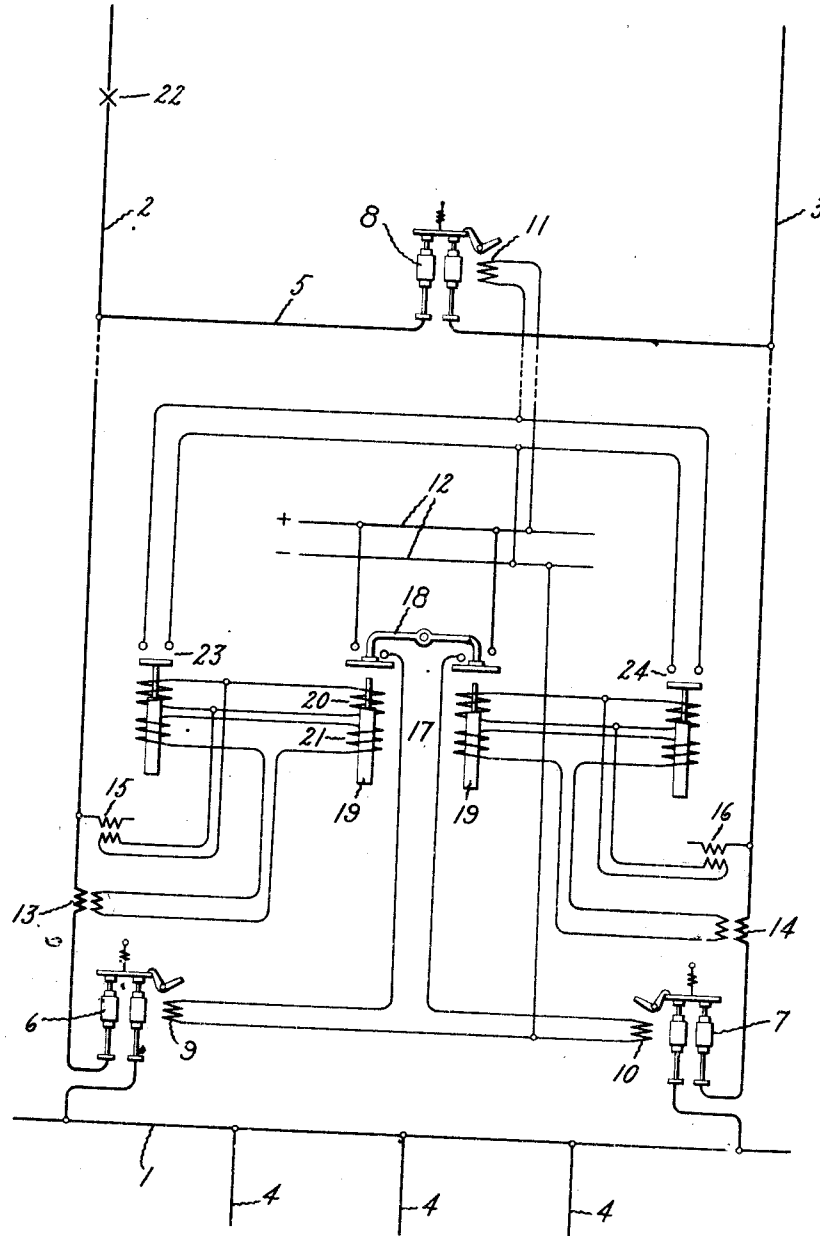


D. BASCH.  
 PROTECTIVE DEVICE.  
 APPLICATION FILED OCT. 9, 1912.

1,062,812.

Patented May 27, 1913.



Witnesses  
*Ernst*  
*J. Ellis*

Inventor  
 David Basch  
 by *Albert H. Davis*  
 His Attorney

# UNITED STATES PATENT OFFICE.

DAVID BASCH, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## PROTECTIVE DEVICE.

1,062,812.

Specification of Letters Patent.

Patented May 27, 1913.

Application filed October 9, 1912. Serial No. 724,730.

*To all whom it may concern:*

Be it known that I, DAVID BASCH, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Protective Devices, of which the following is a specification.

My invention relates to protective devices for electrical apparatus, particularly for transmission systems.

It is common to connect a plurality of feeders to a single set of bus bars, as for example, for supplying the distributing bus bars of a distributing station. Under various conditions, as in case of accident to one of the feeders, that feeder instead of supplying energy to the station, may tend to take energy from the station; obviously this is undesirable in most cases. It is, therefore, common to connect reverse energy relays to the various feeders to direct the operation of the switches in such a manner that the switch connecting the feeder in which the direction of flow of energy has reversed is opened on such reversal. The reverse energy relays commonly used, however, tend to operate not only on reverse energy flow but also on an excessive flow of energy in the proper direction, this often resulting on the short circuiting of one of a plurality of feeders in opening not only the switch in the short circuited feeder, but also the switch in some feeder carrying momentarily an unusually heavy current due to the short circuit, but in the proper direction. The supply of energy to the station is thus interrupted. To prevent such action the reverse energy relays are commonly interlocked in such a way that only one relay can operate at a time. The specification of the patent to Ostermann, No. 1,000,934, describes such an interlocking of relays in detail. One result of the interlocking of the relays is that there can be no response to the simultaneous reversal of energy flow on all the feeders to which the relays are connected. Such interlocking is sufficiently satisfactory in case the feeders are not tied together outside the station, since there is very little chance of independent and simultaneous reversal of energy on two feeders. However, in those cases where the feeders are tied together outside the station, the interlocked relays fail to perform the functions desired whenever

