Westinghouse

Type KF High-Speed Underframe Relay

With Solid State Timing

Application

The KF relay provides high-speed sensing of underfrequency conditions during system disturbances.

Usual applications of the relay involve selective dropping of the system load based on the frequency decrement.

It is particularly applicable for relatively isolated areas where a severe overload (i.e., greater than 50%) could occur due to a tie-line trip.

The relay can be applied to control voltage regulator tap changing mechanisms during low frequency operation.

Speed of operation of the relay is inversely proportional to the decrease of system frequency.

A minimum delay of 6 cycles is required since a sudden shift in the voltage phase angle during a fault will appear as a rapid change in frequency to underfrequency relays.

Features

Solid state timing is available to provide a wider range of time delay adjustmen (6-30 cycles on a 60 hertz base). A 100 m time delay on trip prevents undesirable operation due to other system transient conditions or voltage dips.

Individual settings for frequency, time delay, and Indicating Contactor Switch pickup make the relay suitable over a variety of applications.

Operable over a temperature range of −20°C to +60°C.

Operable over a voltage range of 70 to 110% of rated voltage.

Will not false trip on energization or de-energization.

A high-speed cylinder unit in conjunction with a time-delay-on-pickup telephone type relay provides secure system frequency detection.

Device Number: 81

June, 1972

Westinghouse

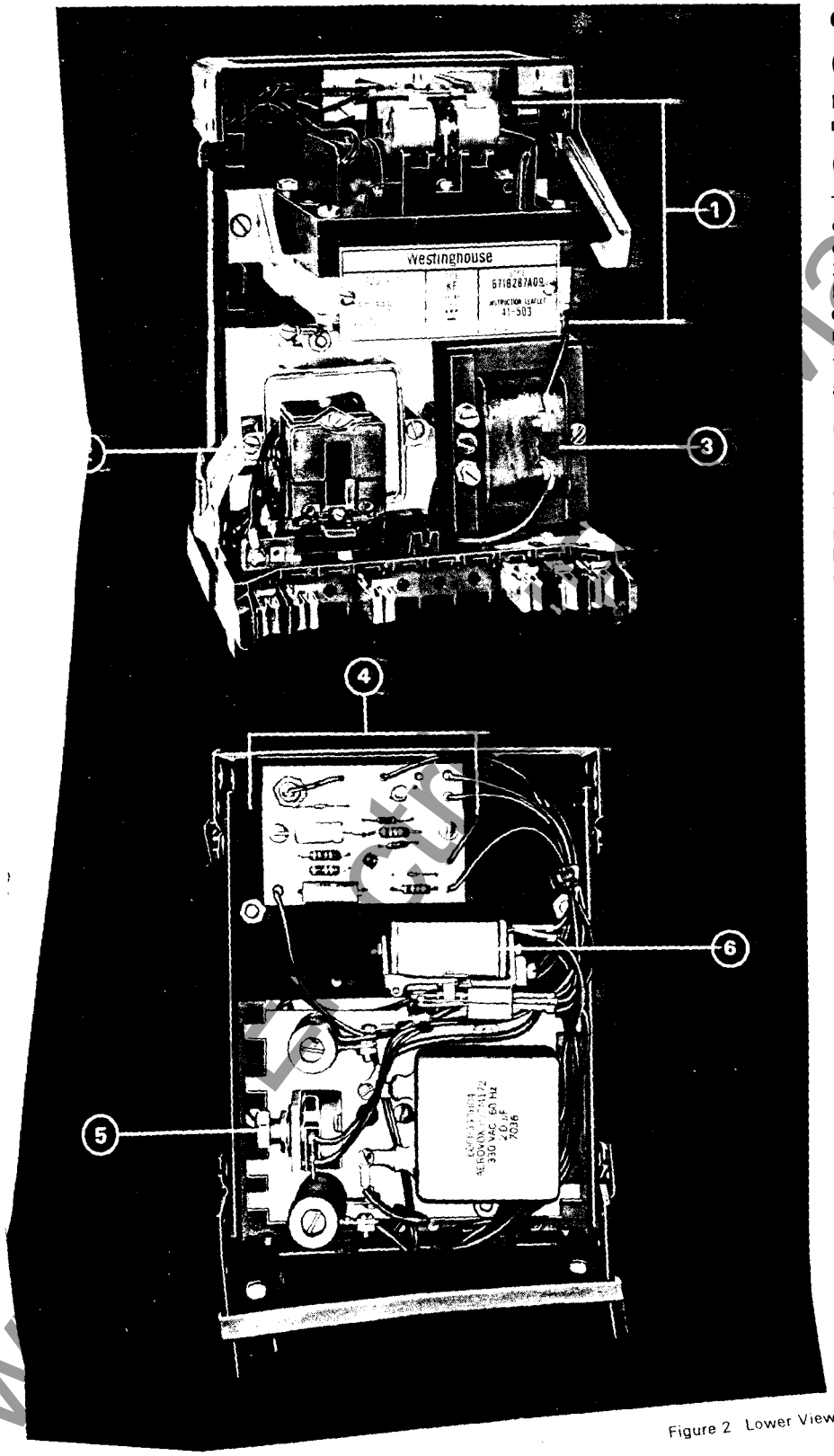

Figure 2 Lower View

Construction

1 Induction Cylinder Unit

Has positive contact opening torque at normal frequency.

2 Indicating Contactor Switch (ICS)

Taps provided for 0.2 or 2.0 amps dc pickup operation. For breaker trip circuits or for operation of a type WL lockout relay, the 2.0 amp tap is used. When the current is low, as when using an SG or MG-6 multi-contact auxiliary relay, the 0.2 amp tap is recommended.

The ICS has 6.5 ohms resistance on the 0.2 amp tap, and 0.15 ohms on the 2.0 amp tap.

3 Frequency Adjusting Reactor

Has adjustments for setting the relay to trip at the desired frequency. The minimum trip frequency can be varied over the operating range of 55-59.5 hertz. The standard 60 hertz KF relay is shipped adjusted for contact closing at 59.5 hertz, unless otherwise specified.

A locking feature is provided to prevent an accidental change in the setting.

4 Solid State Timing Circuit

5 Timer Adjustment

Also provided with a locking feature for prevention of accidental setting change.

6 Telephone Relay (T)

Provides 6 cycle delay **only** on non-adjustable KF. 6-30 cycle adjustable delay is accomplished with a rheostat connected to static timing circuit. See no. 5 above.

Contacts work against gravity.

The telephone relay and the cylinder unit have mechanical spring restraint. This combined with the solid state timing circuit make the relay virtually immune to accidental panel shock.

Type KF High-Speed Underfrequency Relay

With Solid State Timing

Operation

When the applied source frequency drops below the setting of the relay, the cylinder unit will close, energizing the solid-state timing circuit. At this point, the telephone relay is picked up and sets up tripping. The Indicating Contactor Switch (ICS) is also picked up, and will provide trip indication.

The timer will reset when the cylinder unit resets; de-energizing the telephone relay.

The time-delay unit's operation can be selected from one of three types available:

(1) Ac operation, non-adjustable (6 cycles)

(2) Ac operation, adjustable (6-30 cycles)

(3) Dc operation, adjustable (6-30 cycles)

Characteristics

Ratings

The KF relay is rated 120 volts at 60 hertz, or 120 volts at 50 hertz.

Adjustable range of frequency is 55-59.5 hertz for the 60 hertz relay, and 44-49.5 hertz for the 50 hertz relay.

Continuous rating – 110% of rated voltage.

Trip Circuit

The main contacts will close 30 amperes at 250 volts dc, and the seal-in contacts of the ICS will safely carry this long enough to trip a circuit breaker.

Trip Circuit Constants

Indicating Contactor Switch (ICS)
6.5 ohms resistance on the 0.2 amp tap.
0.15 ohms resistance on the 2.0 amp tap.

Burden

12.6 volt-amperes at 120 volts, 60 hertz.
13.4 volt-amperes at 120 volts, 50 hertz.

Timing Circuit Selection

A choice of ac or dc time delay is available. For example, where adjustable time delay is required, a KF relay with the auxiliary time delay relay energized from the tripping battery is available. The ac time delay type utilizes a full-wave bridge rectifier.

By using ac for timing circuit, the following advantage is obtained:

A single style relay is applicable for all tripping battery ratings.

A minimum delay of 6-cycles is required unless the trip circuit is supervised by another device which will be open during faults. Unbalanced faults can cause a sudden shift in the voltage phase angle, producing an apparent rapid change in frequency. The cylinder unit closes momentarily, but will not produce tripping when used with a 6-cycle telephone unit delay.

Where the relay and motor load can be readily isolated, such as a station tapped off a tie line, use a type KO-1 current detector relay, 0.5-2 amperes to supervise the KF trip circuit. Energize the KO-1 relay with one phase of the station supply current so it will reset when the station is de-energized, otherwise the motor inertia may maintain sufficient voltage to operate the KF relay and lock out the expendable feeders. KF relays with time delays as long as 30 cycles have operated for this cause. During actual underfrequency conditions, if the station load is too low to operate the KO-1 relay, no purpose is served in tripping any of its feeders.

While long delays are desirable for security, care must be exercised in load-saving applications to insure that load shedding has been completed before the frequency drops more than 3 cycles (i.e., 57 hertz on 60 hertz system). Otherwise, generation may be curtailed due to plant auxiliary motor trouble. Figure 8 shows the KF rate-of-change of frequency. With a 6-cycle delay relay set for 59.5 hertz, for example, breaker trip coil energization occurs at 0.6 cycle below "trip" frequency (59.5−0.6=58.9 hertz) for a decay rate of 2.5 Hertz per second. This rate corresponds to about 30% overload, assuming an inertia constant of H=3.

