

April 29, 1930.

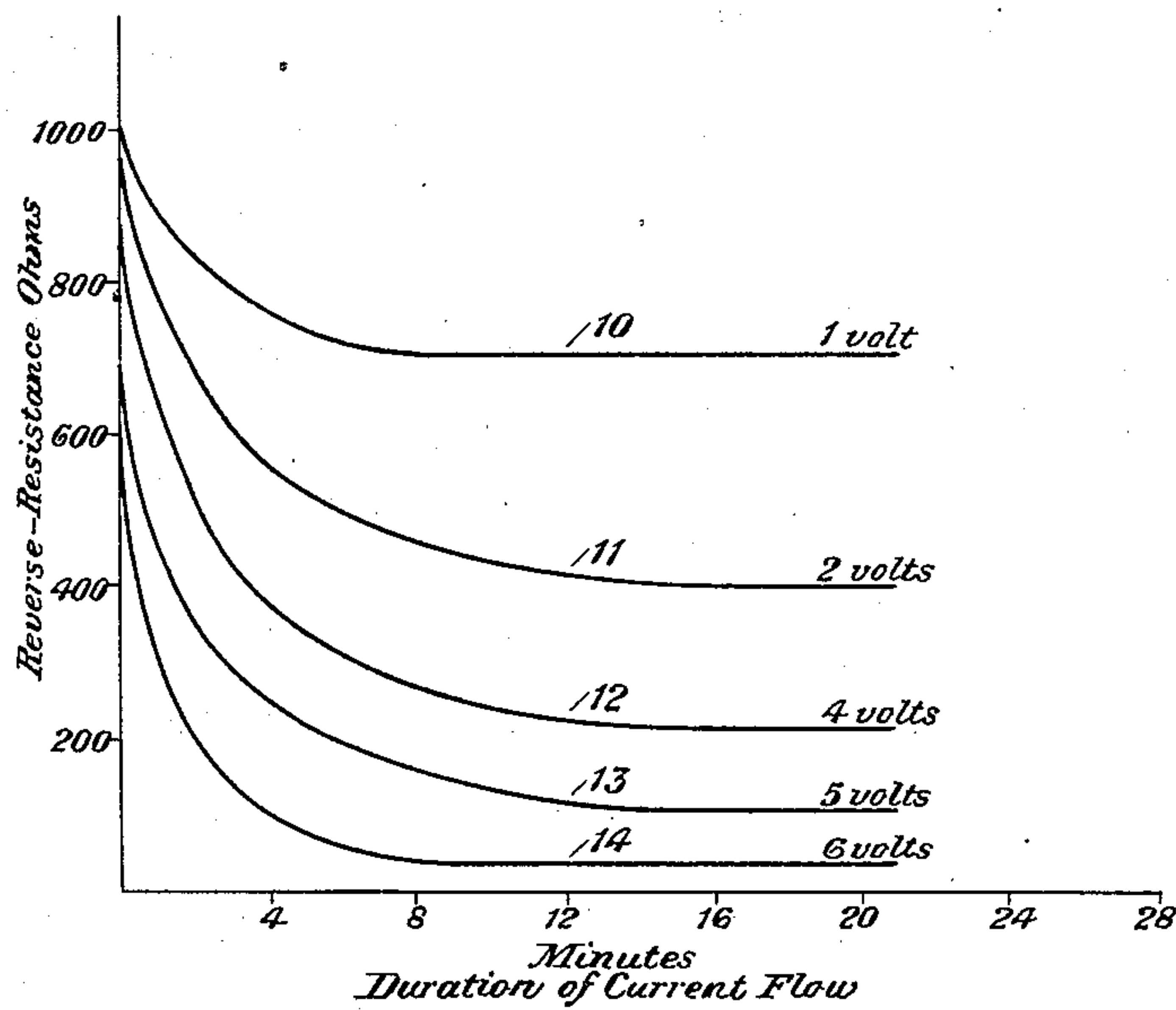
