

E. P. G. WRIGHT
CONDENSER STORAGE EQUIPMENT

Filed Nov. 19, 1938

[illegible]

FIG. 2

The diagram illustrates a complex electronic circuit with multiple stages and components. Key elements include:

- Input Stages:** Two input channels, labeled *NFL* and *FNL*, are shown at the bottom left, connected to the main circuit.
- Central Processing Unit:** A central block contains several transistors (*A*, *B*, *T*), resistors (*W*, *W'*, *W''*, *R*, *R_M*), capacitors (*M*, *M'*, *M''*), and diodes (*MRB*, *MRB*).
- Power Sources:** Multiple DC voltage sources are indicated by battery symbols and labeled *E*, *E'*, *E''*, *E⁴*, and *E³*.
- Signal Path:** A curved arrow indicates a signal path or feedback loop originating from the output of the central unit and returning to its input.
- Output Stage:** The circuit concludes with a final output stage involving a transistor (*A*) and a resistor (*B*).

ATTORNEY

UNITED STATES PATENT OFFICE

2,208,655

CONDENSER STORAGE EQUIPMENT

Esmond Philip Goodwin Wright, London, England, assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application November 19, 1938, Serial No. 241,423
In Great Britain January 4, 1938

10 Claims. (Cl. 179-16)

This invention relates to condenser charging circuits and more particularly to equipment for successively and periodically testing a plurality of condensers to determine if they have been charged and to boost the charges on such condensers as are found to have been charged to an effective value.

It is well-known practice in the electrical art to charge a condenser and to thereafter discharge the condenser through the winding of a relay or other electromagnetic device for causing the operation of such relay or device.

If the interval between the charging and discharging of the condenser is long, leakage from the condenser due to the resistance of the condenser and connected wiring, may permit an appreciable amount of the charge to leak away and the discharge of the condenser will then be insufficient to operate the connected relay or device.

As an example of the use of condensers for operating relays associated therewith by the discharge of such condensers, reference may be had to the application of M. S. Snell and E. P. G. Wright, Serial No. 135,853 filed January 30, 1938, or to the corresponding British Patent No. 476,088 of 1937 which disclose a sender for use in a telephone system in which groups of condensers are employed for storing the digits of the directory number of a wanted subscriber's line, the condensers of each group being selectively charged, either positively or negatively to store different digits. In the setting up of a connection to the line the digits of whose number have been thus stored, the group of condensers are successively associated with relays which are controlled by the discharge of the condensers to, in turn, control impulse sending mechanism. Such condenser groups may also be used for number storage for automatic ticketing systems in automatic telephone exchange systems, for instance, under circumstances in which the storage must endure throughout a telephone conversation, whatever its duration.

It is the object of the present invention to provide means for insuring that the charge on a condenser is maintained above a certain minimum value regardless of how long the charge condition has to endure, in equipment of the type referred to or in any other equipment in which the provision of such means is desirable.

It is a further object of the invention to provide means for maintaining a charge regardless of whether the charge is of positive or negative potential.

These objects are attained in accordance with the present invention by the provision of a testing and recharging equipment which successively and periodically tests a plurality of condensers to determine which of them have been placed in a charged condition and which applies to such of the condensers as are found to be in a charged condition, a charging potential of the same polarity as the detected charge to raise the charge on such condensers to a required potential.

The invention will be more clearly understood from the following detailed description of two embodiments thereof taken in connection with the accompanying drawing in which:

Fig. 1 shows a testing and recharging equipment for a plurality of condensers, the charges of which are always of the same polarity; and

Fig. 2 shows a testing and recharging equipment for a plurality of condensers, the charges of which may be either of positive or negative polarity.

Referring first to Fig. 1, two of a plurality of condensers M^1 and M^2 and a charging circuit for one of the condensers M^1 are disclosed. The charging circuit for condenser M^1 extends from the positive pole of battery E whose negative pole is grounded, through a suitable resistance over the contact of a charging relay A which may be operated in any suitable manner, through the condenser M^1 to ground. So long as the relay A remains operated a full charge will be maintained on the condenser M^1 . After the relay A releases, condenser M^1 will remain charged although it will be assumed that some of the charge will slowly leak away. Other condensers M^2 may be similarly charged.

Associated with the condensers is a switch R having a wiper rm' which may be advanced step-by-step over the terminals of an associated bank by the stepping magnet RM under the control of stepping relay D which, in turn, is periodically operated and released by the interrupter IL . The bank terminals are respectively connected to the ungrounded terminals of the condensers.