After the first priority load has been shed the decay rate will diminish. Even so, unless the overload is quite small, a 30-cycle delay is excessive if three graded frequency priorities are to be accommodated without allowing the system frequency to dip below 57 hertz on a 60-hertz system.

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Internal Wiring (Front View) 120 Volt, FT-21 Case
55-59.5 Hertz Adjustable Frequency Range, Spdt Contacts

With Ac Operated Auxiliary Time Delay Unit

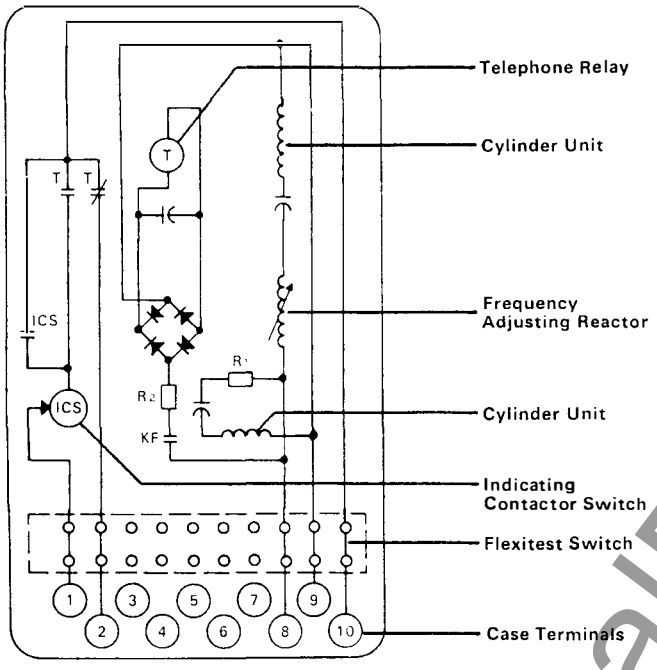

Figure 3 861A659

With Ac Operated Adjustable Auxiliary Time Delay Unit

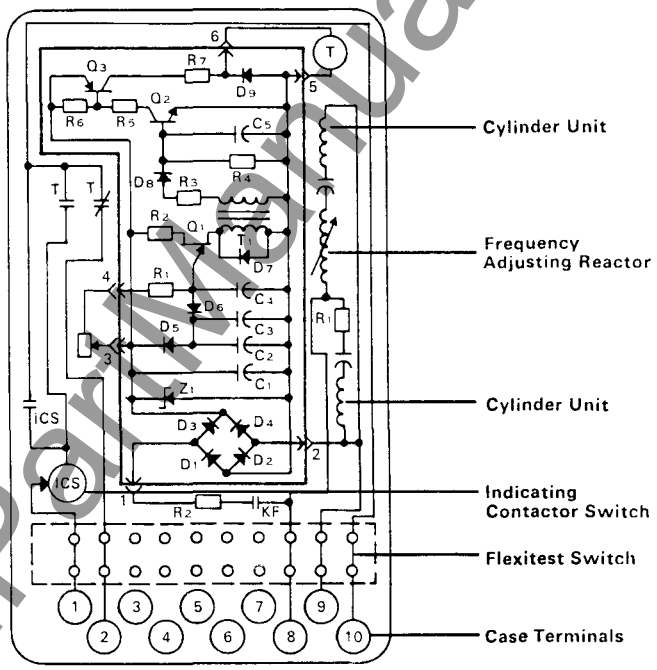

Figure 5 862A525 Sub. 2

With Dc Operated Adjustable Auxiliary Time Delay Unit

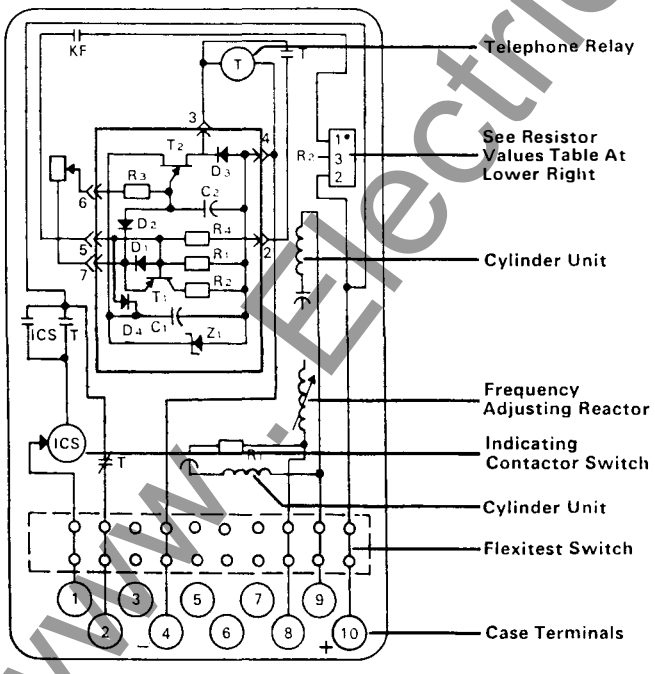

Figure 4

Relay Rating	Trip Voltage	Lead Position	Resistance Value
48/125	48	3	420 Ohms
	125	2	2000 Ohms

849A318 Sub. 7

Type KF High-Speed Underfrequency Relay

With Solid State Timing

Characteristic Curves (60 Hertz)

