, bell crank 11 and wire 19 to the other line wire 15. Current through the solenoid 17 by its core 20 will act to draw the rod 21 to the left opening the valve 22 and simultaneously swinging the segment 14 to the left and breaking the connection between contacts 12 and 13. The opening of valve 22 will connect the water main M with the supply pipe d for the cooling coil D of the transformer and this valve 22 will remain open until closed as hereinafter explained, spring means s being provided to hold the segment 14 in either of its extreme positions.

If the load on the transformer continues to increase the contact 12 will continue to rise and will finally come in contact with the button 23 of oscillating segment 24 establishing a circuit from one line wire 15, wire 16, solenoid 27, wire 28, contacts 23, 12, bell crank 11 and wire 19 to the other line wire 15. Current in the solenoid 27 will draw its core 30 to the left and through rod 31 open the valve 32 simultaneously swinging the segment 24 to its extreme left position and break the connection between contacts 23 and 12. A spring means s' holds the segment 24 in its position and retains valve 32 open until positively closed as hereinafter

described. The opening of valve 32 connects the water main M through pipe e with cooling coil E of the transformer.

Valves 22 and 32 will remain open until contact 12 due to reduction in the load falls back into contact with the button 33 of swinging segment 24, which button was positioned in the path of contact 12 by the movement of the segment to the left. A connection between contact 12 and button 33 will establish a circuit from one line wire 15, through wire 16 to the solenoid 37, wire 38 to contacts 33, 12, bell crank 11 and wire 19 to the other line wire 15 and current in this solenoid 37 will draw on its core 40 to move the rod 31 to the right and close the valve 32 shutting off the water circulation through the coil E of the transformer. The segment 24 will be simultaneously swung to extreme right position with button 23 in the path of any upward movement of contact 12 and all these parts will remain in this position until contact 12 moves over button 23. If the load on the transformer increases again so as to bring contacts 12 and 23 together water circulation through the coil E will be reestablished and thus this coil E may be connected and cut off from the main, dependent upon the load changes. The cooling coil D will remain connected in circuit with the main M until the load decreases sufficiently to bring contact 12 into connection with the contact 43 of swinging segment 14 which in its extreme left position brings this button 43 into the path of movement of contact 12. Upon connection between contacts 12 and 43 a circuit will be established from the lines 15 through the solenoid 47, drawing the rod 21 to the right and simultaneously closing the valve 22 shutting off the circulation through coil D and swinging segment 14 to the right and all these parts will remain in this position until contact 12 again rises into connection with contact 13.

In the system of this invention variations in low loads may repeatedly establish and cut off the circulation through coil D without affecting coil E and similarly higher load variations may bring coil E into and out of operation while leaving the coil D constantly connected to the main M. The turning on or off of the water circulation in each coil is directly responsive to load variations. Either coil is brought into operation simultaneously with the load increase so that the cooling of the oil begins with or before the increased heating effect. The temperature rise of the transformer is thus anticipated and kept within small limits and does not attain excessive values, as for instance where the water circulation is governed by the temperature of the oil which lags behind the load increase and may thus delay the water cooling until long after the load increase has dangerously overheated the transformer.

I claim:

1. The combination with a transformer and a tank therefor, of a plurality of separate conduits for cooling the transformer having independent paths for the cooling medium, and automatic means for successively controlling the flow of cooling fluid through said separate conduits according to the operative condition of the transformer.

2. The combination with a transformer and a tank therefor, of a plurality of separate conduits for cooling the transformer having independent paths for the cooling medium, and automatic means for successively controlling the flow of cooling fluid through said separate conduits according to the load on the transformer.

3. The combination with a transformer and a tank therefor, of a plurality of separate conduits for cooling the transformer having independent paths for the cooling medium, and automatic means for successively increasing the flow of cooling fluid through said separate conduits upon increase in load on the transformer and for successively decreasing the flow upon decrease in load.

4. The combination with a transformer and a tank therefor, of a plurality of separate conduits for cooling the transformer having independent paths for the cooling medium, a valve for each of said conduits respectively for opening and closing the same, and automatic means for successively controlling said valves according to the operative condition of the transformer.

5. The combination with a transformer and a tank therefor, of a plurality of separate conduits for cooling the transformer having independent paths for the cooling medium, a valve for each of said conduits respectively for opening and closing the same, and automatic means for successively opening said valves upon increase in load on the transformer and for successively closing said valves upon decrease in load.

ROBERT V. BINGAY.