INSTRUCTIONS

OVERCOMPENSATION PREVENTION FOR LOAD TAP CHANGERS IN LOW VOLTAGE SELECTIVE OR DUPLEX TYPE NETWORKS

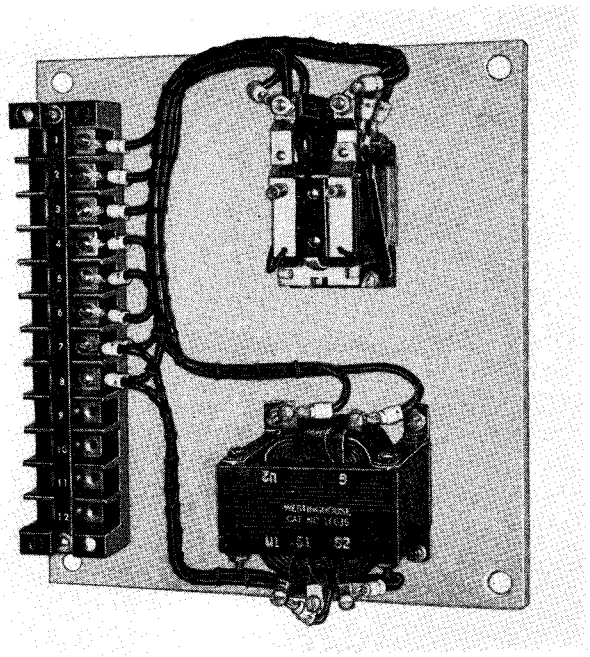

FIG. 1. Current Equalizing Panel

GENERAL

Transformers with automatically controlled load tap changing equipment in Low Voltage Selective or Duplex type substations may temporarily assume the load of an adjoining transformer while that unit is disconnected from the low voltage feeder. Each tap changer is controlled by a primary relay which responds to the resultant of the output of the PT Potential transformer and its associated line drop compensator. An automatic scheme is normally provided to prevent undesirable load tap changer operation during such transformer outages. In the scheme here described, normal currents are maintained in the line drop compensator circuits while one transformer is supplying the load on both feeders.

The equipment designed to counteract such overcompensation consists of an auxiliary current transformer and an auxiliary relay on a sub-panel mounted in the tap changer control compartment of each unit. Figure 1 is a photograph of this panel, while Figure 2 shows its wiring diagram. Figure 3 shows a basic Duplex Type Network circuit prior to application of this scheme while Figure 4 and 5 show the application of this scheme to the units.

SYMBOLS USED IN DRAWING FIGURES

TCT	Auxiliary Current Transformer
TCX	Auxiliary Relay
152	Transformer Circuit Breaker
24	Tie Breaker
24A	Tie Breaker Auxiliary Contact
CT	Current Transformer
C1 & C2	Line Drop Compensators
AT	Auxiliary Transformer
CT	Current Transformer
PT	Potential Transformer

Number in parentheses indicates with which unit a device is associated.