Temperature

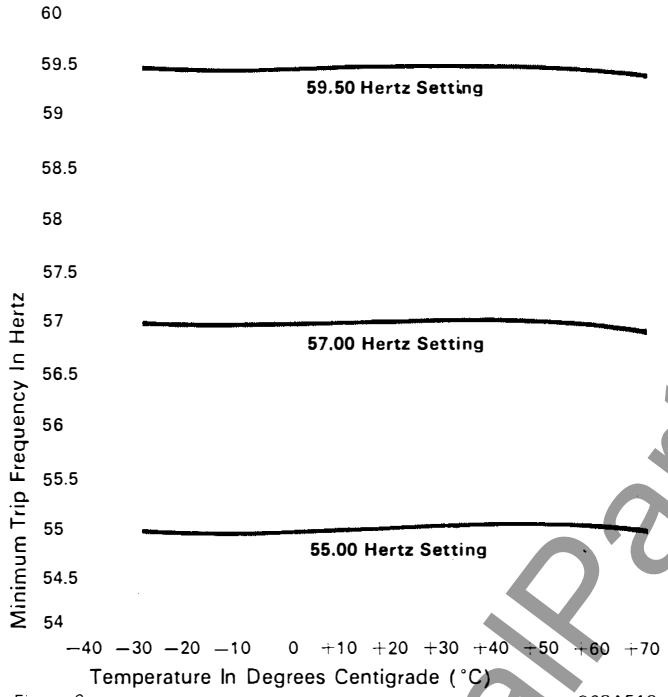

Figure 6 863A519

Voltage

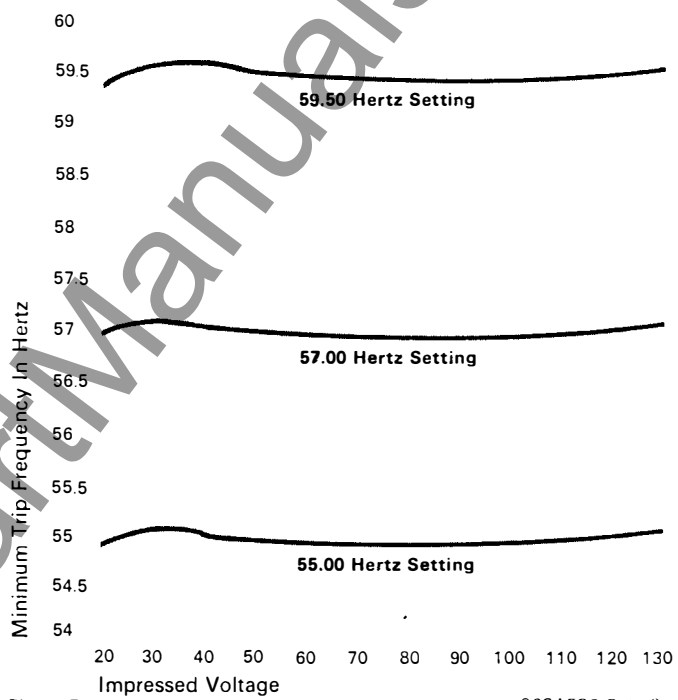

Figure 7 863A520 Sub. 2

Rate Of Change

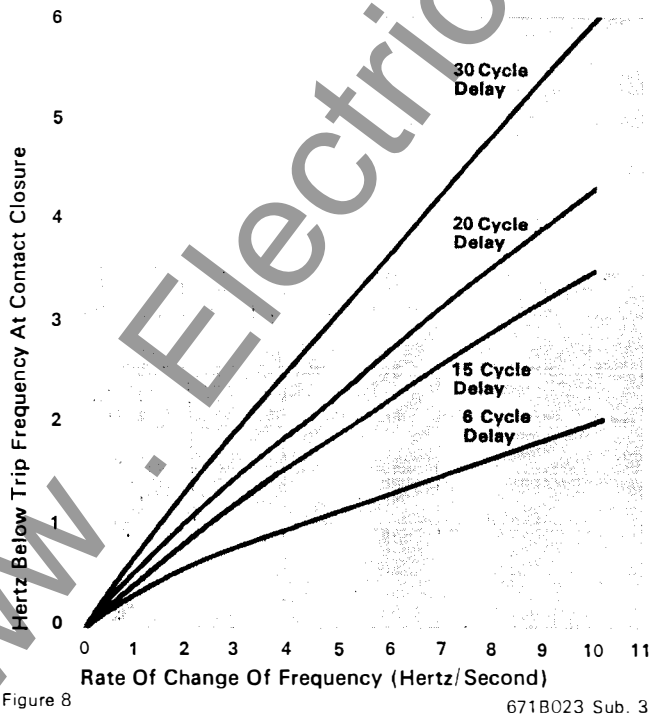

Figure 8 671B023 Sub. 3

Warm-Up

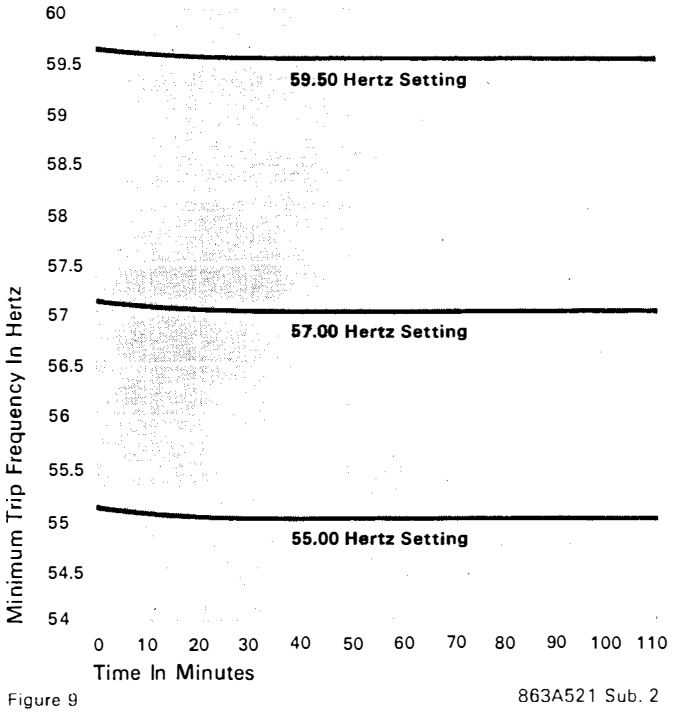

Figure 9 863A521 Sub. 2

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External Connections
Without Time Delay (120 Volts, 60 Hertz)

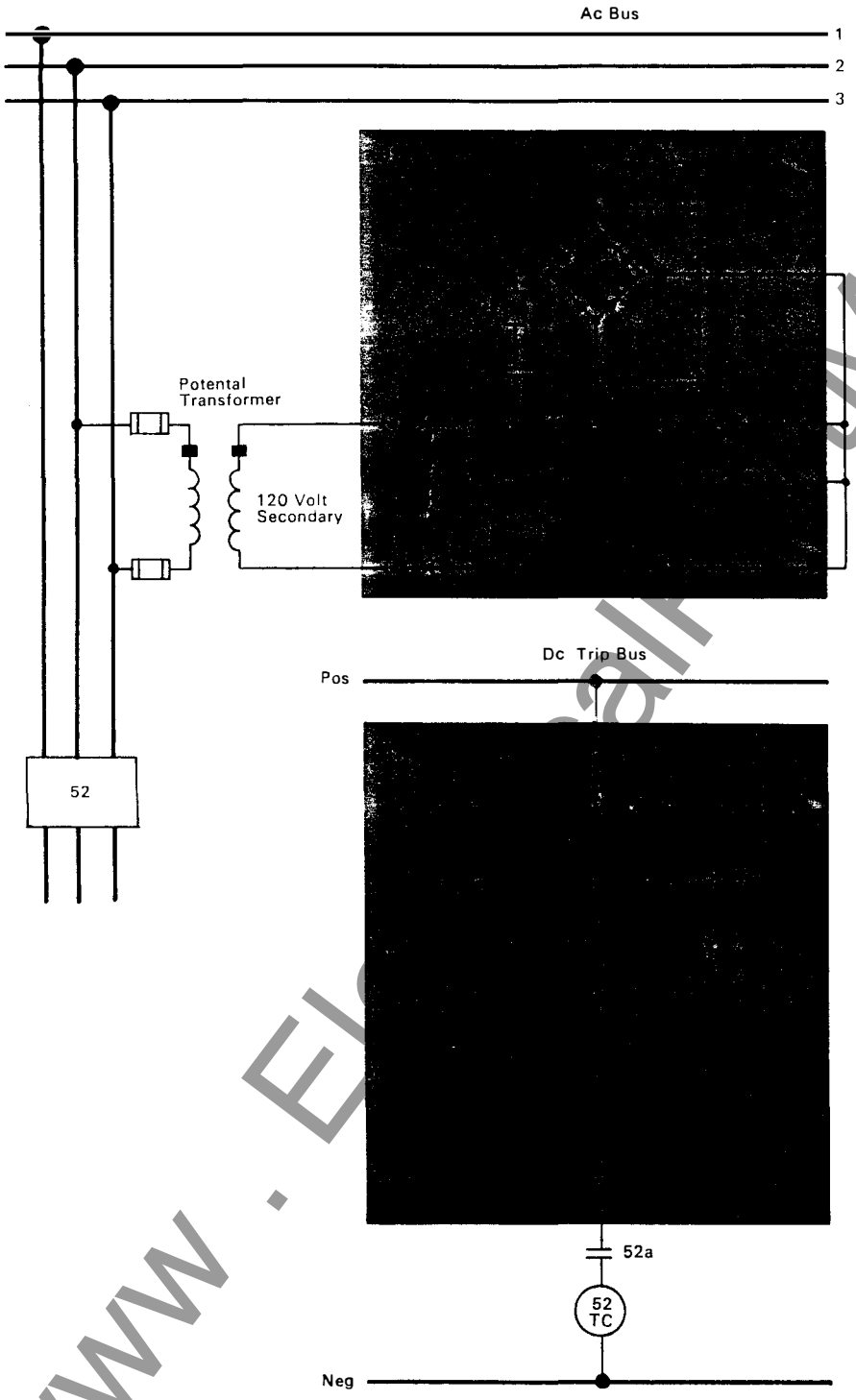


Figure 10

762A574 Sub. 6

Type KF
High-Speed
Underfrequency Relay

With Solid State Timing

External Connections
With Fixed Time Delay (120 Volts, 50 or 60 Hertz)

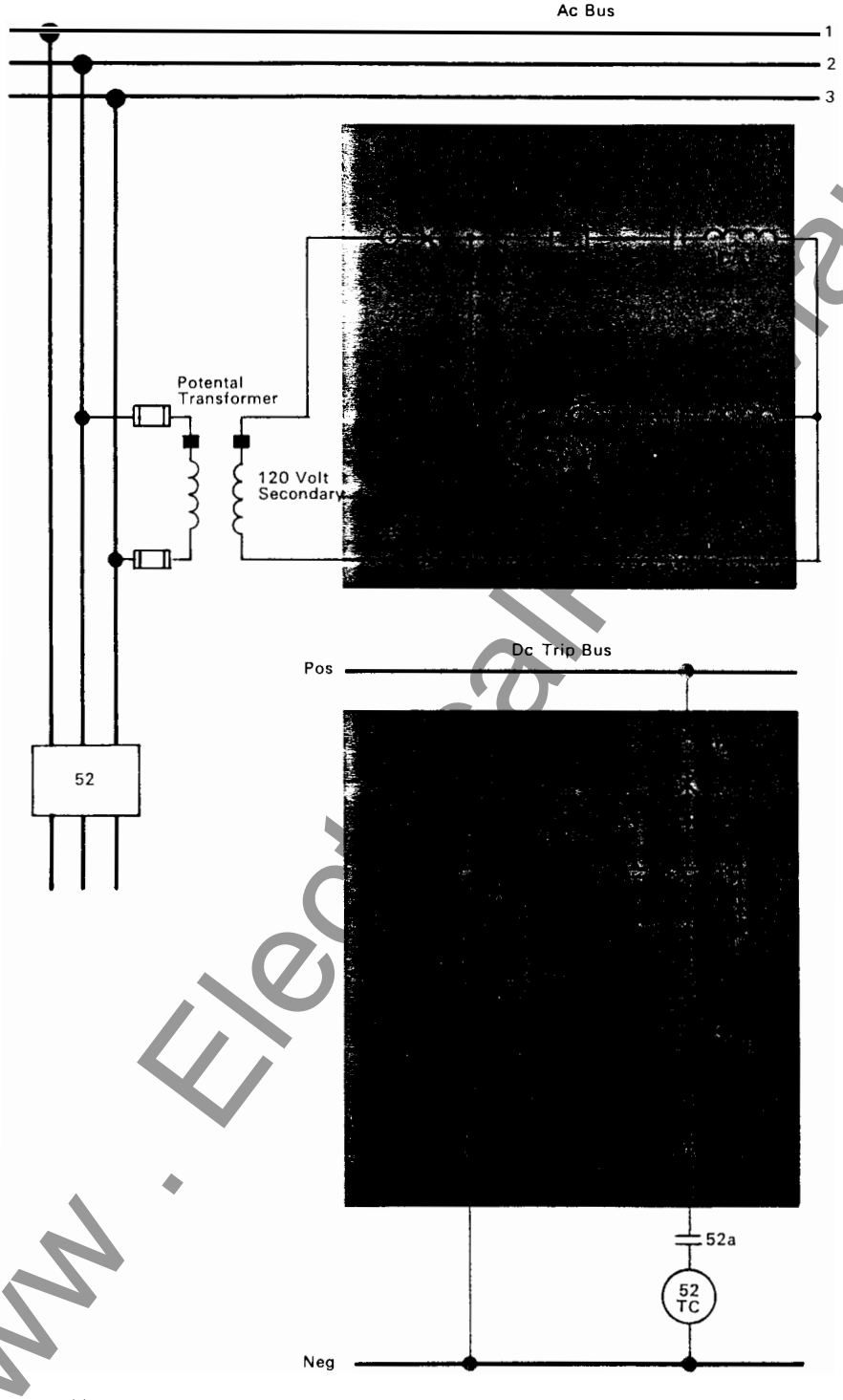


Figure 11

849A178 Sub. 3

Type KF
High-Speed
Underfrequency Relay

With Solid State Timing

Shipping Weights and Carton Dimensions

Type	Flexitest Case Size	Weight: Lbs.		Domestic Shipping Carton Dimensions: Inches
		Net	Shipping	
KF	FT-21	12	16	9 x 12 x 13