the reversal is caused by some action on one of the feeders beyond the point of connection to the tie line. When a short circuit, for example, occurs on one feeder beyond the point of tie line connection, not only will there be a reversal of energy flow on that feeder at the bus bars, but there may be a reversal of energy flow on the remainder of the feeders at the bus bars also, the other apparatus connected to the bus bars pumping back through the bus bars and all the feeders to the tie line and the short circuit. The interlocked relays are incapable of responding to these simultaneous reversals. Hence the use of the tie lines greatly diminishes the usefulness of the interlocked relays.

To retain the advantages of the interlocked relays in tie line systems, to preserve the continuity of connection of the healthy feeders to the bus bars, is one of the objects of my invention.

I prefer to carry out my invention by connecting another and independent reverse energy relay to one of the feeders between the tie line and the bus bars for controlling the operation of a switch or switches in the tie line or lines, this in addition to the interlocked relays. Good practice will probably dictate the connection of such a relay to each of the feeders, any one of these relays being capable of causing the tie line switch or switches to open. Thus on the occurrence of a reversal of energy flow due to action on a feeder beyond the tie line point of connection thereto, an independent reverse energy relay immediately acts to open the tie line or lines; once this line, or these lines, are open the interlocked relays may pick out and disconnect the faulty feeder.

The accompanying drawing is a single line diagram showing a single conductor of each of two feeders of an alternating current system connected to a single bus bar, and the necessary switches, relays and connections for carrying out my invention. The duplication of conductors and parts required to make a complete and operative system will be understood by those skilled in the art.

For the purposes of this description, I have assumed the condition of a distributing station supplied by two feeders which may or may not have the same source of energy. To the bus bar 1 of the distributing sta-

tion are connected two feeders 2 and 3, by which energy is supplied thereto. Energy is distributed through the feeders 4. I will further assume for the purpose of this description that to one or more of the distributing feeders 4 there is connected an auxiliary source of energy or a means which may return energy through the bus bars to the supply feeders 2 and 3 under certain conditions, although it is not desired that this be done. The feeders 2 and 3 may supply other distributing stations; for this or other reasons it may be desirable to connect them together outside of the distributing station by means of the tie line 5. This tie line may be located many miles from the distributing station. Switches 6 and 7 are inserted respectively in the feeders 2 and 3 and a switch 8 in the tie line 5, for the purpose of opening these feeders and the tie line when desired. The operation of these switches is controlled by means of the trip coils 9, 10 and 11 respectively, in the ordinary manner. Any source of energy for the trip coils may be provided, and I have illustrated positive and negative bus bars at 12 for this purpose. Connected to each feeder is a current transformer 13 and 14, and connected to the same respective feeders are the potential transformers 15 and 16. One end of these potential transformers is herein shown unconnected, but it will be understood that this unconnected end in practice may be connected to another conductor of the same feeder. The manner of connecting potential transformers is well understood by those skilled in the art. These current and potential transformers are for supplying the relays with energy.

17 is a diagrammatical representation of a common form of two interlocked reverse energy relays. The walking beam 18 carries at its ends means for closing two sets of contacts. These contacts are shown normally open, but either set may be closed by means of the armatures 19. These armatures do not move the walking beam 18 at the beginning of their movement, but are required to travel a certain distance before communicating their movement to the walking beam, which in its turn, must move a certain distance before either set of contacts can be closed. The reason for this action will be explained later. The armature 19 is controlled by two solenoids 20 and 21, the solenoid 20 being supplied with energy by the potential transformer 15, and the solenoid 21 by the current transformer 13. These solenoids are so connected to their transformers that when energy is flowing in the feeder in the normal direction, that is, from the feeder to the bus bar 1, these solenoids oppose each other. The second armature 19 is also controlled by two similar solenoids which are similarly connected to the current and potential trans-

formers 14 and 16 of the feeder 3. Now it will be apparent that so long as energy flows in the normal direction from the feeders to the bus bar, the walking beam 18 will be maintained in such a position that no contacts are closed. Should, however, the energy reverse in one of the feeders 2 or 3, for example, in the feeder 2, the solenoids 20 and 21, instead of opposing each other, will aid each other, the armature in feeder 2 will be attracted upward and the walking beam 18 moved in such a direction about its pivot that one set of contacts will be closed and the circuit completed from the bus bars 12 through the trip coil 9. The switch 6, will therefore open.

