INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CJ-5 CAPACITOR SWITCHING 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 CJ-5 relay is the master relay for single step current control for capacitor switching where fixed time-delay is required to avoid unmounted switching operations due to high swings in load current. The fixed time-delay may be changed by plugging in a new time-delay element having the desired time interval.

CONSTRUCTION AND OPERATION

The relay consists of a current-operated induction disc element, a type SG auxiliary relay, two fixed resistors, and two thermally-operated time-delay relays.

The operating element is an induction disc type element operating on current. The induction disc is a thin four-inch diameter conducting disc mounted on a vertical shaft. The shaft is supported on the lower end by a steel ball bearing riding between concave sapphire jewel surfaces, and on the upper end by a stainless steel pin.

The moving contact is a small silver rod hemispherically shaped at either end to form a double throw arrangement. It is fastened on the end of a conducting arm. The other end of this arm is clamped to an insulating tube on the disc shaft. The electrical connection is made from the moving contact thru the arm and a spiral spring. One end of the spring is fastened to the arm, and the other to a slotted spring adjuster disc which in turn fastens to the moulded insulation block mounted on the element.

The front and back stationary contact assemblies are both adjustable. Each mounts on a lever which can be set anywhere about the periphery of a calibrated scale. The moulded brackets, upon which the stationary contact leaf springs are mounted, are each secured to their respective lever arms by two screws. These screws may be loosened and the moulded contact supports pivoted to the positions required for correct tracking of both contact assemblies on the calibrated scale.

The moving disc is rotated by an electromagnet in the rear and damped by a permanent magnet in the front.

A resistor is connected in the upper pole circuit of the operating element electromagnet to minimize ambient temperature error.

The auxiliary type SG relay is provided with double-pole double-throw contacts. One set of double-throw contacts is used in conjunction with the induction element contacts and the time-delay element contacts to control the picking up or dropping out of the SG element. The second set of double-throw contacts is used for controlling the switch which connects or removes the capacitor from the line.

The time-delay devices have sealed-in-glass elements and are mounted in standard radio-type octal sockets. They have a single set of

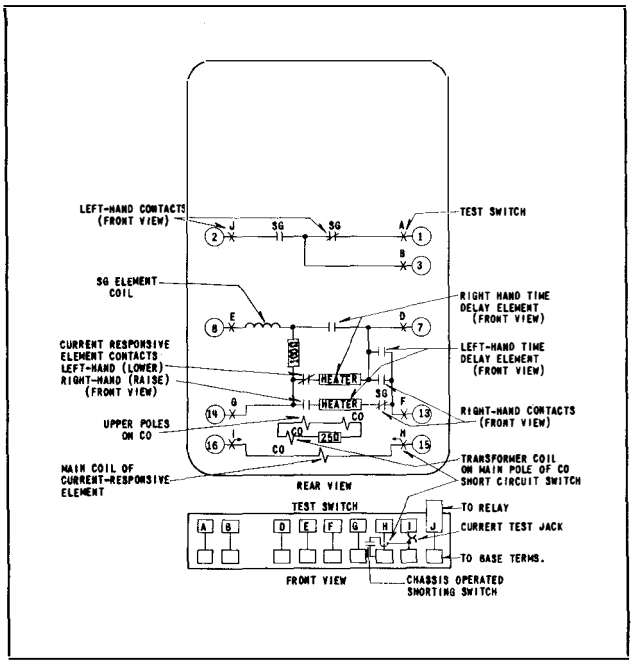

Fig. 1—Schematic Internal Connections Of Type CJ-5 Relay.

contacts, which are normally open and are operated by a heater winding acting upon a bi-metal arm. The construction is such that the contact gap and the time-delay are not affected by variations in ambient temperature. The time-delay of a given element is non-adjustable, but elements are available with a variety of time-delays and because of the socket-mounting construction one element can readily be substituted for another in the CJ-5 relay. The usual time delay is 60 seconds.

