INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE ND ROTOR ROTATION INDICATING RELAY

CAUTION Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type ND relay is designed for use in synchronous condenser control. The function is to detect a locked rotor in the synchronous condenser during the starting period. It will energize the shut-down circuit if the rotor does not begin to turn within a short time-interval after the starting breaker is closed.

CONSTRUCTION AND OPERATION

The type ND relay consists of an assembly of six telephone-type relays, a Rectox rectifier and two resistors.

The relay designated as R in the diagrams alternately picks up and drops out as the rotor of the synchronous condenser turns. An a-c voltage, of magnitude and frequency dependent upon the rotor speed, is impressed on relay terminals 8 and 9, and the action of relay(R) is stabilized by the resistor connected across its coil and the half-wave rectifier connected in series. The variable resistor which also is in series with relay(R) is adjusted at the factory so that (R) is picked up approximately one-half of each cycle of beat voltage when the rotor is just starting to turn. Relays (1), (2), and (3) comprise a counting chain which counts the first few operations of relay(R). Relay (P) is a pendulum-type relay and relay (T) is a slug-type delayed-dropout relay. These two relays together form a timing circuit. If the timing chain functions and relay (3) picks up before the time-setting of the timing circuit, the starting sequence of the synchronous condenser control proceeds normally.

The external schematic for the type ND relay is shown in Fig. 2. In addition to the ND relay (device 14), a 6-contact type MG-6 auxiliary relay (14X), a 115/115 volt 25 v.a. insulating transformer, and a 2000 ohm potentiometer are needed. Also, an "a" contact of the starting breaker (6), a "b" contact of the running breaker (42), and a make contact of the master starting relay (4) must be available.

When the starting breaker is closed, a 60 cycle voltage is induced in the field winding and appears across the field discharge resistor. If the rotor turns, this voltage will change phase with respect to the bus voltage, and the frequency of the induced voltage will increase as the rotor speed increases. If this voltage is beat against the bus voltage through the insulating transformer, the beat frequency will vary directly as the rotor speed. If the two voltages are of equal magnitude and the beat voltage is applied to a relay, this relay will alternately pick up and drop out as the net voltage varies from a maximum to zero due to turning of the rotor. The magnitude of the induced voltage is reduced as the rotor speed increases, but if the drop out voltage of the voltage-sensitive relay is fairly high it will continue to pick up and drop out even though the minimum beat voltage is considerably more than zero.

The elements operate in the following sequence in a starting cycle. When the master control switch is turned to the start position and the master relay (4) closes, a contact of this relay energizes the pendulum relay (P) of the type ND relay (14) through a normally-closed contact of the MG-6 relay (14X). A contact of P picks up the slow-drop-out relay (T). The starting breaker (6) closes, and an auxiliary contact (6a) of this breaker picks up the auxiliary relay (14X). This de-energizes relay (P), and through the make contacts of relay (14X) the shut-down circuit is set up and the two a-c voltages are connected to relay (R). The pendulum of relay (P) starts swinging and makes intermittent contact in the circuit to relay (T). Depending upon the rotor position, relay (R) may or may not pick up immediately. If the rotor turns, however, relay (R) will pick up

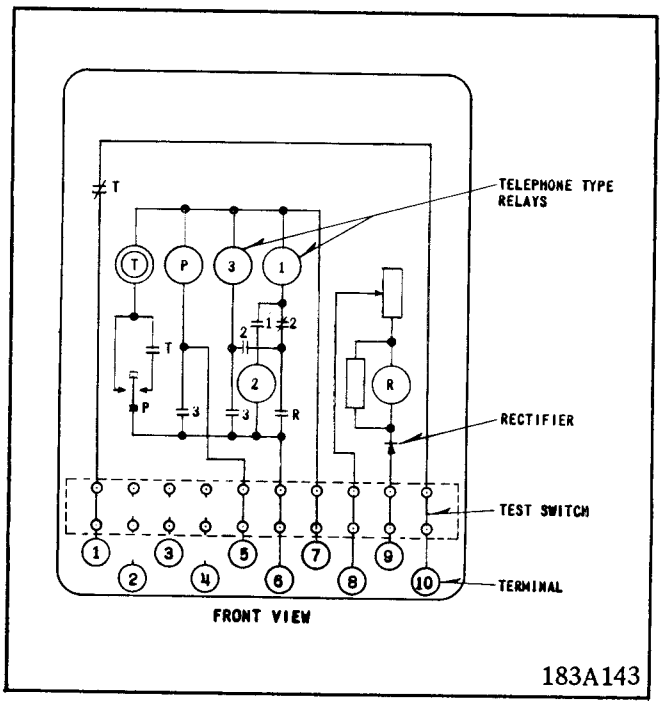

Fig. 1. Internal Schematic of the Type ND Relay in type FT21 case.