Further Information

Prices, Style Numbers, Ordering Information: PL 41-020

Instructions: IL 41-503

FT-21 Case Dimensions: DB 41-075

Other Protective Relays: Selector Guide 41-000

Westinghouse Electric Corporation
Relay-Instrument Division, Newark, N. J. 07101
Printed in USA

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY RELAY IN FT-21 CASE

APPLICATION

The type KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, an auxiliary time delay unit (T), and a full wave bridge. The principal parts of the relay can be seen in Figures 1 and 2.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

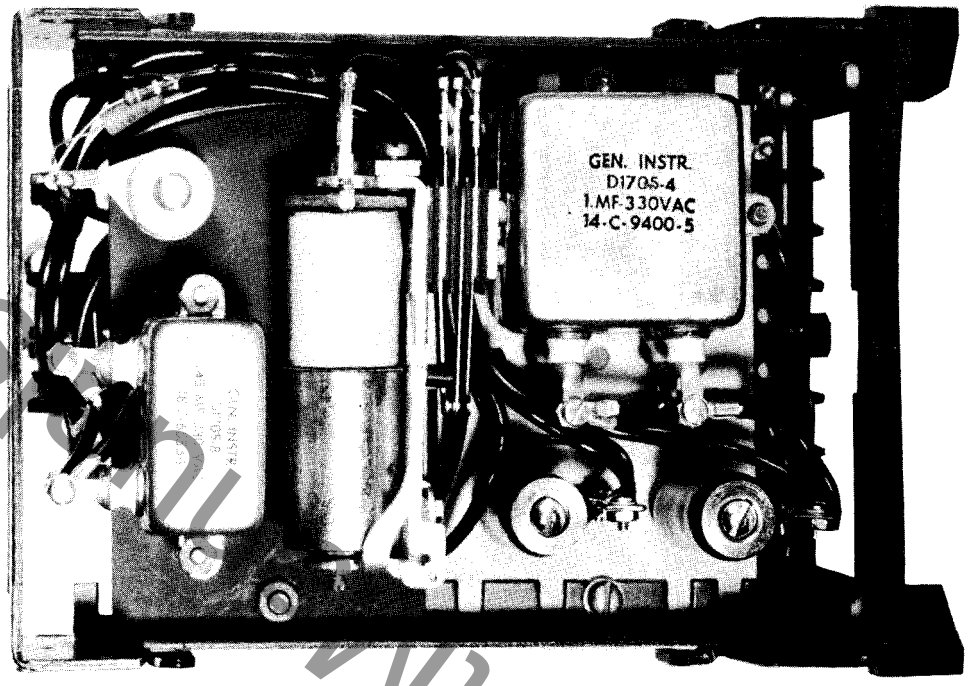
B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

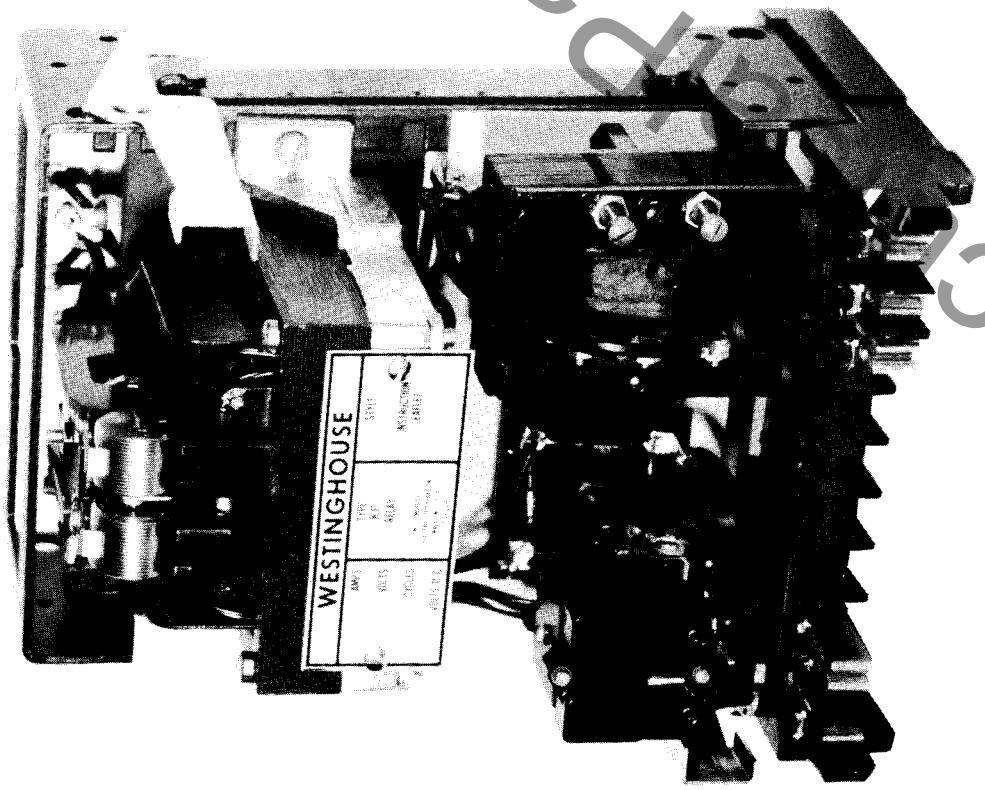
The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.



Rear View



Front View

Fig. 1 Type KF Relay Without Case (Front & Rear View)

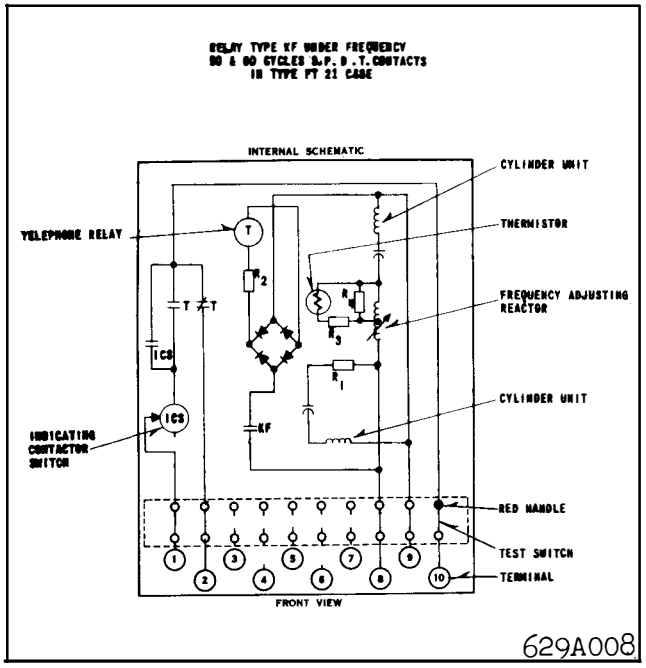


Fig. 2 Internal Schematic of the Type KF Relay.

D. Auxiliary Time Delay Unit

This slugged telephone type unit in conjunction with a resistor, and full wave bridge provides a 2-cycle delay on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applied source frequency is below a preset value. The voltage-frequency curve is shown in Figure 3 and the temperature-frequency curve is shown in Figure 4.

Rating

The type KF underfrequency relay is rated 120 volts at 60 cycles. The adjustable range of frequency is 55 to 59.5 cycles.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

The burden of the KF relay is 12.6 VA at 120 volts, 60 cycles.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

A. Induction Cylinder Unit

1. Contact Gap – The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.

2. Sensitivity – The relay should trip when energized with 120 volts and a source frequency of 59.5 cycles.

B. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the

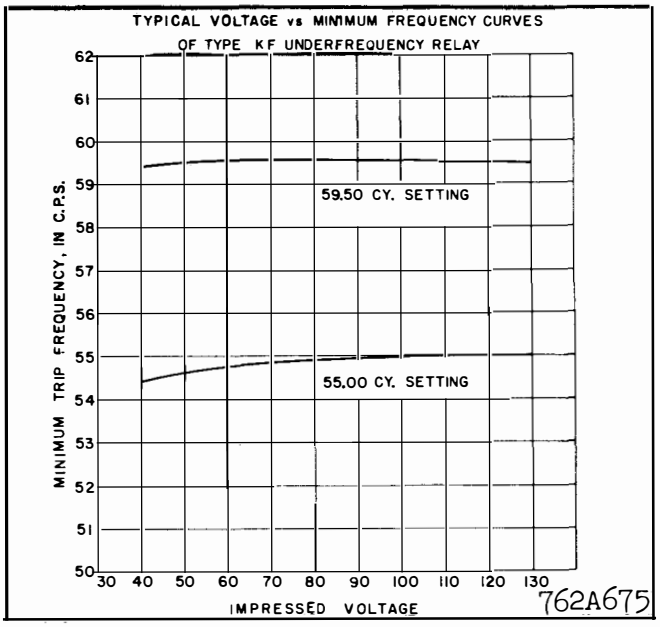


Fig. 3 Typical Voltage-Minimum Frequency Curves of the Type KF Underfrequency Relay.

