Sept. 6, 1927. 1,641,285

D. D. MILLER

RELAY

Filed Sept. 6. 1924

Fig.1

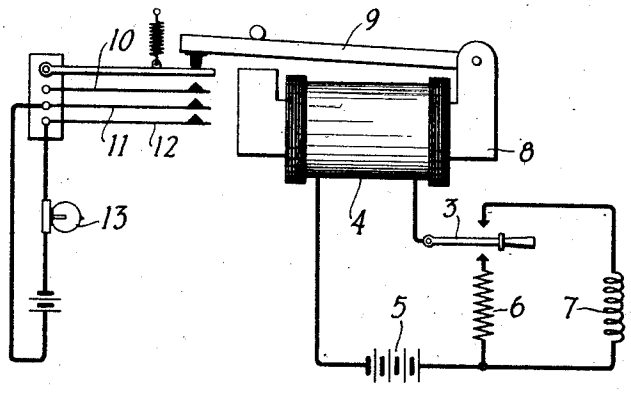


Fig.2

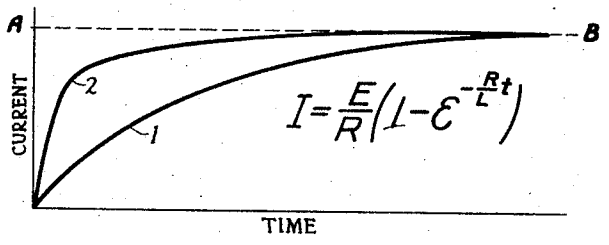
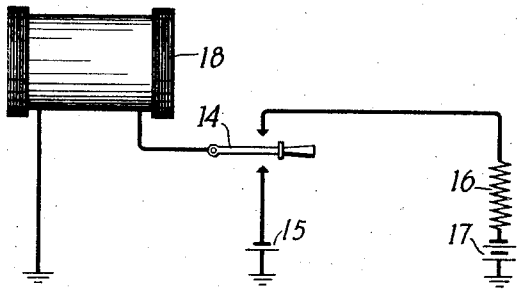


Fig.3



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by Edw. Adams. Atty.

Patented Sept. 6, 1927. 1,641,285

UNITED STATES PATENT OFFICE.

DANIEL D. MILLER, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

RELAY.

Application filed September 6, 1924. Serial No. 736,382.

This invention relates to relays and particularly relays of the type employed in telephone circuits, its object being to produce a reliable marginal relay.

In accordance with this invention the relay is designed with a comparatively heavy armature and a graduated contact spring arrangement whereby the spring pressure is built up gradually before the final contact is made. Through an armature of this nature a relay is produced which depends for its marginal operation on a difference in time rather than a difference in current as has been the case heretofore.

The drawings show two diagrammatic illustrations embodying features of this invention and a graph illustrating the principle whereby the difference in time is gained.

In Fig. 1 a relay is shown connected in a circuit having two alternate arrangements whereby a difference in the operation may be explained;

Fig. 2 shows two curves illustrating the manner in which current builds up in circuits having different characteristics; and

Fig. 3 is a diagrammatic illustration of a relay winding in a circuit equivalent to that shown in Fig. 1, but arranged somewhat differently.

It is well known that when an electric circuit is closed there is a period during which the current rises from zero value to its ultimate value. The manner in which the current rises has heretofore been investigated and is now well known, the formula shown on the drawing being a well-known exponential formula by means of which such curves may be calculated. The curve designated 1 illustrates the rise of current in a circuit in which there is a large amount of inductance, and the curve designated 2 illustrates the rise of current in a circuit in which there is a comparatively small amount of inductance.

Referring now to Fig. 1 it will be noted that by means of a switch 3 the relay winding 4 may be included in a circuit with battery 5 either through a resistance 6 or an inductance 7. If the switch 3 is moved downward so as to include the resistance 6 in series with a relay winding, then the current will rise according to curve 2, and if the switch 3 is moved upward so as to include the inductance 7 in series with the relay winding, then the current will rise according to curve 1. In this connection it is assumed that the ohmic resistance of 7 is the same as the ohmic resistance of 6, so that the ultimate current through the winding of relay 4 will be the same in either case.

The relay illustrated in Fig. 1 consists of the winding 4, the core 8 and the armature 9. The force with which the armature 9 is drawn toward the core 8 depends both on the current flowing through the circuit of the winding 4 and the number of turns. This force is also controlled by the air gap between the core and the armature so that with a certain current flowing through the winding of the relay, the force tending to attract the armature will be greater when the air gap is small than when it is large. As the armature moves downward a spring 10 is encountered and the tension developed by this spring must be overcome before the armature can continue its downward movement. When this tension has been overcome then another spring 11 is encountered and the tension developed by this spring must also be overcome. If the circuit is closed through the inductance 7, then due to the fact that the current rises slowly, the armature will not be immediately attracted and when it finally moves down and encounters the resistance of spring 10, it will be slowed up until the current has risen sufficiently to produce the additional amount of force needed to overcome the tension of this spring. The relay is so adjusted that under this condition the combined spring tension of spring 10 and spring 11 is such that spring 11 cannot be moved far enough downward to make contact with the spring 12.

If, however, the circuit is closed through the resistance 6, then the current building up faster will cause the armature to move quicker and since the armature has a certain amount of weight and is now given a certain amount of speed, there is developed kinetic energy which added to the force developed by the relay winding is enough to overcome the tension of springs 10 and 11 and close the contact between springs 11 and 12. Due also to the fact that the current rises very quickly in this circuit then before the inertia of the armature 9 has been entirely overcome, the air gap between the armature 9 and core 8 will be reduced to practically zero, so that the force which before was insufficient to close the air gap is now sufficient to hold it

closed. Hence it is seen that if two circuits both of the same ohmic resistance are alternately closed, and one of these circuits has less inductance than the other, then in the one case the relay will be operated to close an electric circuit such as one through a signal lamp 13, and in the other case the relay will not be operated.

This same action may be illustrated in Fig. 3 wherein the switch 14 when thrown to its lower position closes a circuit directly to battery 15 and in the other case through a resistance 16 to a battery 17. The battery 17 is of higher potential than the battery 15, but the inclusion of the resistance 16 in the one case limits the current so that the final current flow in each case is the same. The winding 18 necessarily has a certain amount of inductance and hence when the switch 15 is closed so as to form a circuit through the battery 15, the relation between the resistance and inductance in the circuit is different than when the switch 14 is thrown so as to include resistance 16 in series with the higher potential battery 17. In this case and for the reasons given hereinbefore, the relay 18 will act to close a secondary circuit when the switch 14 is moved to include the resistance 16 in series with it and will not operate when a circuit is closed through the battery 15.

What is claimed is:

Means for producing a marginal relay operation comprising a relay provided with an armature having an appreciable mass, a source of current and a circuit including said source of current and said relay, said circuit having two branches with means to close each of said branches separately, each said branch having means to render the steady flow of current the same, and other means to render the transient currents at corresponding times during the building up of current in said branches different whereby a greater amount of energy is stored in said armature during the first part of its stroke when said relay is energized through one said branch than when said relay is energized through the other said branch, and spring means for adjusting said relay so that it will operate in one said branch and will not operate in the other said branch.

In witness whereof, I hereunto subscribe my name this 3 day of September A. D., 1924.

DANIEL D. MILLER.