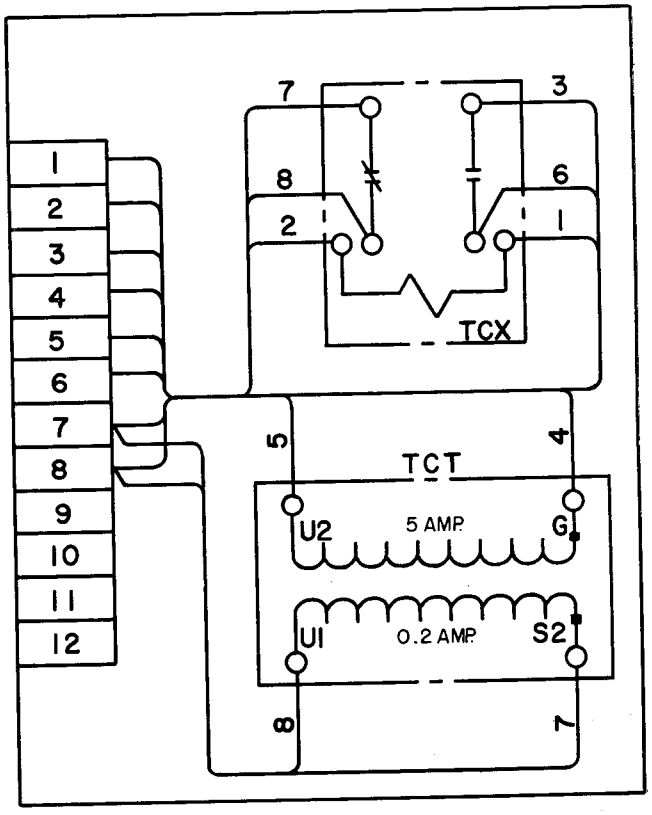

FIG. 2. Current Equalizing Panel—Diagram

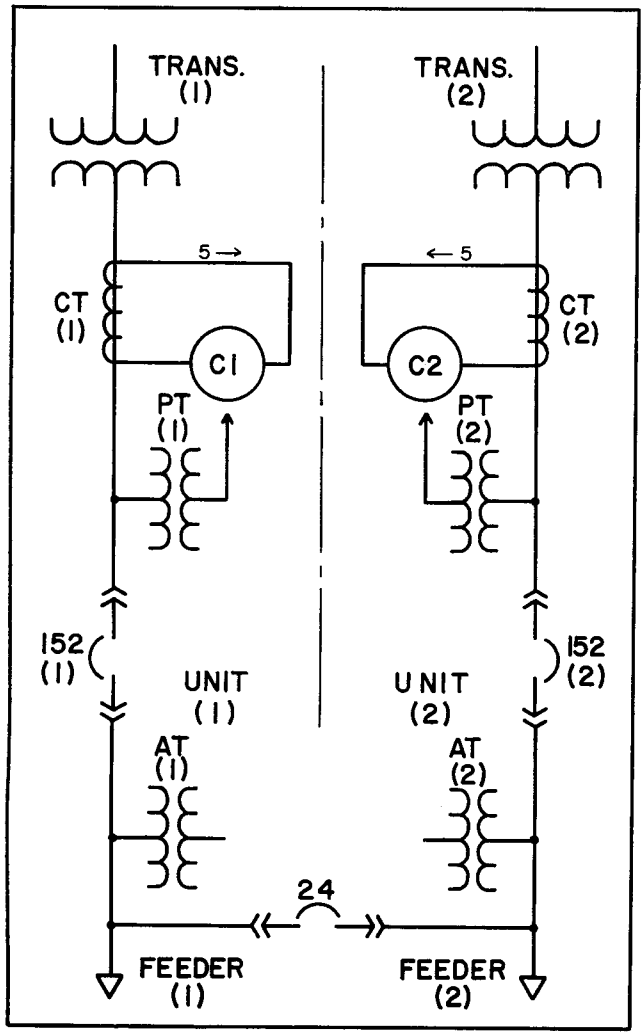

FIG. 3. Basic Duplex or Low Voltage Selective Circuit

Refer to the simplified diagram in Figure 3 and assume tie breaker 24 to be open, with breakers 152(1) and 152(2) closed; transformers 1 and 2 carrying the load on feeders 1 and 2, respectively; and a 5 ampere current flowing in each of the compensators, C1 and C2. Assume also that each of the compensators has been adjusted for the expected voltage drop between its respective feeder bus and load center and that the voltage regulating relays are balanced.

For convenience we will consider the case where breaker 152(2) is tripped so that the load is transferred to transformer 1. The functioning of the circuit would be similar if breaker 152(1) were to be tripped.

With tie breaker 24 in its normally open position both transformers and their load tap changers operate independently. If, however, transformer breaker 152(2) were tripped it would be customary for tie breaker 24 to close automatically and supply the load on both feeders through transformer (1) and breaker 152(1). This would circulate 10 amperes through C1 since all of the current would now be supplied by transformer (1). A normally open auxiliary contact on circuit breaker 152(2) may be inserted in the voltage regulating relay circuit of transformer (2) to prevent its tap changer from attempting to correct the output voltage. However, without some safeguards against overcompensation, the tap changer of unit 1 would operate to raise the output voltage to correct for what the compensator C1 would interpret as an increase in line drop between the transformer bus and the load center.