In practice it has been found that the armatures 19 tend to move and close their contacts not only on the occurrence of reverse energy flow but also in case of overload, since in such a case the current solenoid 21 may so over-power the potential coil 20 as to raise the armature 19 and thus produce the same operation as on the occurrence of a reversal of energy flow. Supposing the tie line is not used, a short circuit of one of the feeders, as for example, a short-circuit on the feeder 2, will not only produce a reversal of energy in this feeder between the point of short circuit and the bus bar 1, but will also produce an overload condition on the feeder 3 which supplies the short circuit through the bus bar 1. To provide against a consequent simultaneous action of both armatures 19 and the operation of both switches 6 and 7, the two relays at 17 are interlocked mechanically by means of the walking beam 18 which allows the engagement of but one set of contacts at a time. Such an interlocking of relays, the necessity therefor and their operation are more completely described in the United States Patent to Ostermann above referred to. This interlocking of relays is perfectly satisfactory where no tie line is used. The use of the tie line 5, however, produces conditions not suitable for the operation of the interlocked relays at 17. Suppose now that the tie line 5 is used, and that a short circuit occurs on the feeder 2 at the point 22 beyond the point of connection of the feeder 2 to the tie line 5. Not only does there occur a reversal of energy flow in the feeder 2, energy being supplied from the feeders 4 and the bus bar 1 direct to the feeder 2, but there is also a reversal of energy flow through the portion of the feeder 3 between the bus bar 1 and the tie line 5, both the bus bar and the main portion of the feeder 3 supplying energy to the short circuit over the tie line. Thus there is a reversal of energy flow through both feeders 2 and 3 simultaneously, tending to the simultaneous operation of both of the relays at 17 which action, however, is impossible by reason of the interlocking.

Furthermore, provided these relays were not interlocked, they would be incapable of picking out the faulty feeder and their failure to do so would result in opening both switches 6 and 7 and a cessation of supply of energy to the bus bar 1. Now to entirely disconnect a faulty feeder from the bus bar 1 and still maintain the connection of the healthy feeder or feeders thereto in order to continue the supply of energy to the distributing station, I have provided the switch 8 in the tie line and the independent relay 23. This relay is connected to the current and potential transformers 13 and 15 of the feeder 2. This relay is similar to each of the relays at 17, but is entirely independent of every other relay and is free to act and close its contacts under the action of its solenoids unhindered by the action of any other relay. The closing of the contacts of this relay, it will be seen, completes a circuit from the supply buses 12 through the trip coil 11, resulting in the opening of the switch 8 and the cutting of the tie line 5. Now suppose a short circuit occurs, for example, at the point 22 on the feeder 2, the switch 8 in the tie line 5 being closed, as it will be in normal operation of the system. On the occurrence of the short circuit, each relay at 17 is prevented from closing its contacts by the other, as before. The relay 23, however, is free to operate on the reversal of energy flow, and does operate, opening the switch 8. The tie line 5 now being cut, the energy in the feeder 3 must resume its normal direction, that is, to the bus bar 1, supplying energy to the short circuit 22 only through this bus bar. The right hand armature 19 is now free from the effect of a reverse energy flow and hence ceases to oppose, at least with the same force, the closing of contacts by the left hand armature 19, which is still effected by a reverse energy flow. This results in the closing of the proper pair of contacts and the opening of the switch 6. It will be apparent that the relay 23 will operate not only in the case of reverse energy flow due to an action on the feeder 2, but that it will also operate on reverse energy flow due to an action on the feeder 3, since, as before pointed out, a reversal of energy flow occurs on both feeders between the bus bars and the tie line connections on an action on either feeder beyond the point of connection to the tie line. However, as the opening of the tie line 8 is essential to the operation of the protective system, good practice may prescribe

the addition of another independent reverse energy relay 24 connected to the feeder 3. The closing of the contacts of either of these independent reverse energy relays 23, 24 will result in the opening of the switch 8. It will be apparent that a reverse energy flow due to an action on one of the feeders between the point of connection to the tie line and point of connection to the bus bar 1, will result in the opening of the proper feeder switch 6 or 7, and also the opening of the tie line switch 8. Thus any action at any point on any feeder producing a reversal of energy causes the complete segregation of the faulty feeder from the rest of the system.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination with a receiving station, two feeders connected thereto, a tie line connecting together the feeders, a switch for disconnecting each feeder from the station and a switch for opening the tie line, of means for operating said switches including a trip coil for each switch, a source of energy for said trip coils, a reverse energy relay connected to each feeder the two relays being incapable of operating simultaneously, each relay controlling the supply of energy to the trip coil of the switch of the feeder to which it is connected, and another reverse energy relay connected to one of the feeders and controlling the supply of energy to the trip coil of the switch of the tie line.
2. The combination with a receiving station, two feeders connected thereto, a tie line connecting together the feeders, a switch for disconnecting each feeder from the station and a switch for opening the tie line, of means for operating said switches including a trip coil for each switch, a source of energy for said trip coils, a reverse energy relay connected to each feeder the two relays being incapable of operating simultaneously, each relay controlling the supply of energy to the trip coil of the switch of the feeder to which it is connected, and another reverse current relay connected to each of said feeders, each of said last mentioned relays controlling the supply of energy to the trip coil of the switch of the tie line.

In witness whereof, I have hereunto set my hand this 8th day of October, 1912.  
DAVID BASCH.

Witnesses:

BENJAMIN B. HULL,  
HELEN ORFORD.