as the beat voltage increases and will drop out as it decreases. When relay (R) first picks up, relay (1) of the counting chain closes and sets up a circuit for relay (2) to pick up as soon as the by-pass around it is removed by the dropping out of relay (R). A contact of relay (2) sets up a circuit so that when relay (R) again picks up, relay (3) picks up and seals in through one of its own contacts. A second contact of relay (3) re-energizes relay (P) and holds the circuit to relay (T) closed. This prevents the contact of relay (T) in the shut-down circuit from closing. When the starting breaker (6) opens and the running breaker (42) closes, the auxiliary relay (14X) and the ND relay are completely de-energized.

If the rotor had not started to turn when the starting breaker closed, relay (R) either would not have picked up, or if it picked up it would not have dropped out again. Relays (2) and (3) in the counting chain would not have picked up, and relay (2) would have dropped out and completed the shut-down circuit through its back contact.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the mounting stud for mounting projection or by means of the four mounting holes on the flange for semi-flush mounting. Either the stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to be terminal and furnished with the relay for thick panel mounting. The terminal stud may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detail information on the FT case refer to IL-41-076.

The values of the induced voltage which appears across the field discharge resistor at the moment the starting breaker is closed (before the rotor begins to turn) should be ascertained, and the 2000 ohm potentiometer shown in the external schematic (Fig. 2) should be connected and adjusted so that the two voltages that are to be beat against each other are equal initially.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

The time delay between de-energization of relay (P) and dropping-out of relay (T), should be approximately 3 seconds. With the relay in the normal operating position, this delay may be checked by connecting terminals 6 and 7 to a 125 volt d.c. source and picking up the relay (P) by connecting terminal 5 to terminal 6 momentarily. The interval between the de-energization of relay (P) and closing of the (T) contact connected between terminals 1 and 10 can be measured with a cycle counter or other time-measuring means. The two contact gaps of relay (P) should be approximately equal when the relay is de-energized. If the time delay is too long the gaps should be increased by equal amounts, using the adjusting screws provided. If the delay is too short, the gaps should be reduced by equal amounts until the required delay is obtained.

If the initial voltage across the field discharge resistor is 115 volts or more the potentiometer associated with the insulating transformer should be adjusted for a balance between the 115 volt bus voltage and the field discharge resistor voltage.

