AUTOMATIC CONTROL

By EDWARD A. HIGGINS, '29

The switching equipment which will be discussed in the following article was installed at the Rutland Substation of The Ohio Power Company. Rutland being in an isolated place, it was decided that the most economical and serviceable manner of supplying that locality with power was by means of an automatic transformer substation.

To show all details of the equipment in a drawing would require several pages; hence, the accompanying diagram is greatly condensed and generalized. The diagram shows a common bus to which power may be supplied, either from source A or source B. Either A or B may be the preferred line, the other being the emergency line. By the preferred line is meant that which will supply the common bus with power during normal operation. In this discussion, we will consider A as the preferred line, and B as the emergency line.

Beginning with both lines dead, it is desired to supply a load on the common bus, by Line A, and to have line B energized and in readiness for supplying power, in case line A fails. In order to attain the first condition, the operation will proceed as follows: with the isolating switch (between incoming lines and station equipment) closed, the transfer switch in the position for automatic control, and the change-over switch in the position to make A the preferred line, the alternating current under-voltage relays for the preferred line will operate if the voltage of the line is correct, and the single or reverse phase voltage relay for line A will operate if the supply is three phase and of the correct phase rotation. The auxiliary relay, for operating the contacts of the main closing relay, is energized by the action of the under-voltage relays with the manual operation of the closing button of the master element for line A, and it completes the circuit to the coils of the time-delay closing relay for line A, which, in turn, energizes the control contactors for the oil circuit-breaker of line A. After a time-delay, the control contactor for the oil circuit-breaker of A, closing, seals itself in, and energizes the motor of the oil circuit-breaker. The motor circuit is mechanically opened when the breaker reaches the closed position.

To attain the second condition, that is, to have line B energized and in readiness for automatic operation, the closing button of the master element for line B should be pulled (manually).

Next, let us consider the action which takes place if line A fails, and line B is prepared to take the load. Since the alterating current under-voltage relays and the single or reverse phase voltage relay for line B are energized, the auxiliary relay for operating the contacts of the main closing relay will complete the circuit to the time-delay closing relay for line B. After a time delay, the time-delay closing relay will trip the breaker for line A and close the breaker for line B.

When the supply of line A has been restored to its normal condition, it is again desired for line A to carry the load. When the voltages of lines A and B are in synchronism, the synchronizing switch for line A will close. It is to be remembered that the change-over switch is still in the position to make A the preferred line. The time-delay closing relays will then close the breaker for line A, afterwards, tripping the breaker for line B.

If the change-over switch is in the position to make B the preferred line, the operation of the apparatus is similar to that described when A was the preferred line. With the transfer switch in the position for manual operation, the breakers for A and B can be operated by the manual operation of the master elements for lines A and B respectively, all automatic features being cut out.

Provision is made for the protection against excessive currents due to bus shorts and the like. In case of over-load on the line in service, say line A, the alternating current over-current relay for line A closes its contacts. With these contacts closed, the auxiliary relay for operating the contacts of the main over-current relays is energized and the contacts close. This action completes the circuit to the tripping coils of the breakers for A and B, thus causing the breakers to trip. The auxiliary relay must be reset by hand before the breakers can be reclosed either manually or automatically. The breakers should be thoroughly inspected after every lock-out.

The out-going breaker has automatic reclosing equipment; hence, lock-out will not take place due

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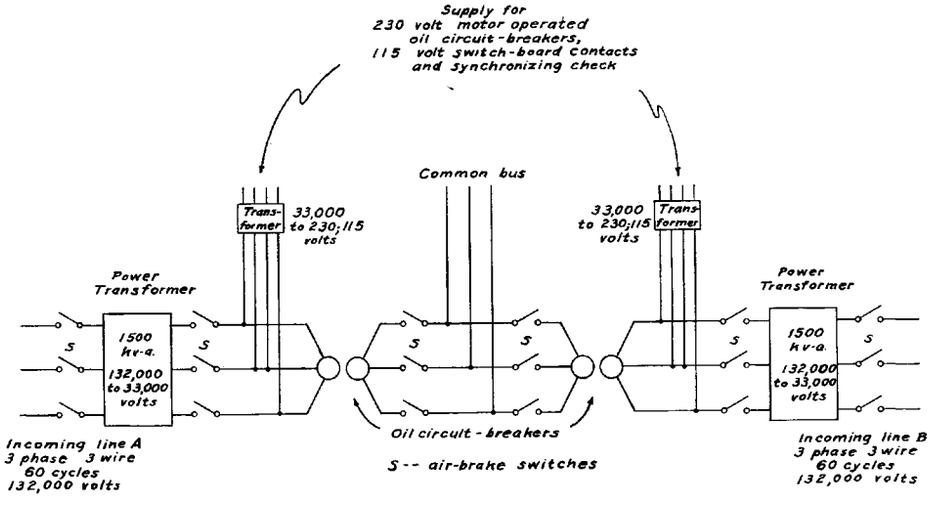

General Circuit Diagram

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to any surge, or momentary over-load. There are three reclosing periods, 15, 20, and 25 seconds. For example, on over-load, the breaker trips. Fifteen seconds later it recloses, and if the load is again normal, stays closed. If over-load conditions still prevail, the breaker again trips. If after the third reclosure the breaker does not stay in, it is automatically locked out and cannot be reclosed until the reclosure equipment is reset by hand, as stated in the preceding paragraph.

The carrier current for dispatcher telephone service is imposed on the 132,000 volt feeders, hence, if both of the 132,000 volt incoming lines are open the telephones cannot be used. This condition seldom prevails. A high-voltage coupling capacitor (132,000 volts, .001 microfarad) is used for the carrier current.

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