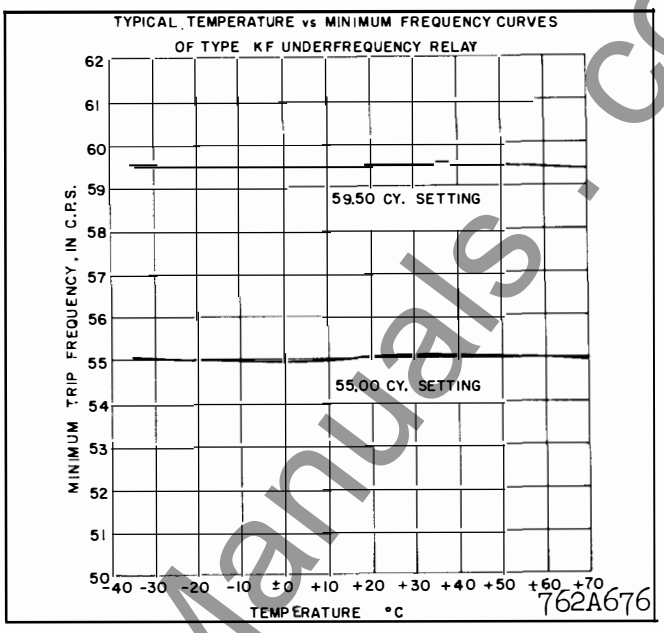


Fig. 4 Typical Temperature-Minimum Frequency Curves of the Type KF Underfrequency Relay.

particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047'' between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

Auxiliary Time Delay Unit (T)

Apply 50 volts a.c. to terminals 8 and 9. Manually close the contacts of the induction cylinder unit. The T unit should operate. Reduce voltage to 30 volts. The T unit should drop out.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus imparing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See ''Acceptance Check'').

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025'' clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

   With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

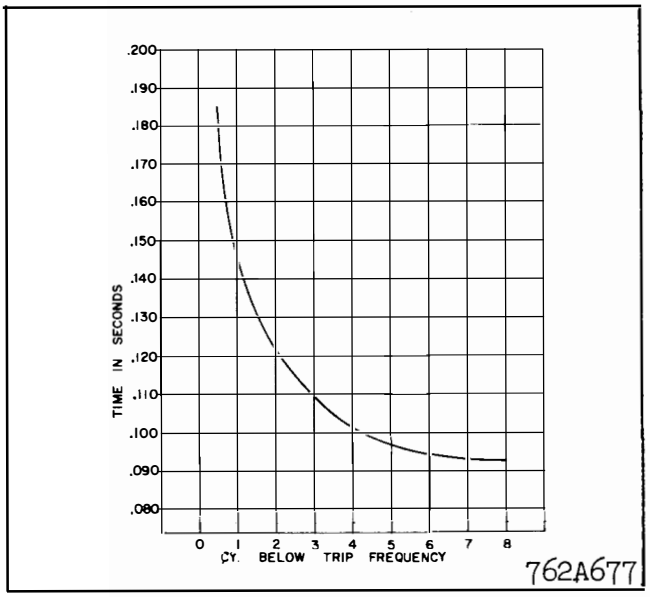


Fig. 5 Typical Frequency-Time in Seconds Curve of the Type KF Underfrequency Relay.

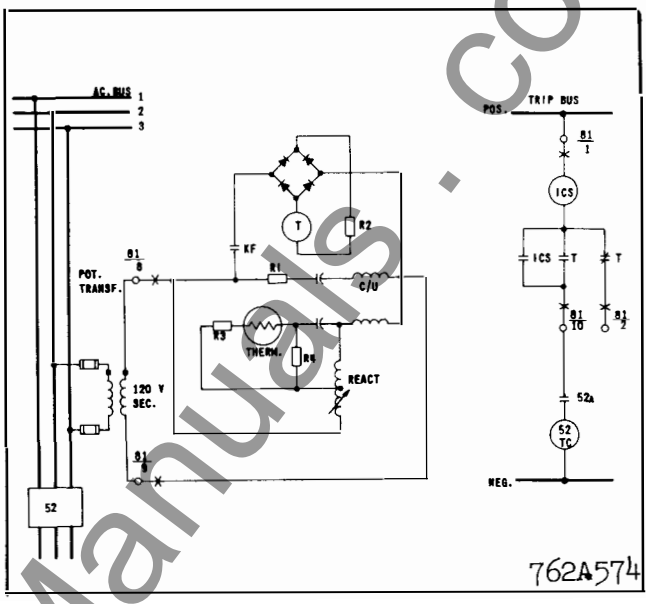


Fig. 6 External Connections for the Type KF Underfrequency Relay.

The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 1/8 of a turn in the same direction.

B. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

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.

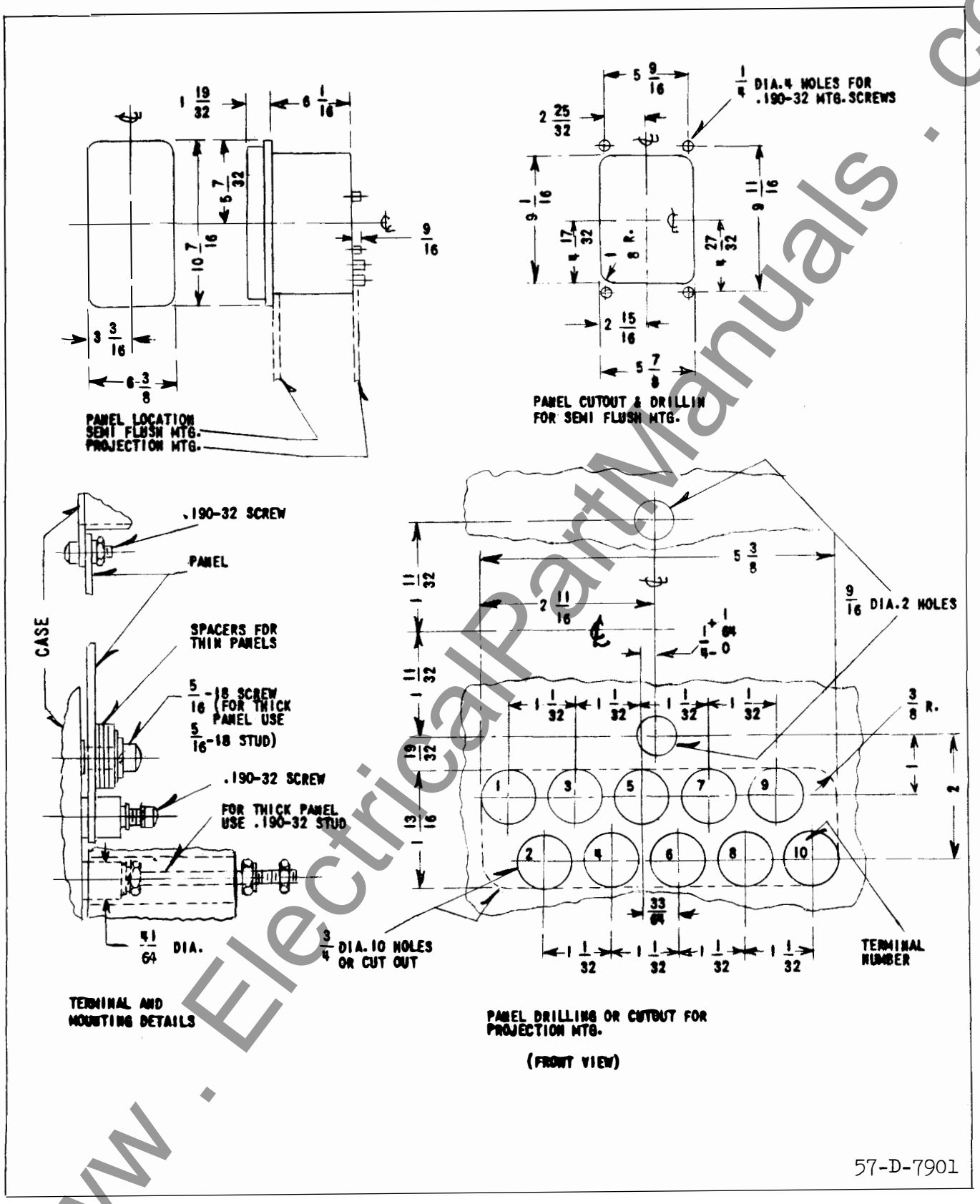
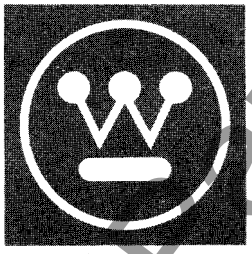


Fig. 7 Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.



WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, an auxiliary time delay unit (T), and a full wave bridge. The principal parts of the relay can be seen in Figures 1.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of

SUPERSEDES I.L. 41-503B
*Denotes changes from superseded issue.

