INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE HQS PHASE SELECTOR RELAY FOR SELECTIVE-POLE CARRIER RELAYING

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 HQS relay operates on negative and zero sequence currents to select the faulted phase when a single phase-to-ground fault occurs on the protected transmission line. The zero sequence current is obtained from the neutral of the line current transformers, and the negative sequence current from an external three-phase filter supplied with the relay.

CONSTRUCTION AND OPERATION

The type HQS relay consists of three phase selector elements, three contactor switches, and three operation indicators mounted in the standard case of Figure 4. The external three-phase negative sequence filter is mounted in the case of Figure 3. The operation of this relay in the carrier scheme is described in I.L. 41-600.2.

Phase Selector

The phase selector element is similar to the H directional element as used in the type HZ and HRK-P relays. The primary of a small current transformer receives the zero sequence component of line current which causes a large current to flow in a one-turn movable aluminum secondary. Two other current coils are mounted on either side of a magnetic frame and these coils receive the negative sequence component of line current from an external filter. These zero and negative sequence elements are assembled at right angle to each other with the one-turn loop in the air gaps of the negative sequence current coil flux path. The interaction of the two fluxes produces torque and rotates the loop in a direction depending on the relative instantaneous direction of current flow in the two coils.

An Isolantite arm extends from the moving loop and supports a rectangular silver contact which bridges two stationary contacts mounted on either side of the loop. The stationary contacts are silver conical surfaces mounted on the lower end of vertically hanging springs. The contact separation is adjustable by a small screw near the upper end of the rigid stationary contact supporting arm. One of these supporting arms hangs parallel to each of the four stationary contacts. The set screw on the lower end of this arm provides the contact follow adjustment. Two additional screws on the movement frame beneath the negative sequence coil iron limit the movement of the loop. There are three of these phase selector elements, one for each of the three phases and designated S_A, S_B and S_C for phases A, B, and C respectively. The sub numbers 2 and 0 indicate the negative and zero sequence coils.

Contactor Switch

The d-c. contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch

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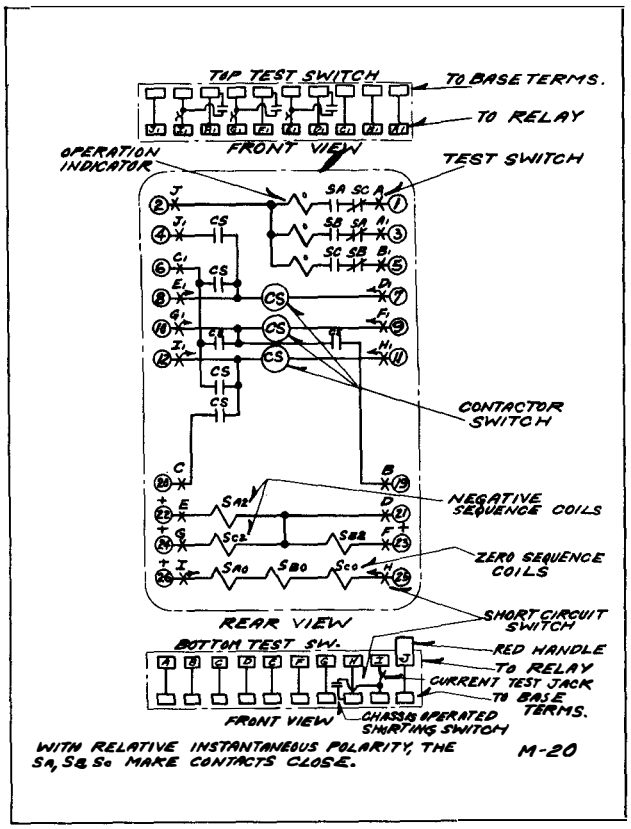

Fig. 1—Internal Schematic of the Type HQS in the Type FT Case.

contacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. These contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker.