Figures 4 and 5 illustrate the circuit designed to prevent unnecessary tap changer operation which would result from the over-compensation described in the preceding paragraph. Figure 4 illustrates conditions for each transformer supplying its own feeder. Figure 5 illustrates conditions when transformer (1) is supplying both feeders.

A pair of coupling current transformers, TCT(1) and TCT(2), are used in conjunction with main current transformers, CT(1) and CT(2), and a pair of TCX auxiliary relays.

With tie breaker 24 in Figure 4 open, breaker auxiliary contacts 24 are open; the TCX relays are de-energized, and 5 amperes are flowing in each of the compensators, C1 and C2.

Under unbalanced load conditions, unequal load currents flow through the individual compensators because the TCT secondaries are shorted by the normally closed TCX2 contacts of the TCX relays.

When the 152(2) breaker is opened, as in Figure 5, tie breaker 24 as well as its auxiliary 24A contacts are automatically closed. Closing the 24A contacts energizes the TCX relays in both units from the AT auxiliary transformers, first closing the TCX1 contacts, then opening the TCX2 contacts, thereby placing the secondaries of TCT(1) and TCT(2) in series. Because of the manner in which their secondary windings are coupled, the TCT transformer primaries offer the lowest impedance to current flow when the currents in the two primaries are identical in phase angle and magnitude. Note that the opposite secondary leads of the two auxiliary current transformers must be grounded for proper functioning of the circuit.

The current in CT(1) which is now 10 amperes, is forced to divide equally between the TCT transformers of the two units so that 5 amperes flow through C1 and TCT(1) and the remaining 5 amperes flow through the TCX1 contacts of both units, C2 compensator, and TCT(2) before returning through the common ground connection. Thus, when either unit is tripped out, the currents in both compensators, C1 and C2 will be equal and will have a