EFFECTIVE NOVEMBER 1965

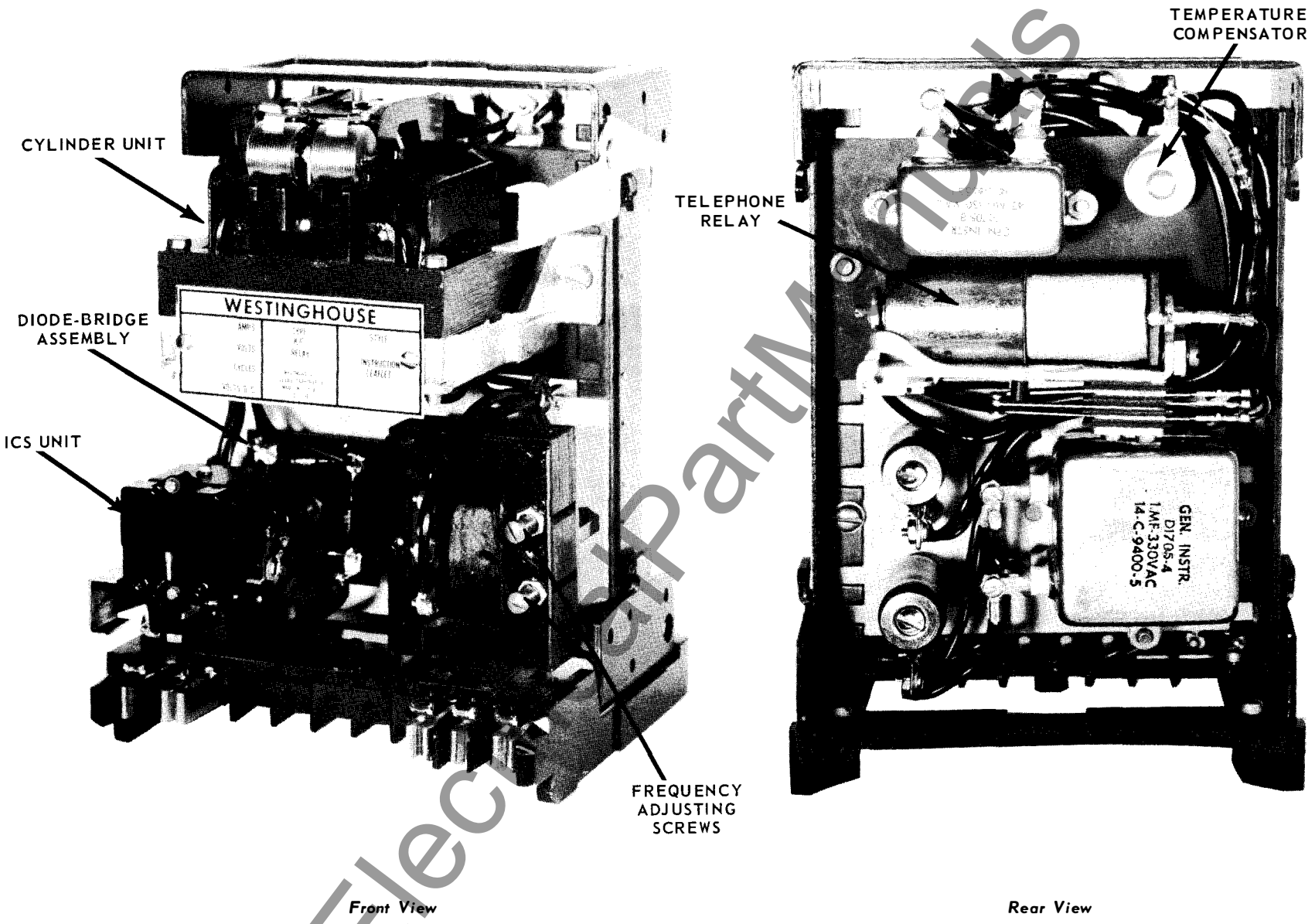
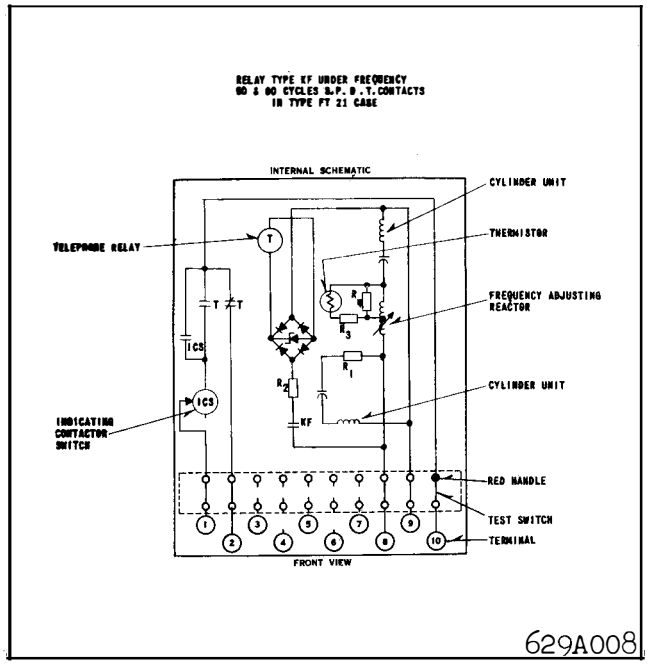


Fig. 1 Type KF Relay for 60 Cycles Without Case. (Front & Rear View)



* *Fig. 2 Internal Schematic of the Type KF Relay.*

capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

This slugged telephone type unit in conjunction with a resistor, and full wave bridge provides a 2-cycle delay on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applied source frequency is below a preset value. The 60 cycle voltage-frequency curve is shown in Figure 3 and the temperature-frequency curve is shown in Figure 4. The 50 cycle voltage-frequency curve is shown in Figure 6, and the temperature-frequency curve is shown in Figure 7. Typical 60 cycle and 50 cycle contact closing time curves are shown in figures 5 and 8 respectively.

Rating

The type KF underfrequency relay is rated 120 volts at 60 cycles, or 120 volts at 50 cycles. The adjustable range of frequency is 55 to 59.5 cycles for the 60 cycle relay and 44 to 49.5 cycles for the 50 cycle relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

The burden of the KF relay is 12.6 VA at 120 volts for the 60 cycle relay, and 13.4 VA at 120 volts for the 50 cycle relay.

SETTINGS

* The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ cycle below rated frequent unless otherwise specified. Turning either of the in a clockwise direction decreases the frequency at which the relay trips. The frequency-time curves shown in figure 5 to 8 is drawn for variations of frequency in cycles below the trip frequency.

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation

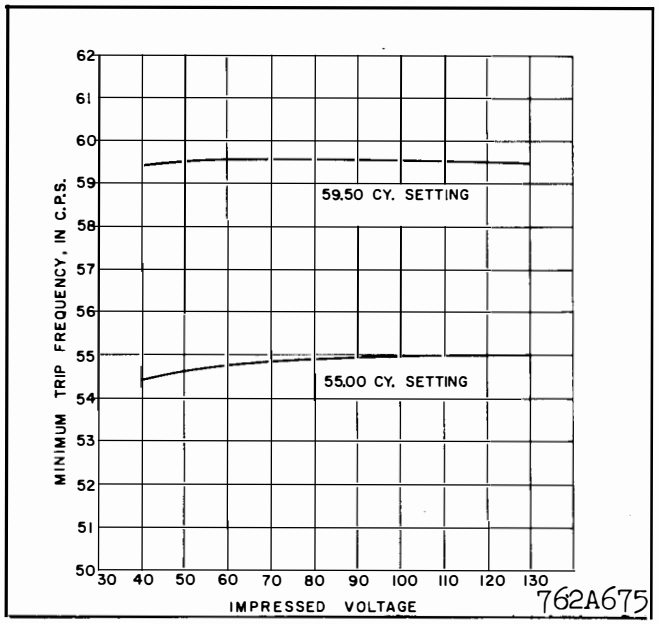


Fig. 3 Typical Voltage-Minimum Frequency Curves of the 60 cycle underfrequency relay.

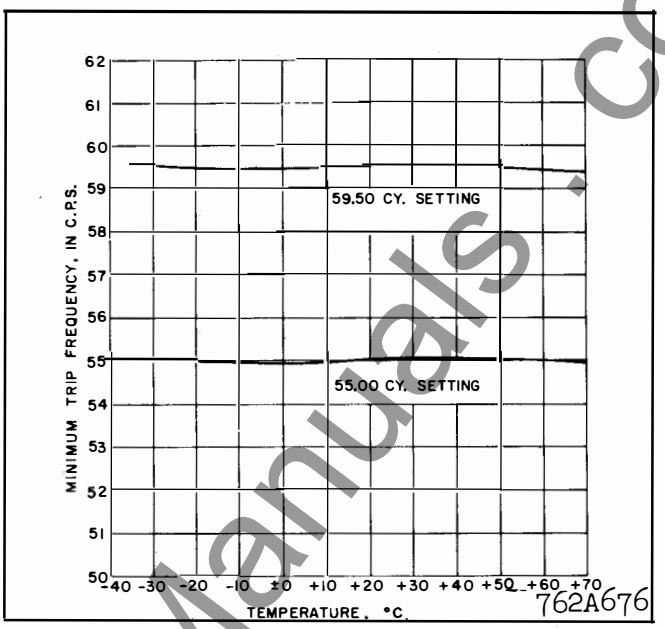


Fig. 4 Typical Temperature-Minimum Frequency Curves of the 60 cycle KF underfrequency relay.

of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

Contact Gap — The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.

B. Frequency Adjusting Reactor

* 1. Minimum trip — Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 cycles, for the 60 cycle relay and 49.5 cycles for the 50 cycle relay.