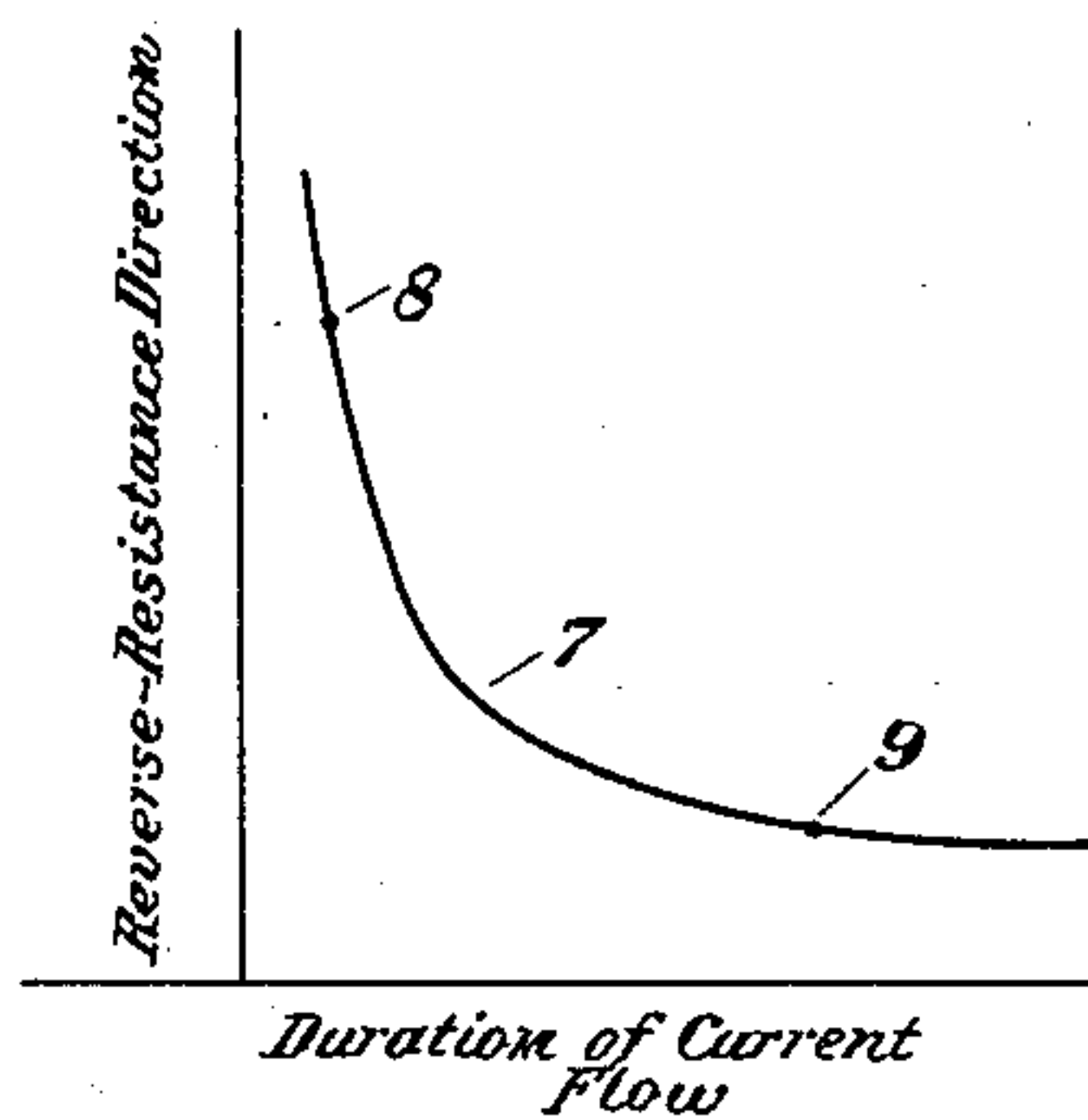