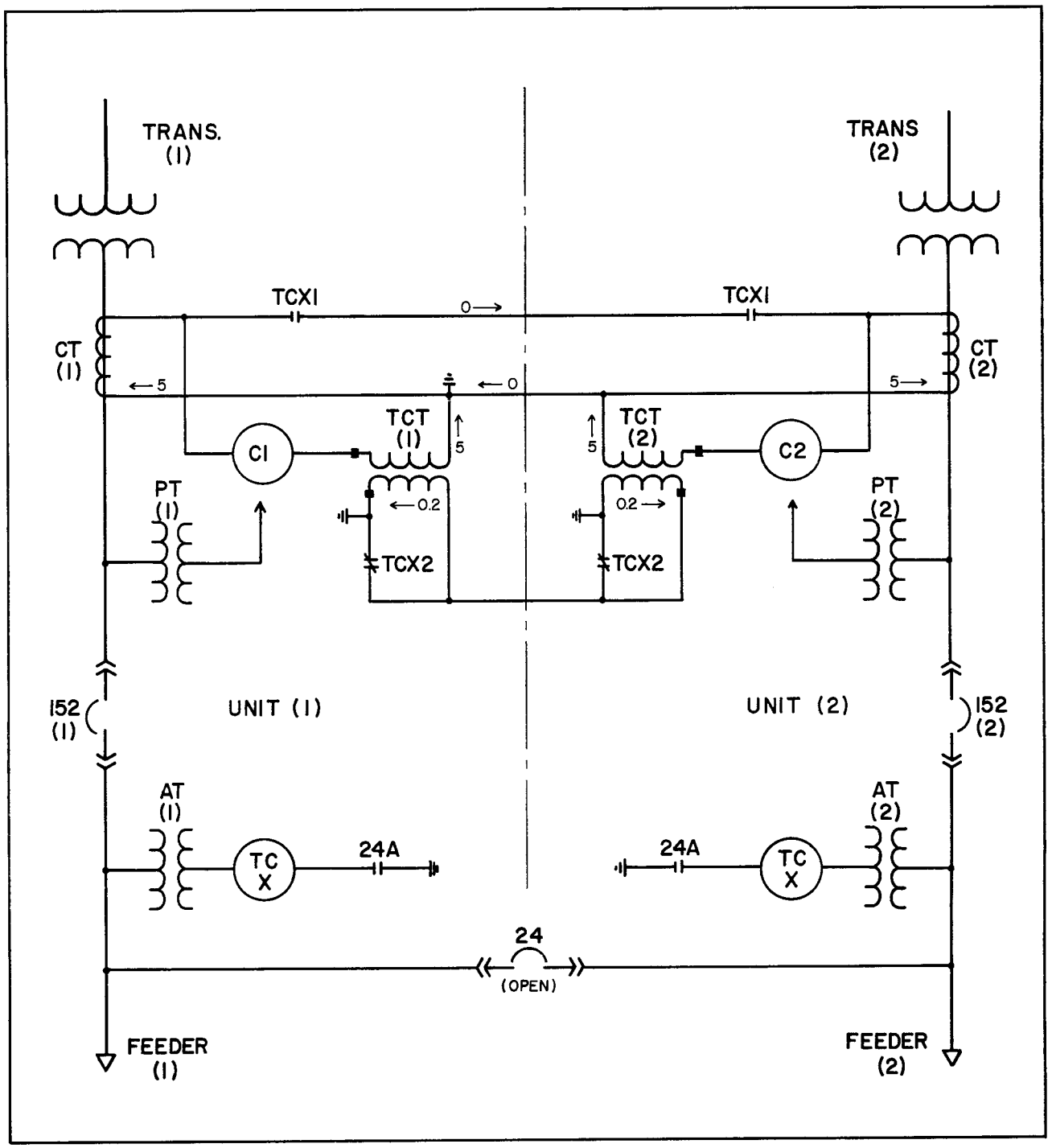

FIG. 4. Duplex Station with Normal Breaker Conditions

value equal to the average of the two separate currents which would flow in them if each unit were still supplying its own load. When the 152(2) breaker is reclosed, tie breaker (24) will reopen and the control circuit will be restored to its initial condition prior to the tripping of 152(2).

For proper functioning of this scheme, it is essential to maintain voltage on the TCX relay circuit in Figures 4 and 5; therefore, the TCX coil is wired directly to one side of the AT auxiliary transformer control source rather than through a control circuit breaker.

The auxiliary transformers are shown in the accompanying figures connected to the feeder side of the transformer breaker to emphasize the importance of maintaining voltage on the TCX circuit

