J. L. WOODBRIDGE.

ELECTROMAGNETIC SWITCH.

APPLICATION FILED FEB. 6, 1915.

1,225,388.

Patented May 8, 1917.

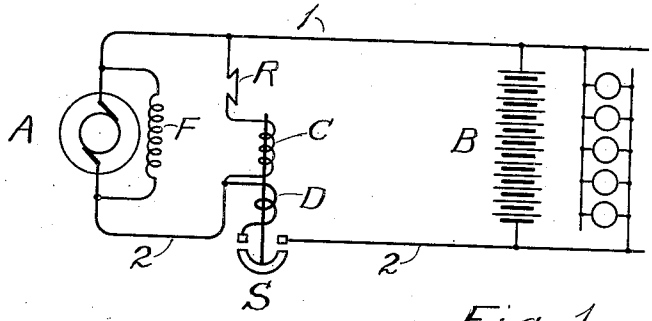


Fig. 1.

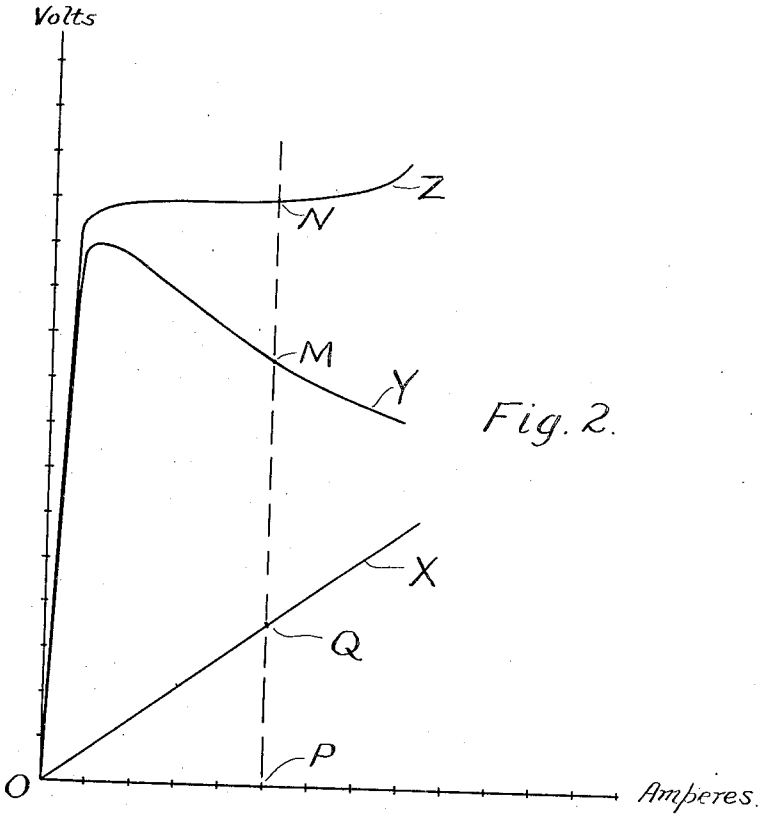


Fig. 2.

WITNESSES:

Joseph H. Gracy

R. Whitestone Jr.

INVENTOR

Joseph Lester Woodbridge,

BY

Augustus B. Stoughton.

ATTORNEY.

UNITED STATES PATENT OFFICE.

JOSEPH LESTER WOODBRIDGE, OF PHILADELPHIA, PENNSYLVANIA.

ELECTROMAGNETIC SWITCH.

1,225,388. Specification of Letters Patent. Patented May 8, 1917.

Application filed February 6, 1915. Serial No. 6,413.

To all whom it may concern:

Be it known that I, JOSEPH LESTER WOODBRIDGE, a citizen of the United States, and a resident of Philadelphia, in the county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Electromagnetic Switches, of which the following is a specification.

My invention relates to switches which are operated by a coil responsive to the voltage across a given circuit, and one of the objects of my invention is to make the operation of such switches more accurate in response to said voltage. For this purpose I employ a coil for controlling the operation of the switch, and in series therewith I connect a resistor having a marked negative temperature coefficient sufficient to produce a drooping characteristic, that is a drop in voltage across the terminals of the resistor with increments of current within a certain range. The resistance of the operating coil is so designed as to coöperate with the characteristics of the resistor to produce the results set forth below.

One embodiment of my invention will now be described in connection with the accompanying drawings, in which Figure 1 is a diagrammatic representation of apparatus and circuits involving features of my invention, and Fig. 2 is a diagram showing the relation of voltage and current in different parts of the control circuit of Fig. 1.

Referring to Fig. 1, A is a dynamo and F its field coil, the dynamo being connected to the circuit 1, 2. Across this circuit is also connected a storage battery B. In the conductor 2 is interposed an electromagnetic switch S having two operating coils C and D. Coil D is connected in series with conductor 2, while coil C is connected in shunt across the circuit 1, 2. Coil C, therefore, determines the closing of the switch in accordance with the voltage across the circuit 1, 2. After the switch is closed current from the dynamo to the battery passing through coil D will cause the latter to coöperate with coil C to hold the switch in the closed position, while reversal of current in the coil D caused by a lowering of the voltage of the dynamo and a discharge of the battery will cause coil D to oppose coil C and when this reversal of current reaches a sufficient value the switch will open.

It is usually found that in a switch of this character the magnetizing force required to close the switch is considerably greater than the value to which this magnetizing force must fall in order to permit the switch to open. As a result of this, the dynamo voltage must rise to a value abnormally high in order to close the switch, or if the switch is designed to close at normal voltage a very considerable reversal of current in the coil D will be necessary to open it, and as soon as the switch is opened the current in coil D being interrupted, the switch is liable to close again causing some chattering.

In the present invention these results are obviated by inserting a resistor R having a marked negative temperature coefficient in series with coil C. This negative temperature coefficient should preferably be of sufficient value to cause an actual drop in the voltage across the terminals of the resistor with increments of current within a certain range of current values. A suitable characteristic for this resistor is shown by the curve Y in Fig. 2 which represents the relation of voltage and current in the resistor. In order to secure the best results the resistance of coil C should be adapted to the characteristic curve Y in such a manner that the characteristic of the two combined shall produce a characteristic curve similar to that shown by the curve Z in Fig. 2. In order to produce this result the resistance of coil C should be as shown by the line X in Fig. 2. Then the curve Z will be derived from curves X and Y by adding the ordinates, as, for example, the ordinate PQ of curve X added to the ordinate PM of curve Y produces the ordinate PN of curve Z. The curves X and Y should be such that their combined characteristic curve Z starting from the origin O nearly vertically should turn abruptly when a certain voltage is reached and become nearly horizontal.

As a result of this combination, it will be seen that when the voltage across the circuit 1, 2 is below the critical value, only a very small amount of current will flow through the coil C, but when the voltage rises to this critical value the current in the coil C will increase rapidly with very small further increments of voltage. This will cause the switch S to close very positively at the desired voltage, and to open again with very little fall of voltage, and a very small reversal of current in the coil D.

Having described my invention what I claim and desire to secure by Letters Patent is—

In an electromagnetic switch, the combination of a movable switch element, a coil adapted, upon energization, to operate said element to close the switch, said coil having a rising voltage characteristic with increments of current therethrough, and in series with said coil a negative temperature coefficient resistor of material characterized by a drooping voltage characteristic with increments of current through it and adapted to substantially neutralize the rising voltage characteristic of the coil.

In testimony whereof, I have hereunto signed my name.

JOSEPH LESTER WOODBRIDGE.

Witnesses:
R. A. WHITSTONE, Jr.,
W. G. ROGERS.