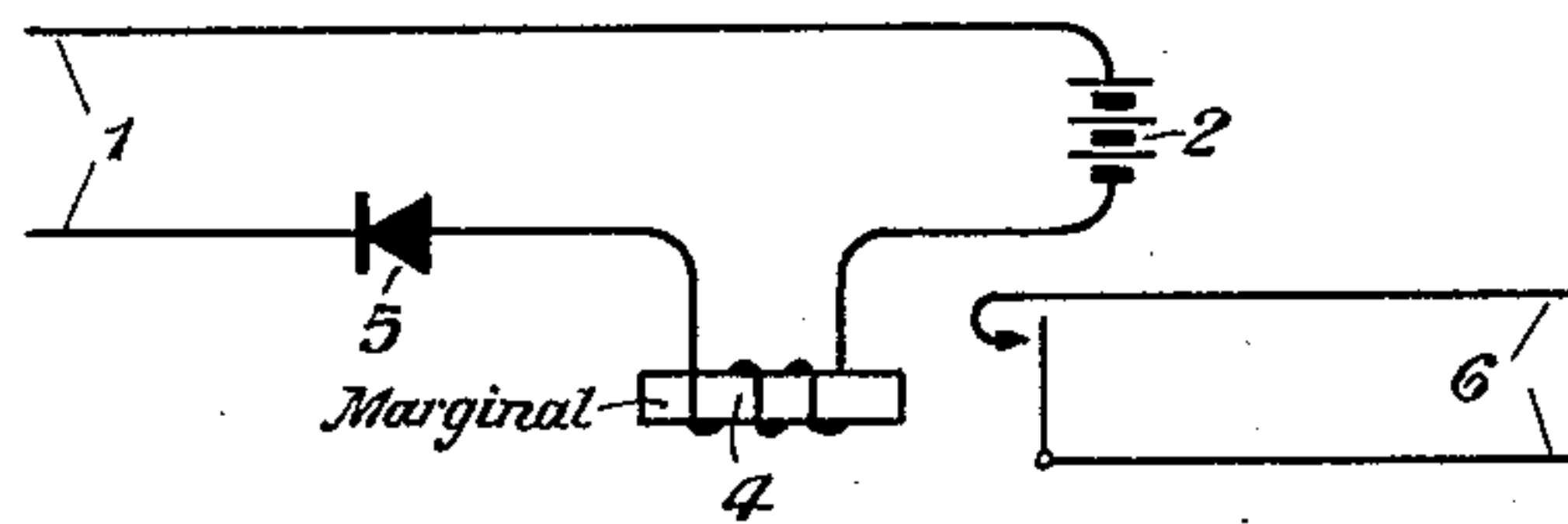
E. W. NILES ET AL