Three of these contactor switches are used, one in each of the three trip circuits to seal in the trip circuit.

Operation Indicator

The operation indicator is a small solenoid coil connected in the trip circuit. When the coil is energized, a spring-restrained armature releases the white target which falls by gravity to indicate completion of the trip circuit. The indicator is reset from outside of the case by a push rod in the cover or cover stud.

Three Phase Negative Sequence Filter

The filter consists of three mutual reactors each with three windings connected as shown in Figure 2. With unbalanced three-phase currents flowing in the input terminals, the output voltage and current will be proportional to the negative sequence components of the unbalanced input. The detailed explanation of the filter is beyond the scope of this leaflet and is covered in catalog section 41-287 on the type CRS relay.

CHARACTERISTICS

The type HQS relay is an auxiliary relay used in the carrier relaying scheme with the types HZ, HRK-P and RSN relays. There are no settings required.

The minimum pick-up of the type HQS Relay and the filter is as follows:

Polarizing Winding Turns	Amperes	Maximum 3Io Amperes	Connection of Links
17	1.0	15.0	1 to B, 2 to 3 4 to A
10	1.3	25.0	1 to B, 2 to A
7	1.55	32.0	3 to B, 4 to A
3	2.37	75.0	2 to A, 1 to 3 4 to B

This is the total phase current passed thru the filter and relay to neutral with the other two phase currents zero. The corresponsing negative and zero sequence values are each one third of the values given above.

The negative sequence coils of the type HQS relay are normally connected in star to terminals A', B', and C' of the negative sequence filter. The neutral of this star should not be grounded. The terminals A", B", and C" should be connected together to the neutral of the main current transformers. It is important that no other elements be connected between A", B" and C" and the star a neutral point.

The alternate connection is used where other equipment must be connected between A", B" and C" and the neutral point. In this case the negative sequence coils are connected between terminals A'A", B'B" and C'C". With this connection zero sequence current must be

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eliminated or by passed around the filter. Delta current is not satisfactory because it causes an undesirable phase shift in the filter.

RELAYS IN TYPE FT CASE

The type FT cases are dust-proof enclosures 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.

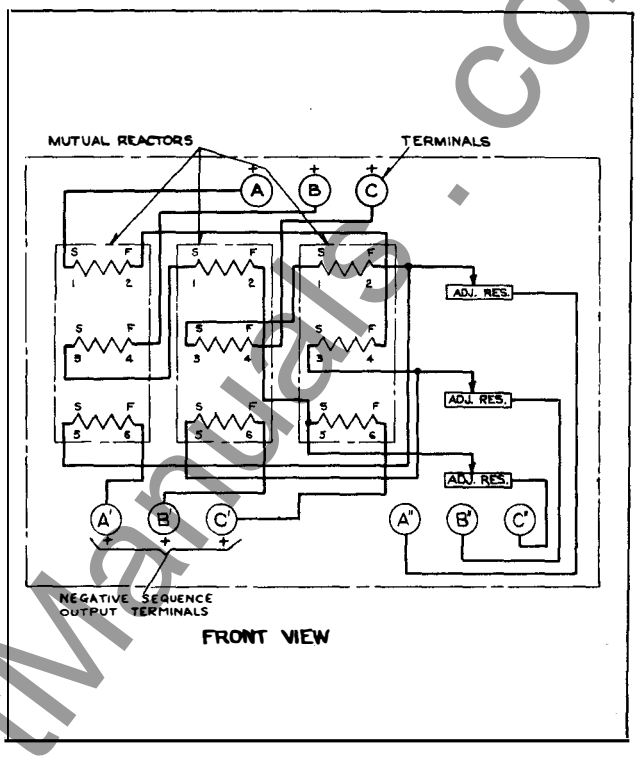

Fig. 2—Internal Connections of the Three Phase Negative Sequence Filter.