When in the operation of the switch R the wiper rm' engages the first terminal of the bank to which the condenser M^1 is connected, if this condenser has been charged by the operation and subsequent release of relay A , a discharge circuit for this condenser will be established from ground through the condenser over wiper rm' , the upper back contact of relay D through the winding of relay C to ground. Relay C operates in this discharge circuit and locks in a

circuit extending from ground through its winding over the upper back contact of relay D over its own front contact through resistance W' to the positive terminal of the battery E' , the negative terminal of which is grounded.

During the time that relay C remains operated, or until relay D subsequently operates, a recharging circuit for condenser M' is established from the positive terminal of battery E' through resistance W' over the contact of relay C, wiper rm' , through condenser M' to ground and the charge on condenser M' is restored to a value which will be adequate to operate any device to be controlled thereby.

Upon the next closure of the interrupter contact IL, relay D operates releasing relay C and stepping magnet RM and the magnet RM upon releasing advances wiper rm' one step. Upon the next opening of the interrupter contact IL, relay D releases again operating magnet RM preparatory to advancing the wiper rm' another step and connecting test relay C over the wiper rm' to the next condenser M^2 . This condenser is now tested and recharged if required. In this manner, as the switch R is advanced step by step at intervals predetermined by the interrupter IL, successive condensers are tested and recharged.

Should any condenser be tested and found to have not been initially charged to indicate a selective control condition, relay C will not be operated and consequently while the switch wiper is standing on the bank terminal to which such condenser is connected, no circuit will be established for applying recharging current from battery E' to the condenser.

Referring now to Fig. 2, a testing and recharging circuit is shown for use with a plurality of condensers which may have been initially charged either positively or negatively. Two such condensers M' and M^2 and the charging circuit of condenser M' are disclosed. The charging circuit of condenser M' may extend from ground through the condenser over contacts of relay A through a suitable resistance to the positive terminal of battery E , the negative terminal of which is grounded, or over the contacts of relay B through a suitable resistance to the negative terminal of battery E^3 the positive terminal of which is grounded dependent on whether relay A or relay B is operated. Thus the condenser may be either positively or negatively charged. Other condensers such as M^2 may be similarly charged.

Associated with the condensers is a switch R having a wiper rm' which may be advanced step by step over the terminals of an associated bank by the stepping magnet RM under the control of the stepping relay SA. Relays SA and SB are alternately operated and released by the interrupters NFL and FNL. The interrupters may be driven from a common shaft at such a speed that the contacts of interrupter FNL are closed for 750 milliseconds while the contacts of interrupter NFL are open for the same period and the contacts of interrupter NFL are closed for 750 milliseconds while the contacts of interrupter FNL are open for the same period. The bank terminals of switch R are respectively connected to the ungrounded terminals of the condensers.

When in the operation of the switch R the wiper rm' engages the first terminal of the bank to which the condenser M' is connected, if that condenser has been charged positively by the operation and subsequent release of relay A a

discharge circuit for this condenser will be established from ground through the condenser over wiper rm' , upper contacts of relay SB when that relay is operated by the closure of the interrupter contacts FNL through the rectifier MRB and the winding of test relay T to ground. Relay T will thereupon operate and lock in a circuit extending through its winding and rectifier MRB, the lower contacts of relay T and the lower contacts of relay SB through resistance W' to the positive terminal of battery E' , the negative terminal of which is grounded.

During the interval that relay SB remains operated by the closure of interrupter contact FNL a recharging circuit for condenser M' is established from the positive terminal of battery E' , through resistance W' , over the lower contacts of relays SB and T, the upper contacts of relay SB, wiper rm' through condenser M' to ground and the charge on condenser M' will be restored to its initial positive value.

Had condenser M' been initially charged negatively, the discharge path therefor just traced through the rectifier MRB would not have been effective, and consequently, test relay T would not have been operated during the interval that relay SB was operated. However, upon the release of relay SB by the opening of the interrupter contacts FNL and the operation of relay SA by the closing of interrupter contacts NFL an effective discharge circuit is established for condenser M' from ground through the condenser over wiper rm' , the inner upper contact of relay SA, through rectifier MRA and the winding of test relay T to ground. Relay T will thereupon operate and lock in a circuit extending through its winding and rectifier MRA, the upper contacts of relay T, the upper contacts of relay SA, through resistance W^4 to the negative terminal of battery E^4 , the positive terminal of which is grounded.