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ELECTRICAL DELAY CIRCUIT ARRANGEMENT

Filed Sept. 24, 1928

2 Sheets-Sheet 1



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ELECTRICAL DELAY CIRCUIT ARRANGEMENT

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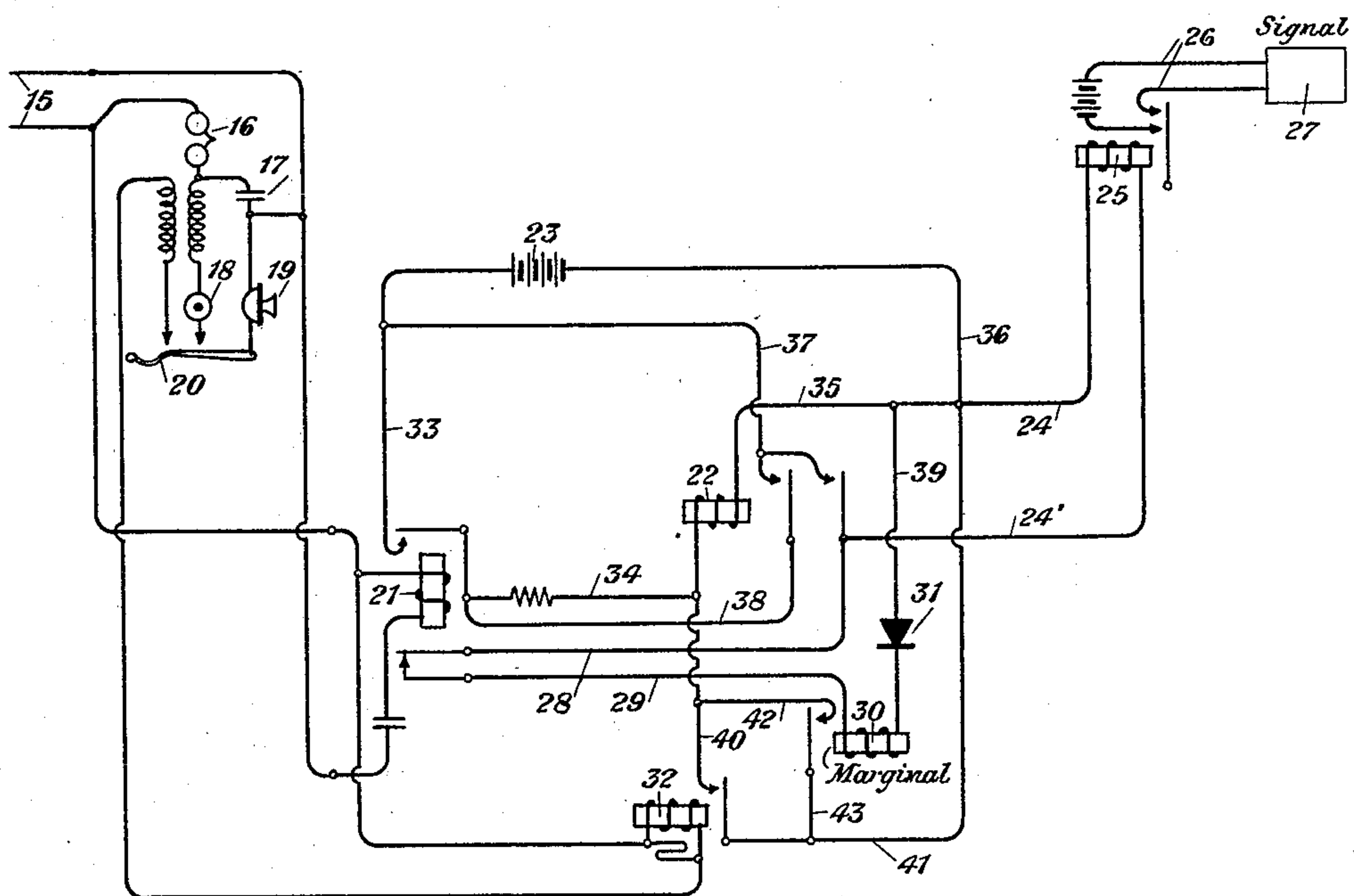


Fig. 4

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UNITED STATES PATENT OFFICE

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ELECTRICAL DELAY-CIRCUIT ARRANGEMENT

Application filed September 24, 1928. Serial No. 307,833.

This invention relates to improved arrangements for introducing a time element in the operation of electric circuits and apparatus.