When the induction element contacts close to the right-hand side (indicating that the load current is at or above the value at which it is desired to connect the capacitor to the line in order to raise the voltage), the heater of the left-hand time delay element is energized through the right-hand back contact of the SG element. If the induction element contact remains closed until the time-delay element contact can close, these contacts complete an energizing circuit for the SG element coil. The SG back contacts open, deenergizing the time-delay element, and the associated front contacts seal around the time-delay element contact. The front contact on the left-hand side of the SG element closed to energize the switch which connects the capacitor to the line. In case this does not raise the voltage sufficiently to open the left-hand contact of the induction element, the associated time-delay element remains deenergized because the SG element back contacts are open.

If the line current drops sufficiently to maintain the left-hand contact of the induction element closed for the required time, the right-hand time-delay contact closes and bypasses the SG element coil. A resistor in series with the coil limits the current to slightly over one ampere. The SG element drops out and this current is interrupted by opening of the right-hand make contact of the SG relay. Closing of the left-hand break contact of the SG element opens the switch which connected the capacitor to the line. The equipment then is in readiness to go through another similar cycle.

Construction of Relay Case

The relay elements are mounted in a type FT case. This is a dustproof enclosure combining relay elements and knife-blade test switches in the same case. This combination provides a compact, flexible assembly easy to maintain, inspect, test and adjust. There are three main units of the type FT case: the case, cover and chassis. The case is an all welded steel housing containing the hinge half of the knife-blade test switches and the terminals for external connections. The cover is a drawn steel frame with a clear window which fits over the front of the case with the switches closed. The chassis is a frame that supports the relay elements and the contact jaw half of the test switches. This slides in and out of the case. The electrical connections between the base and chassis are completed through the closed knife-blades.

Removing Chassis

To remove the chassis, first remove the cover by unscrewing the four captive nuts at the corners. This exposes the relay elements and all the test switches for inspection and

testing. In opening the test switches they should be moved all the way back against the stops. With all the switches fully opened, grasp the two cam action latch arms and pull outward. This releases the chassis from the case. Using the latch arms as handles, pull the chassis out of the case. The chassis can be set on a test bench in a normal upright position as well as on its top, back or sides for easy inspection, maintenance and test.

After removing the chassis a duplicate chassis may be inserted in the case or the blade portion of the switches can be closed and the cover put in place without the chassis. The chassis operated shorting switch located behind the current test switch prevents open circuiting the current transformers when the current transformers when the current type test switches are closed.

When the chassis is to be put back in the case, the above procedure is to be followed in the reversed order.

Electrical Circuits

Each terminal in the base connects thru a test switch to the relay elements in the chassis as shown on the internal schematic diagram. The relay terminal is identified by numbers marked on both the inside and outside of the base. The test switch positions are identified by letters marked on the top and bottom surface of the moulded blocks. These letters can be seen when the chassis is removed from the case.

The potential and control circuits thru the relay are disconnected from the external circuit by opening the associated test switches. Opening the current test switch short-circuits the current transformer secondary and disconnects one side of the relay coil but leaves the other side of the coil connected to the external circuit thru the current test jack jaws. This circuit can be isolated by inserting the current test plug (without external connections), by inserting the ten circuit test plug, or by inserting a piece of insulating material approximately 1/32" thick into the current test jack jaws. Both switches of the current test switch pair must be open when using the current test plug or insulating material in this manner to short circuit the current transformer secondary.

Testing

The relays can be tested in service, in the case but with the external circuits isolated, or out of the case as follows:

Testing in Service

The ammeter test plug can be inserted in the current test jaws after opening the knife-blade switch to check the current thru the relay. This plug consists of two conducting strips separated by an insulating strip. The ammeter is connected to these strips by terminal screws and the leads are carried out thru holes in the back of the insulated handle.

Voltages between the potential circuits can be measured conveniently by clamping #2 clip leads on the projecting clip lead lug on the contact jaw.