Removing Chassis

To remove the chassis, first remove the cover by unscrewing the captive nuts at the corners. This exposes the relay elements and all the test switches for inspection and testing. The next step is to open the test switches. Always open the elongated red handle switches first before opening any of the black handle switches or the cam action latches. This opens the trip circuit to prevent accidental trip out. Then open all the remaining switches. The order of opening the remaining switches is not important. 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 for test as well as on its back or sides for easy inspection and maintenance.

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 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. The elongated red handle switch should not be closed until after the chassis has been latched in place and all of the black handle switches closed.

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 diagrams. 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

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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.

A cover operated switch can be supplied with its contacts wired in series with the trip circuit. This switch opens the trip circuit when the cover is removed. This switch can be added to the existing type FT cases at any time.

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 posts up and in the top test switch jaws 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 will 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 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 two mounting studs. Either of these studs 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.

The external connections of both the relay

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and the filter are shown in the Carrier Current Schematic for selective pole tripping supplied with each terminal.

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 contact.

Phase Selector Element

Check the free movement of each element with the relay in a vertical position to see that it is free from friction and properly centered. The loop should assume a vertical position with the contacts open when the element is completely deenergized.

With the loop in the neutral position determined by gravity, adjust both left-hand stationary contacts (front view) so that there is contact gap of .010" between moving contact bridge and the stationary contacts. Adjust the left hand back stop screws for .010" contact deflection. Adjust the left stop which strikes against the loop so that it makes contact against the loop at the same time the moving contact deflects the stationary contact against the two back screws. Repeat these adjustments for the right hand contacts and stops.

Connect terminals 25 and 24 together and pass 1 ampere, 60 cycles, from terminals 26 to 23. (This test is without the filter). The moving contact of the bottom element (S_C) should move to the right and bridge the stationary contacts. Reverse the connections to terminals 25 and 26. The left-hand contacts should now remain firmly closed. Raise the current to 15 amperes and make sure that the loop stop screws have the adjustment for minimum contact vibration. This current should be passed only momentarily to prevent overheating the fault detector coils.

Repeat the tests on the middle element (S_B) by connecting terminals 22 and 25 together and passing current through terminals 21 and 26 and on the top element (S_A) by connecting terminals 25 and 22 together and passing current through terminals 19 and 26.

Adjust the bearing screws of the moving loop so that there is about .010 inch end play. See that the loop does not bind or strike against the iron or coil when pressed against either end jewel.

Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core of 1/64" when the switch is picked up. This can be done by turning the relay up-side-down or by disconnecting the switch and turning it up-side-down. Then screw up the core screw until the moving core starts rotating. Now, back off the core screw until the moving core stops rotating. This indicates the points where the play in the assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the core screw approximately one turn and lock in place. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 3/32" by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 4 amperes d-c. Test for sticking after 30 amperes d-c have been passed through the coil. The coil resistance is approximately .025 ohms.

Operation Indicator

Adjust the indicator to operate at 1.0 ampere d-c. gradually applied by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward.

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If the two helical springs which reset the aramture are replaced by new springs, they should be weakened slightly to stretching to obtain the 1 ampere calibration. The coil resistance is approximately 0.16 ohm.

Three - Phase Negative Sequence Filter

The filter is adjusted for balance at the factory and no further adjustments or maintenance should be required. With balanced three phase currents of 10 amperes, 60 cycles, phase rotation A, B, C, introduced into the input terminals as marked on Fig. 2, the voltage between the output terminals A', B', and C', should be zero. Use a high resistance voltmeter for this check.

Connect terminals A', B', and C' to terminals 20, 22 and 24 of the type HQS relay. Connect the relay terminals 19, 21 and 23 together. With balanced three-phase currents of 5 amperes, 60 cycles, phase rotation A, B, C, applied to the filter input terminals A, B, C, and the neutral made by connecting terminals A", B" and C" together, the voltage across the relay terminals 19 and 20, 21 and 22, and 23 and 24 should be zero. Now, reverse the connections to the filter input terminals A and B and check the voltage now appearing across the relay terminals. These three voltages should be substantially 0.7 volt.