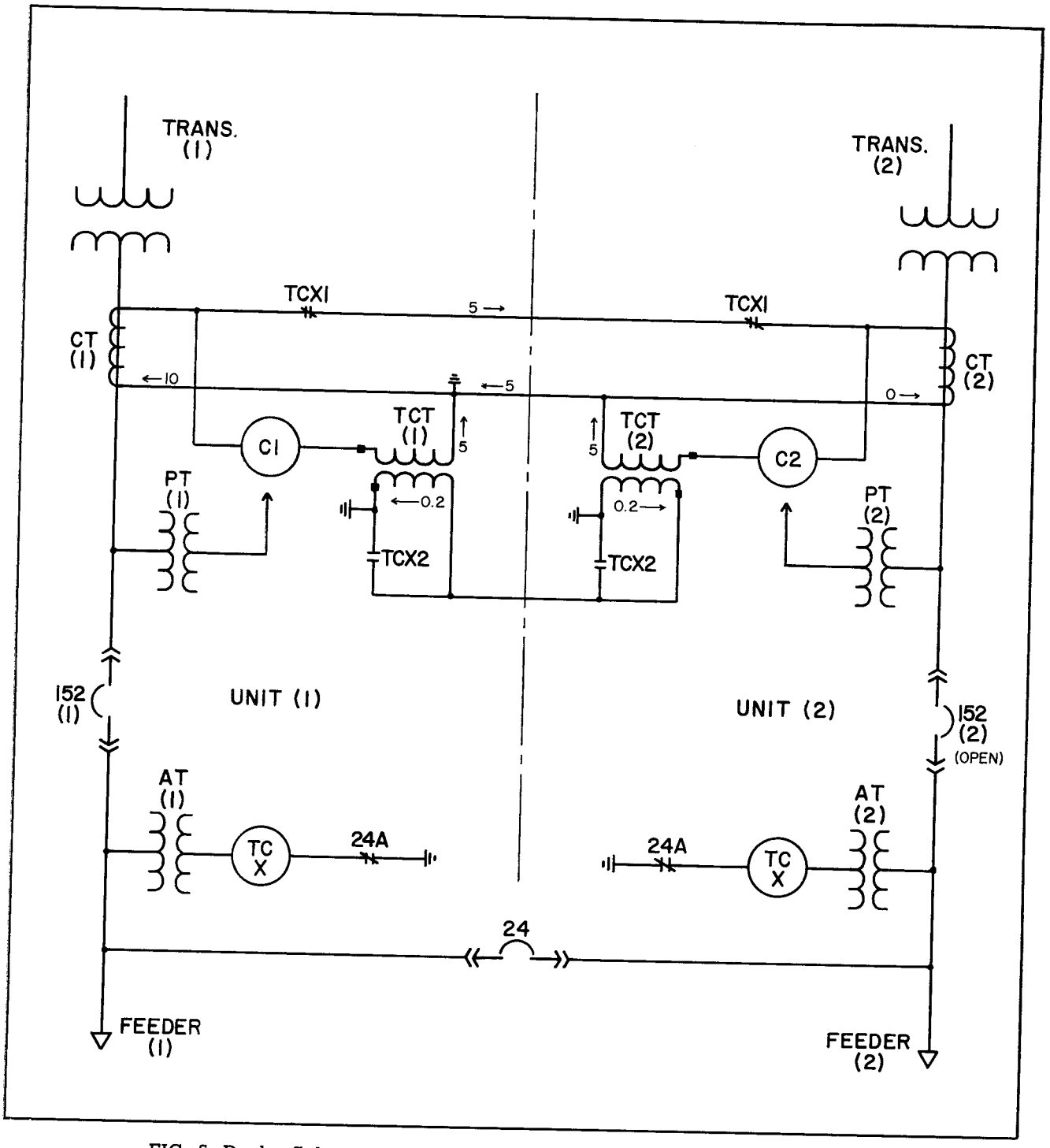

FIG. 5. Duplex Substation with both Feeders Supplied Through One Transformer

whenever the associated feeder is energized. Where the auxiliary transformers are connected on the transformer side of the circuit breaker an automatic transfer scheme may be employed to supply both TCX relays from the particular auxiliary transformer which is still energized whenever one unit is de-energized.

LIMITATIONS OF COMPENSATING SCHEME

In the scheme here described for obtaining equalization of current in the compensator circuits, the least disturbance of line regulation would result if the load currents were equal just prior to tripout (assuming the compensator settings were equal). This is true because, regardless of the degree of

unbalance in the loads on the two units prior to tripout of unit 2, the average current will flow in C1 after tripout.

The amount by which this average current flowing through C1 compensator differs from the current flowing through C1 immediately prior to the tripout of unit 2 determines the extent to which the tap changer will operate to correct for an apparent change in load center voltage.

EXPANSION OF SCHEME FOR ADDITIONAL UNITS

The addition of units and feeders to the system does not render the existing compensating equipment obsolete if designed in accordance with the scheme illustrated in Figures 4 and 5. In this scheme the required ratio of transformation of the TCT coupling current transformers remains the same regardless of the number of units in the interconnecting network. The compensating control panel required for a third unit is identical to those used for units 1 and 2.

Refer to the factory for information on the proper connections for this and other special applications.

For complete details on the application of current equalizing on Spot Network transformers, refer to the instruction leaflet covering the particular paralleling control used for the load tap changer.

RENEWAL PARTS DATA FOR COMPENSATING PANEL

Panel complete, 591D423G01
SG Relay *S# 1544314
Auxiliary CT ratio 5/0.2 *S# 323B602A02

* Included on complete panel.

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