* 2. Time Curve — Apply 120V, rated frequency to the relay for at least 1 hour to allow the relay to reach normal operating temperature. Deenergize the relay and instantaneously apply 120V at three cycles below the trip frequency. The relay contacts should close in .100 ± .006 seconds.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

Apply 50 volts a.c. to terminals 8 and 9. Manually close the contacts of the induction cylinder unit. The T unit should operate. Reduce voltage to 30 volts. The T unit should drop out.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

All contacts should be periodically cleaned. A

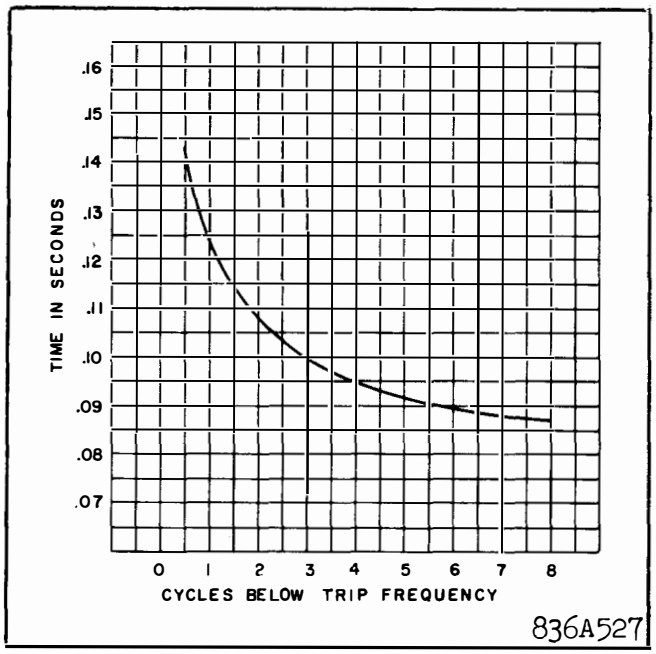


*Fig. 5 Typical Frequency-Time Curve of the 60 cycle KF Underfrequency Relay.

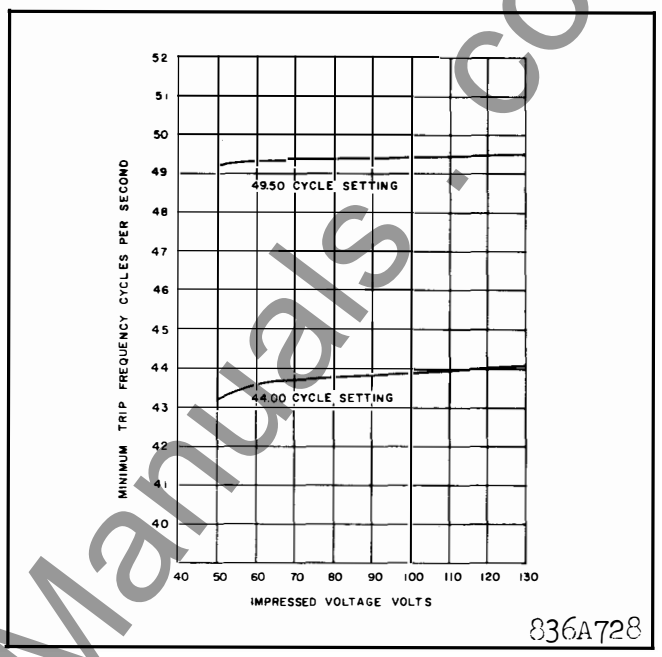


Fig. 6 Typical voltage-minimum trip frequency curves of the 50 cycle KF underfrequency relay.

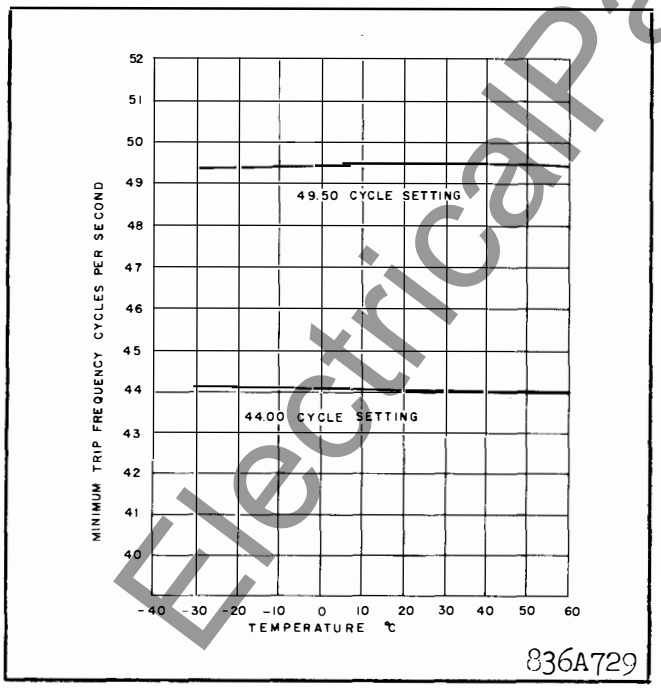


Fig. 7 Typical temperature-minimum trip frequency curves of the 50 cycle KF underfrequency relay.

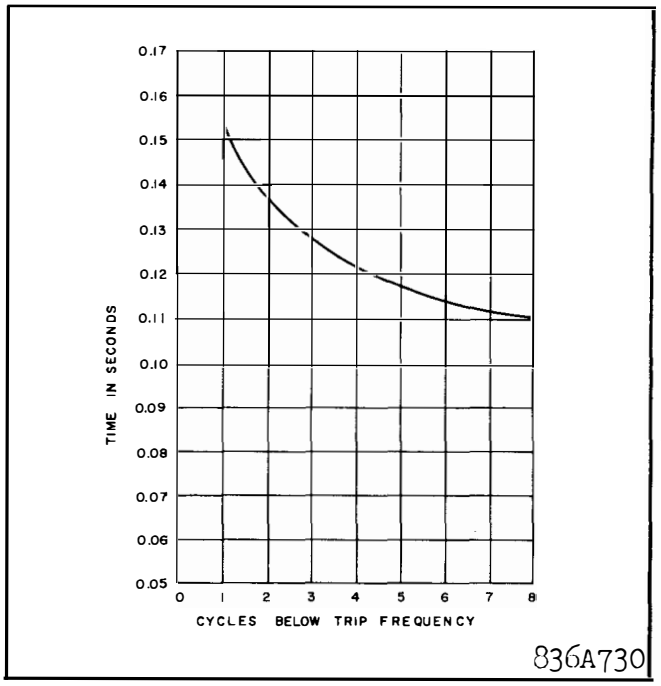


Fig. 8 Typical frequency-time curve of the 50 cycle KF underfrequency relay.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See "Acceptance Check").

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.
2. The contact gap adjustment for the cylinder unit is made as follows:

   With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

   The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

   The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.
3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

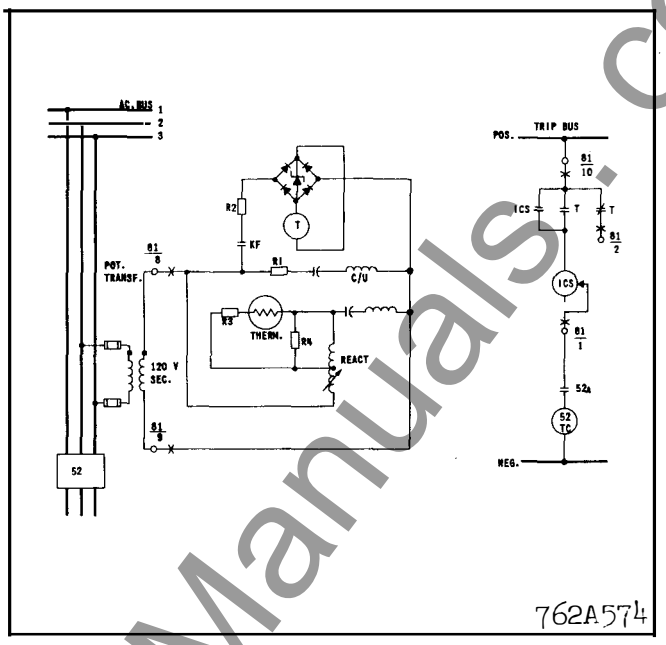


Fig. 9 External Connections for the Type KF Underfrequency Relay.

The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 1/8 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to the desired value and adjust the screws in the reactor (see Figure 1) until the cylinder unit contact closes to the left.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

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.