Testing in Case

With all blades in the full open position, the ten circuit test plug can be inserted in the contact jaws. This connects the relay elements to a set of binding posts and completely isolates the relay circuits from the external connections by means of an insulating barrier on the plug. The external test circuits are connected to these binding posts. The plug is inserted in the bottom test jaws with the binding post up and in the top test switch jaws (when used) with the binding posts down.

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the current elements using clip leads, care should be taken to see that the current test jack jaws are open so that the relay is completely isolated from the external circuits. Suggested means for isolating this circuit are outlined above under "Electrical Circuits".

Testing Out of Case

With the chassis removed from the base, relay elements may be tested by using the ten circuit test plug or by #2 test clip leads as described above. The factory calibration is made with the chassis in the case and removing the chassis from the case may change the calibration values by a small percentage. It is recommended that the relay be checked in position as a final check on calibration.

INSTALLATION

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

CHARACTERISTICS

The type CJ-5 relay has adjustable high and low current contacts that can be set around a calibrated scale between the limits of 1 and 4 amperes. The moving contacts assume a position corresponding to the current through the relay and will stay in that position until the current changes. If the current changes either gradually or suddenly, the contacts will assume a new position corresponding to the change unless the travel is limited by the setting of the adjustable contacts.

The induction element has inverse timing; that is, the greater the change in current the faster the relay contact will travel. However, the time delay of the induction element usually is only a few seconds and is negligible as compared to the delay of the thermally-operated elements. If the current in the induction element is barely sufficient to close the contacts, the contact resistance at this light pressure may reduce the voltage on the time-delay element sufficiently to cause a substantial increase in the time. If the current change is .05 to .1 ampere greater than that required to barely close the induction element contacts, this effect is negligible. However, the time delay elements themselves have a tolerance of $\pm$ 15% of the nominal delay, and the nominal value applies only when these elements are energized at their 117 volt rating. Variations from this value affect the timing approximately inversely as the square of the voltage. Because of these factors, precise time-delays should not be expected.

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 if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be periodically cleaned with a fine file. S#1002110 file 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 soft silver and thus impairing the contacts.

The relay has front and back adjustable stationary contacts. To adjust these properly, set the two levers so they both point to the same calibration point at approximately mid-scale. The contact leaf springs of the operating element should be positioned such that they are just free of the contact hook brackets to insure no initial tension of the leaf springs. Then adjust the position of the front and back contacts so they both just touch on either side of the moving contact. This is done by loosening the two screws at the top of each lever and rotating the adjust-

able contact assembly slightly contact assembly slightly until the desired contact positions are obtained. The screws should be tightened securely.

To calibrate the relay, it should be connected to a suitable 60-cycle current supply. Current corresponding to the various values marked on the semi-circular scale plate should be applied to the relay and the position of the adjustable contacts check for the various values. Readjustments can be made by rotating the notched spring adjuster with a screw driver blade inserted in one of the notches.

The time-delay elements will give long, trouble-free service, and because of their construction it is not possible to adjust them or to perform any maintenance on them.

The SG relay element should have approximately 1/8" contact gap, with about 3/64" follow in the make contacts and 1/32" follow on the break contacts.

ENERGY REQUIREMENTS

The 60-cycle burdens of the type CJ-5 relay are as follows:

Operating element current coil with resistor in upper coil, VA = 7.25/65° lag at 5 amperes. SG element plus resistor, VA = 11/60° lag at 120 volts. Time-delay element, VA = 5 at unity power factor at 117 volts.

Contact Rating

The main SG element contacts will carry 12 amperes continuously and 30 amperes for one second, and will interrupt 30 amps non-inductive load at 115 volts 60 cycles. For d-c, interrupting ratings for non-inductive circuits are given in the table that follows:

Volts	Amps.
24	15
48	8
115	2.4
230	0.75
550	0.25

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.