During the interval during which relay SA remains operated by the closure of interrupter contacts NFL, a recharging circuit for condenser M' is established from the negative terminal of battery E^4 , through resistance W^4 , over the upper contacts of relays SA and T, the inner upper contacts of relay SA and wiper rm' , through condenser M' to ground and the charge on condenser M' will be restored to its initial negative value.

Relay SA upon operating also closes the circuit for stepping magnet RM preparatory to advancing the wiper rm' another step. As soon as the interrupter NFL opens its contacts and relay SA consequently releases, the circuit of magnet RM is opened and the switch wiper rm' is advanced into a position to test the charged condition of another condenser, such as M^2 .

The test could in each case be made by a thermionic or a gaseous discharge tube responsive to the potential on the condenser.

In the use of the proposed testing and recharging circuit it would probably be desirable to test and boost the charges on condensers at about half-hour intervals.

What is claimed is:

1. In a signaling system in which a condenser is charged to indicate a desired control condition, means for testing said condenser to detect the charged condition thereof, and means responsive to said testing means for boosting the charge on said condenser if a charge is found thereon.

2. In a signaling system in which a plurality of

condensers are selectively charged to indicate desired control conditions, means for successively testing said condensers to detect the charged condition thereof, and means responsive to said testing means for boosting the charge on any of said condensers if a charge is found thereon.

3. In a signaling system in which a plurality of condensers are selectively charged to indicate desired control conditions, means for successively testing said condensers periodically at desired time intervals to detect the charge condition thereof, and means responsive to said testing means for boosting the charge on any of said condensers if a charge is found thereon.

4. In a signaling system in which a condenser is charged either positively or negatively to indicate desired control conditions, means for testing said condenser to detect the charged condition thereof, and means responsive to said testing means for boosting the charge on said condenser to a higher positive or negative value in accordance with the initial charge if a charge is found thereon.

5. In a signaling system in which a plurality of condensers are selectively charged either positively or negatively to indicate desired control conditions, means for successively testing said condensers to detect the charged condition thereof, and means responsive to said testing means for boosting the charge on any of said condensers to a higher positive or negative value in accordance with the initial charge if a charge is found thereon.

6. In a signaling system in which a condenser is charged to indicate a desired control condition, a test relay, means for establishing a discharge circuit from said condenser to said relay whereby said relay is operated if said condenser is in a charged condition, a source of current and a recharging circuit for said condenser from said source of current controlled by said relay.

7. In a signaling system in which a plurality of condensers are selectively charged to indicate desired control conditions, a test relay, a switching means for successively and periodically establishing a discharge circuit from said condensers to said relay whereby said relay is operated if any one of said condensers is in a charged condition, a source of current and a recharging circuit from said source controlled by said relay for recharging any one of said condensers found to be in a charged condition.

8. In a signaling system in which a plurality of condensers are selectively charged to indicate desired control conditions, a test relay, a switch, means for advancing said switch step by step to successively and periodically establish discharge circuits from said condensers to said relay whereby said relay is operated if any one of said condensers is in a charged condition, a source of current and a recharging circuit from said source controlled by said relay for recharging any one of said condensers found to be in a charged condition.

9. In a signaling system in which a plurality of condensers are selectively charged either positively or negatively to indicate desired control conditions, a test relay, an operating circuit for said relay having two branches, said branches being provided with oppositely poled polarity discriminating devices, means for alternately rendering said branches effective, a switching means for periodically extending said operating circuit to successive ones of said condensers whereby said relay is operable if any one of said condensers is found to be in a positively or negatively charged condition, sources of current of opposite polarities and recharging circuits from said sources controlled by said test relay and said first means for recharging any one of said condensers found to be in a charged condition to a higher positive or negative value in accordance with its initial charged condition.

10. In a signaling system in which a plurality of condensers are selectively charged either positively or negatively to indicate desired control conditions, a test relay, an operating circuit for said relay having two branches, said branches being provided with oppositely poled polarity discriminating devices, two relays alternately and periodically operable for rendering said branches effective, a switch, means controlled by one of said latter relays for advancing said switch step by step for extending said operating circuit to successive ones of said condensers whereby said test relay is operable if any one of said condensers is found to be in a positively or negatively charged condition, sources of current of opposite polarity and recharging circuits from said sources controlled by said test relay and said latter relays for recharging any one of said condensers found to be in a charged condition to a higher positive or negative value in accordance with its initial charged condition.

ESMOND PHILIP GOODWIN WRIGHT.