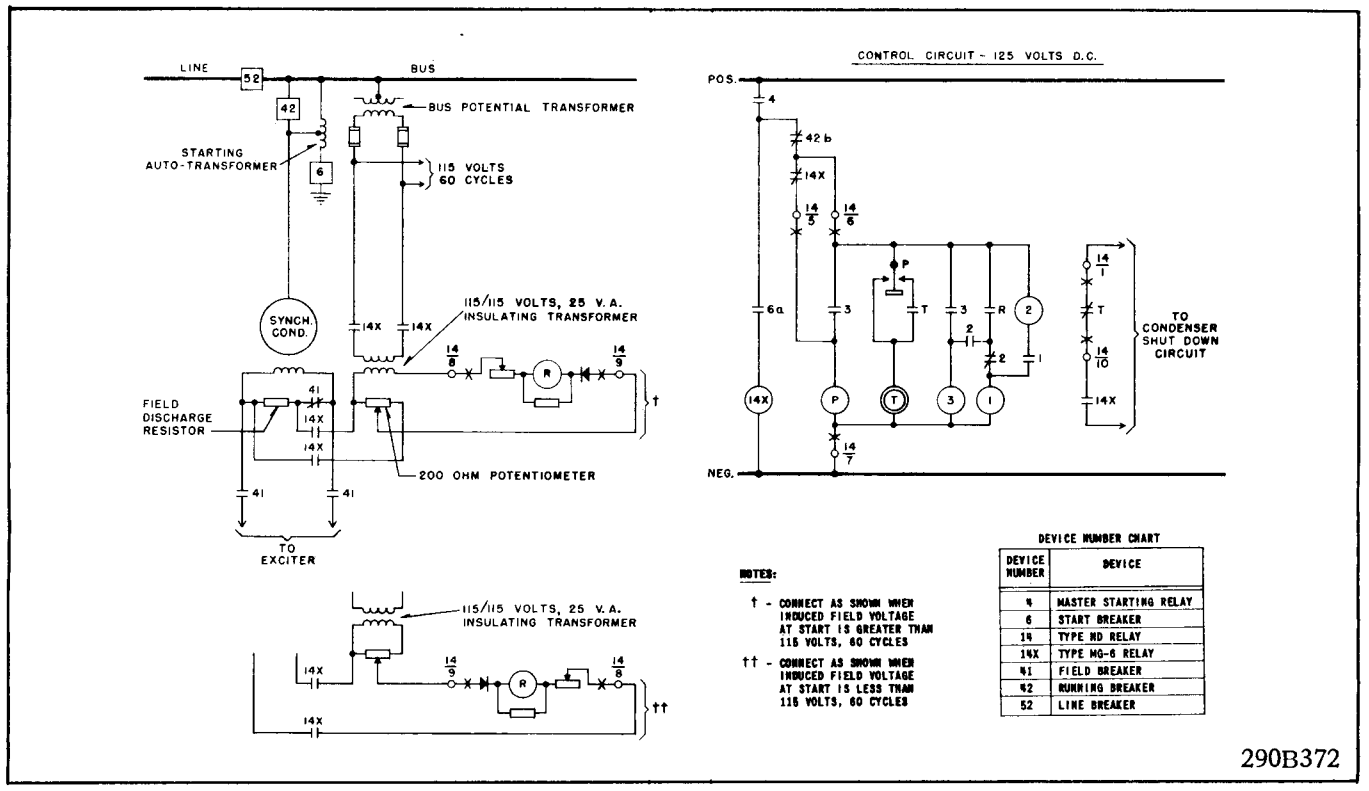

Fig. 2. External Schematic of the Type ND Relay for Locked Rotor Protection of a Synchronous condenser.

Then relay (R) should be adjusted to pick up with approximately 170 volts, 60 cycles, impressed across terminals 8 and 9 and to drop out at approximately 145 volts. These values will allow relay (R) to be picked up for approximately one-half of each of the first beat cycles, and they are used in the factory adjustment. The pickup and dropout adjustment probably can be made with sufficient accuracy entirely by means of the series adjustable resistor. However, if the dropout voltage is considerably different from 145 volts when the pickup voltage is 170 volts, it may be corrected by changing the initial pressure of the lower contact spring against the operating arm and changing the follow of the upper contact spring. If required, the position of the core and coil in the relay frame may be altered to change the air gap between the armature and the pole face.

With the voltage adjustments recommended for relay (R), the variation of the beat voltage between maximum and minimum allows ample voltage margin and time interval for relay (R) and the counting chain to respond to the beat voltage. However, if the initial voltage across the field discharge resistor should be less than 115 volts, the alternate connections shown at the bottom of Fig. 2 should be used. The potentiometer should be adjusted so that the voltage at the tap is equal to the initial voltage across the field resistor and the pickup and dropout voltages of relay (R) should be reduced accordingly. For example, if the initial voltage across the field resistor should be only 90 volts, the pickup and dropout voltages of relay (R) should be 90/115 of 170 and 145 volts, or approximately 133 and 114 volts respectively.

The function of the counting chain, relays (1), (2) and (3), may be checked by connecting terminals 6 and 7 to a 125 volt d.c. source and manually operating the armature of relay (R). On closing the armature of (R), relay (1) should pick-up; and on releasing the armature, relay (2) should pick up. On the second closing of relay (R), relay (3) should pick up and seal in.

ROUTINE MAINTENANCE

All contacts should be periodically cleaned. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended because of the danger of embedding small particles in the face of the contact material and thus impairing the contact.

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

ENERGY REQUIREMENTS

The coils of the various elements of the ND relay have the following burdens. The duty is momentary.