5 An illustration of one of the uses of arrangements embodying the principles of this invention may be found in telephone signaling circuits. In certain types of telephone systems, such for example as those termed
10 continuously operated station auxiliary circuits, it is the practice to provide at the subscriber's station signaling apparatus which, when started by the operator's signal, will remain continuously in operation until the
15 subscriber answers. If the operator should signal on such a line when the subscriber was absent, such apparatus would remain operated indefinitely. This would cause an excessive drain upon the battery supply in instances where the station was unattended.
20 In accordance with the arrangements of this invention a time element may be introduced in the operation of the auxiliary signal apparatus at the station. With the arrangements
25 of the invention the signal may be operated for a desirable interval of time and then automatically discontinued. Sometimes the opposite effect may be accomplished by the arrangements of the invention. For example, in certain alarm circuits utilized in
30 central offices it is desirable to permit a certain condition to exist for a certain interval of time, but if the condition persists, to have an alarm circuit operate. The arrangements of the invention for introducing a time element
35 in the operation of electrical circuits and apparatus may be utilized to accomplish this purpose. Other uses and purposes of the arrangements of the invention will appear more
40 fully from the detailed description thereof hereinafter given.

In the arrangements of the invention a rectifier of the contact variety, such for example as the copper oxide rectifier, is included in series in a circuit including a marginal relay and a constant potential source of direct current. The rectifier will be so
45 poled as to oppose the flow of the current through the marginal relay. This marginal relay will be adjusted so that it will not oper-

ate on the flow of current through the high resistance of the rectifier in its initial condition. However, under certain voltage values, copper oxide rectifiers decrease in resistance with time in a constant voltage circuit. This will permit greater current to flow. After a certain interval of time this current would be sufficient to operate the marginal relay. This relay may control many
55 other types of circuits and apparatus in whose operation it is desired to introduce a time element.

The invention may be more fully understood from the following description, together with the accompanying drawing in the Figures 1, 2, 3 and 4 of which the invention is illustrated. Fig. 1 is a circuit diagram illustrating the arrangements of the invention in its broader aspects. Figs. 2 and 3
65 are graphical illustrations of the principles of operation of the invention. Fig. 4 is an illustration of the arrangements of the invention as utilized in a telephone signaling circuit.

In Fig. 1 is shown a circuit 1 which
75 may be termed the control circuit. This circuit will include a substantially constant voltage source of direct current 2, a marginal relay 4 and a rectifier 5. The rectifier 5 may be of the contact variety, such as
80 a copper oxide rectifier, and will be so poled as to oppose the flow of current from battery 2 through the marginal relay 5. The marginal relay 5 may either serve to open or close a circuit 6, which may be termed the
85 controlled circuit.

When the control circuit 1 is closed and the current starts to flow through the rectifier 5, its initial resistance is quite high. This may be shown by the curve 7 of Fig. 2. For example, at point 8 of the curve shortly after the current starts to flow the resistance of the rectifier is high. After the current has been flowing the resistance will decrease until at a point such as 9 on the curve it is comparatively low. In other words, the rectifier will decrease in resistance with time in a constant voltage circuit, until a point is reached where the current is sufficiently increased to operate the marginal relay.
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In Fig. 3 are shown a set of curves such as 10, 11, 12, 13 and 14 illustrating the reverse current-resistance characteristics of a rectifier with various values of voltage across it plotted against the duration of current flow in minutes. It will be seen that with the arrangements of the invention it is possible to introduce a time interval of substantial duration into the operation of electric circuits and apparatus.