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.

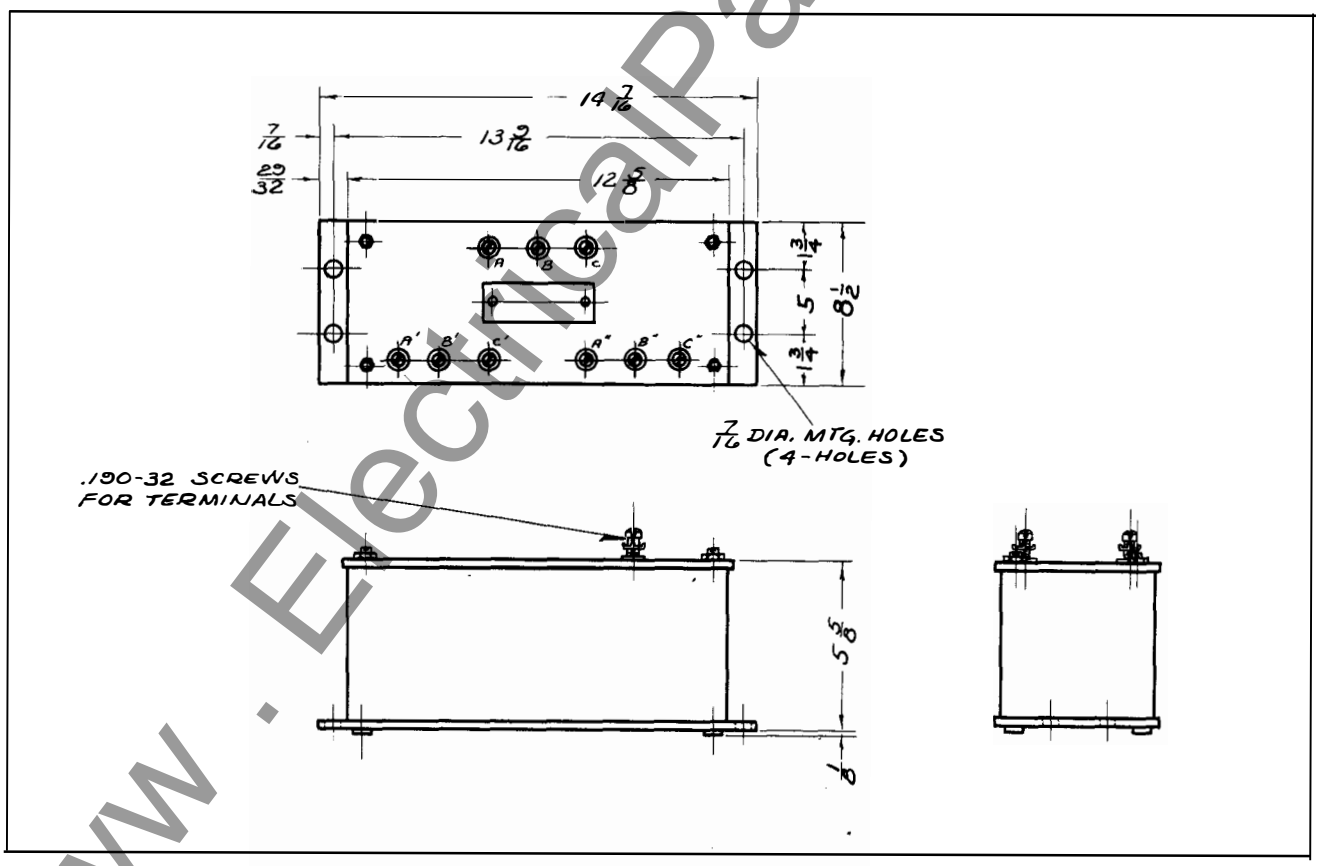

Fig. 3—Outline and Drilling Plan of the Three Phase Negative Sequence Filter.