(R) element and Rectox.	7 v.a. at 230 (max) v. 60 cyc.
(P) element	8 watts at 125 v. d.c.
(T) element	5 watts at 125 v. d.c.
(1) and (3) elements . .	3 watts at 125 v. d.c.
(2) element (in series with (1)) . .	0.8 watts at 62.5 v. d.c.

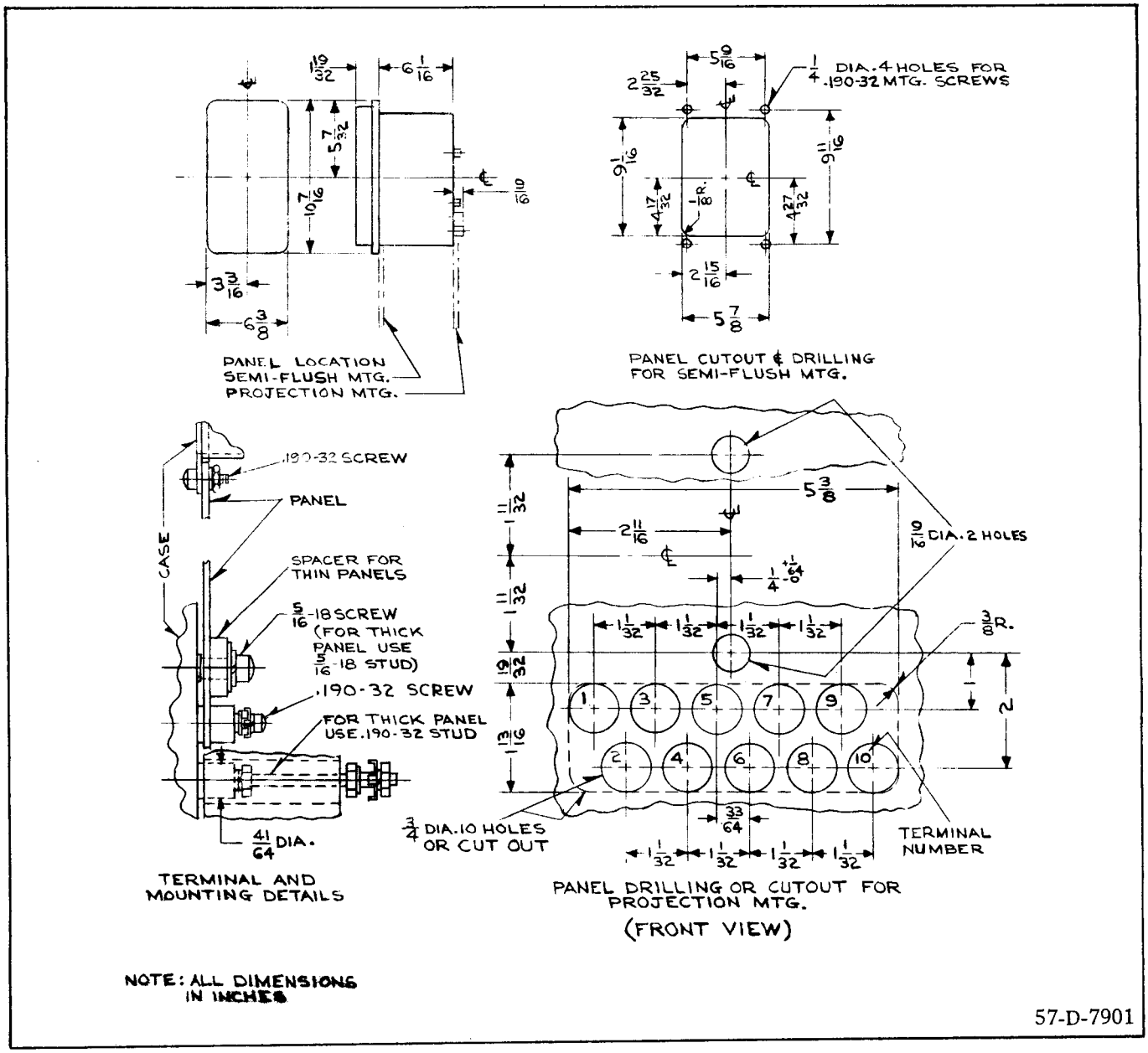

Fig. 3. Outline and Drilling Plan for the Type ND Relay in the Type FT21 case.

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