In Fig. 4 is shown a telephone subscriber's station equipped with continuously operated auxiliary signaling circuits, the operation of which is controlled, however, after a certain interval of time by the arrangements of the invention. A subscriber's line 15 is shown. At the subscriber's station would be provided the usual bell 16, condenser 17, receiver 18, transmitter 19 and switchhook 20. The subscriber's line would be extended so that when ringing current comes in over the line it would be transmitted from the tip conductor of the line through a condenser and the winding of an alternating current responsive relay 21, and thence back to the ring conductor of the subscriber's line. This would operate the alternating current relay 21 and would close the following circuit: from battery 23, conductor 33, contact and armature of relay 21, conductor 34, winding of relay 22, conductors 35 and 36 to the battery 23. The closing of this circuit will operate relay 22. The following locking circuit for relay 22 will then be closed: from battery 23, conductor 37, inner contact of relay 22, conductors 38 and 34, winding of relay 22, conductors 35 and 36 to the battery 23. The operation of relay 22 will also close the following circuit: from battery 23, conductor 37, outer armature and contact of relay 22, conductor 24', relay 25, conductors 24 and 36 to the battery 23. This will operate relay 25, which will close the circuit 26 and operate the signal 27. Heretofore, the signal 27 would remain operated until the subscriber answered and removed his receiver from the switchhook. Under such conditions talking current would flow through the relay 32. This would operate the relay 32 and close a short-circuit comprising conductors 40 and 41 about the winding of relay 22, thereby releasing relay 22 and discontinuing the operation of the signal 27. As has been pointed out, however, if the station should be unattended the relay 27 would remain operated indefinitely and cause a serious drain on the battery supply therefor. In accordance with the arrangements of this invention, the marginal relay 30 and the contact rectifier 31 are added to the circuit arrangements of the prior art. When relay 22 has operated and locked up and the operator at the central office has ceased to ring, the following circuit will be closed: from battery 23, conductor 37, outer contact and armature of relay 22, conductor

28, armature and contact of relay 21, conductor 29, winding of relay 30, rectifier 31, conductors 39 and 36 to the battery 23. As the rectifier 31 is so poled as to oppose the current flow through this circuit its initial resistance will be sufficiently high so that the marginal relay 30 will not operate. However, after a sufficient interval of time the resistance of the rectifier will decrease. This has been more fully illustrated in the description of Figs. 2 and 3. After a sufficient interval of time the resistance of the rectifier will have decreased sufficiently so that the current through the marginal relay 30 will be sufficient to operate this relay. The operation of relay 30 will close a short-circuit comprising conductors 42, 43 and 41 about the operating winding of relay 22. This will release relay 22, opening the circuit through the relay 30, and stop the operation of the signal 27. Accordingly, with the arrangements of this invention, even though the station equipped with continuously operated auxiliary signal apparatus should be unattended nevertheless after a desired interval of time the auxiliary signal will cease to operate.

It is pointed out that even if the rectifier is so poled as not to oppose the current flow, that a somewhat similar action is obtained except that the resistance initially and after heating is much lower than in the case when the rectifier is poled to oppose the current flow. Accordingly, while the arrangements of the invention have been disclosed as embodied in certain specific arrangements, it is understood that they are capable of use in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A control circuit comprising a source of current, a marginal responsive device and a rectifier of the contact variety poled to oppose the flow of current from said source through said device, and controlled apparatus operated by said device.
2. A control circuit comprising a source of current, a marginal relay and a copper oxide rectifier poled so as to oppose the flow of current from said source through said relay, and a controlled circuit operated by said relay.
3. A telephone line, subscriber's apparatus connected thereto, means for extending said line, a responsive relay in said line as extended, a signaling circuit operated by said responsive relay, a marginal relay and a contact rectifier poled to oppose the current flow through said marginal relay associated with said signaling circuit, and means controlled by said marginal relay for discontinuing the operation of said signaling circuit.
4. An electrical circuit comprising a source of current, a marginal responsive device and

a rectifier of the contact variety poled to oppose the flow of current from said source through said responsive device, the constants of said source and said rectifier being so chosen that the circuit will operate on that portion of the reverse current resistance-time curve whereby a time element will be introduced in the operation of said responsive device.

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10 5. An electrical circuit comprising a source of current, a marginal responsive device and a rectifier of the contact variety, the constants of said source and said rectifier being so chosen that the circuit will operate on
15 that portion of the reverse current resistance-time curve whereby a time element will be introduced in the operation of said responsive device.

In testimony whereof, we have signed our names to this specification this 22nd day of September, 1928.

ELIOT W. NILES.

WILLIAM H. EDWARDS.

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