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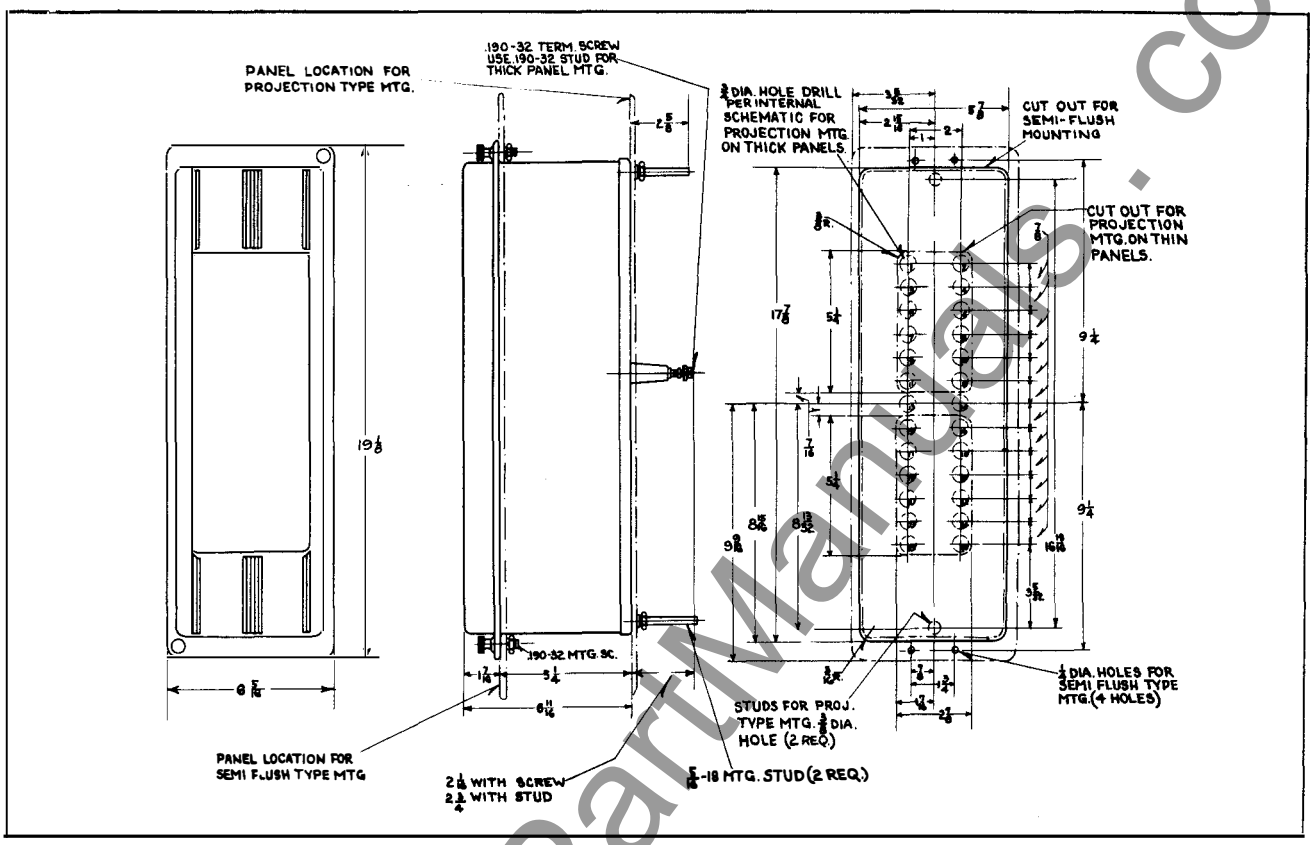

Fig. 4—Outline and Drilling Plan of the M20 Projection or Semi-Flush Type FT Flexitest Case.

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