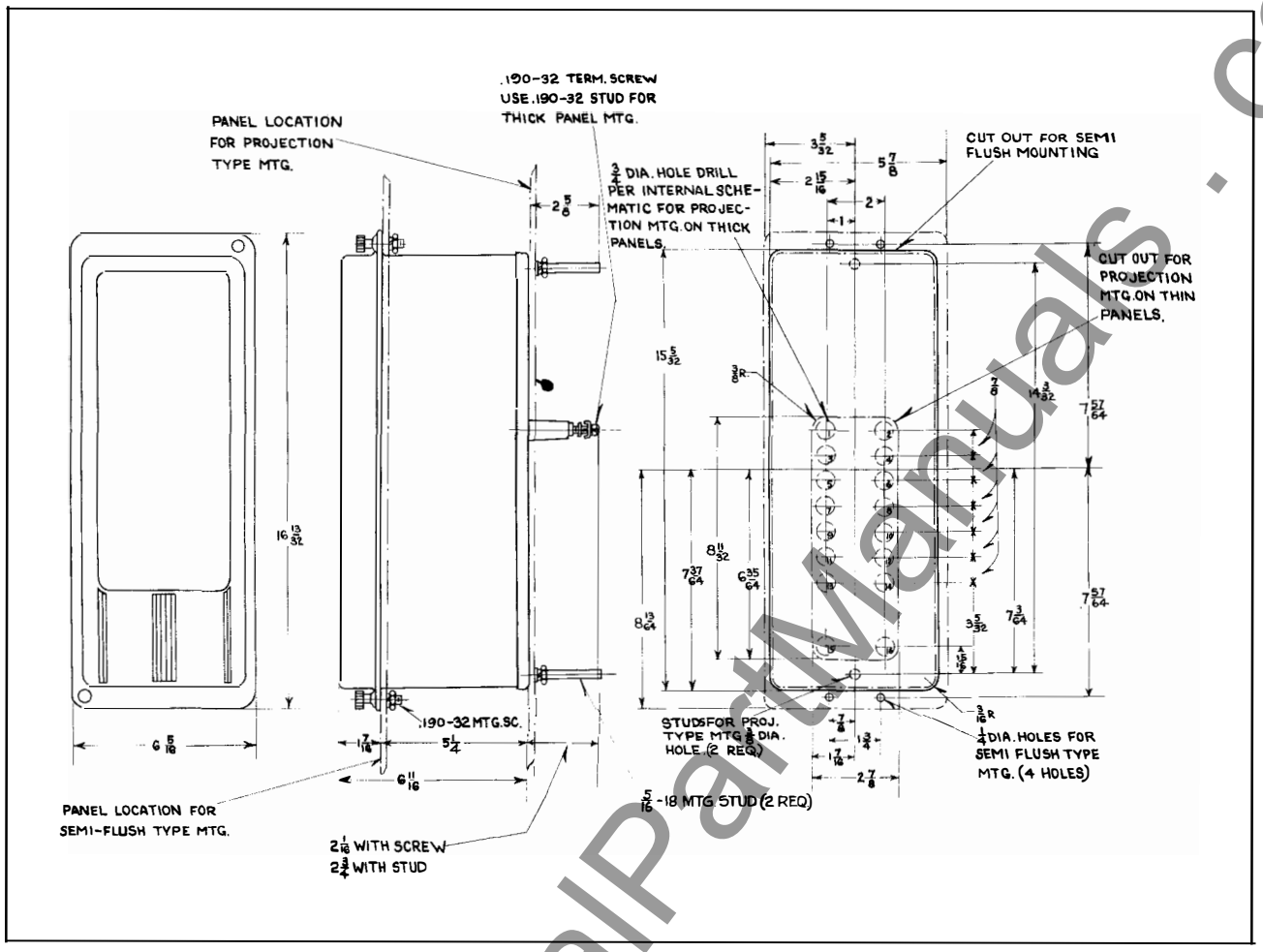

Fig. 2—Outline And Drilling Plan For Type CJ-5 Relay In The Semi-Flush Or Projection Type FT Case. See The Internal Schematic For The Terminals Supplied. For Reference Only.

WESTINGHOUSE ELECTRIC CORPORATION

METER DIVISION • **NEWARK, N.J.**

Printed in U. S. A.