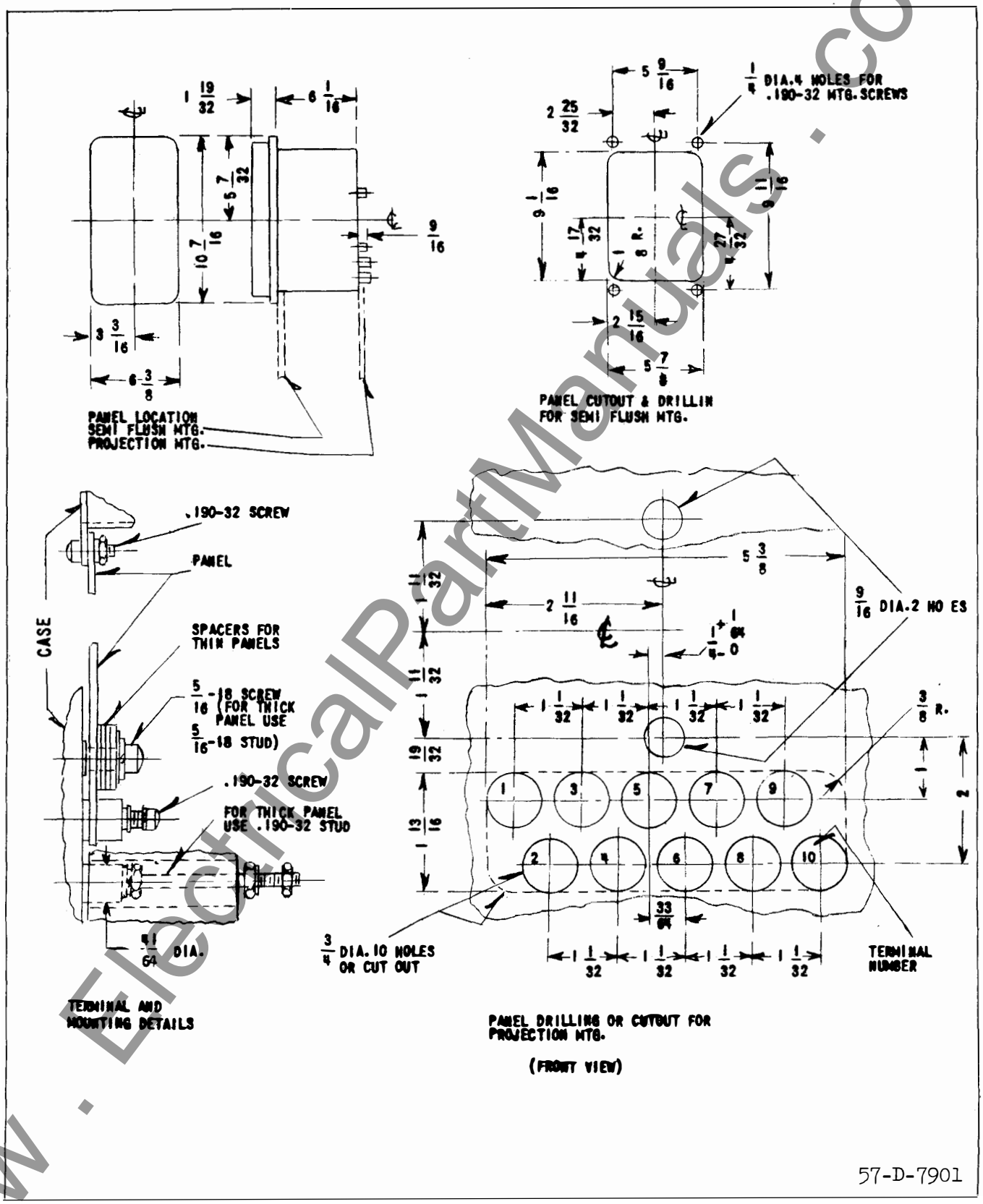


Fig. 10 Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, and auxiliary time delay unit(T), and a full wave bridge. The principal parts of the relay can be seen in Figure 1.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

SUPERSEDES I.L. 41-503C
Complete Revision

EFFECTIVE OCTOBER 1966

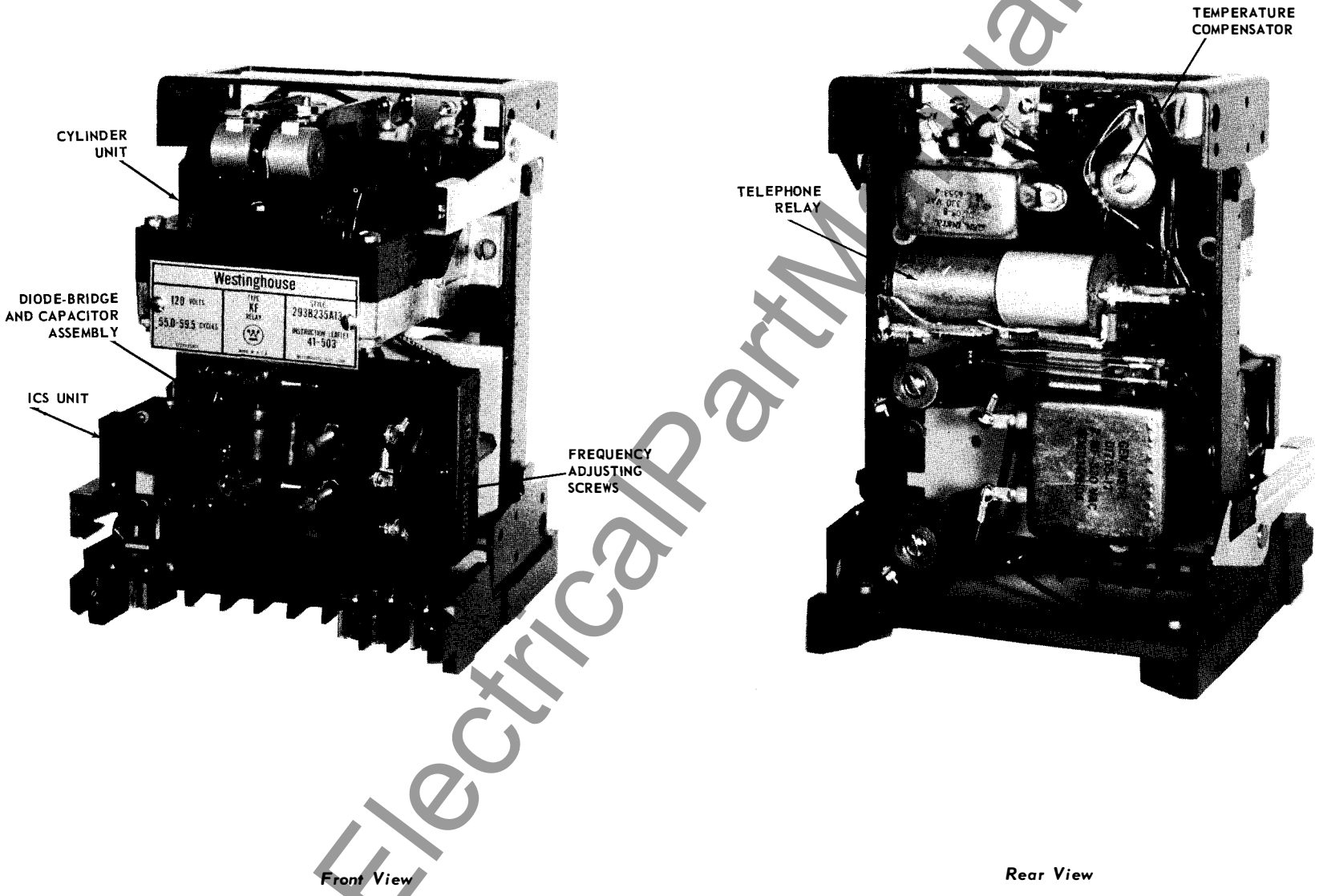


Fig. 1. Type KF Relay for 60 Cycles Without Case. (Front & Rear View)

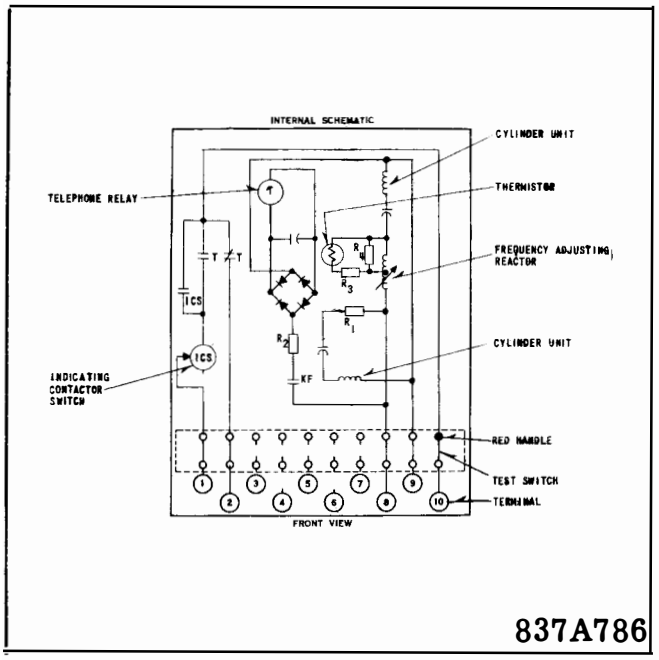


Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.

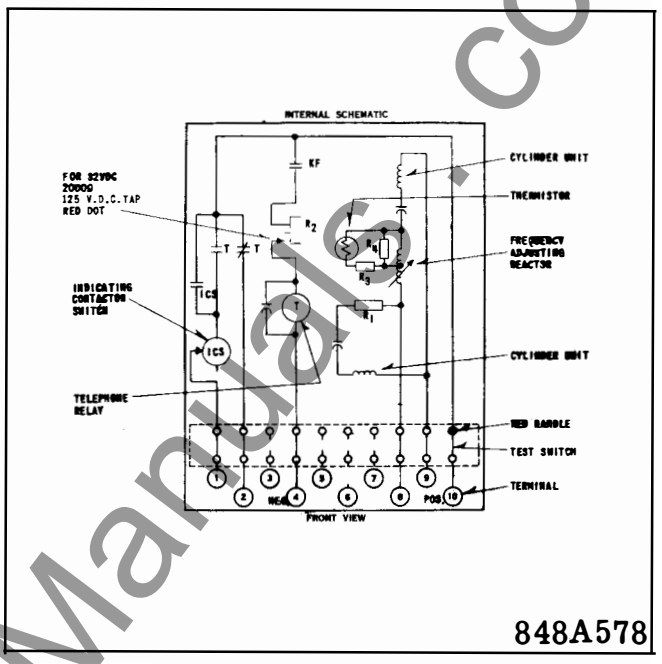


Fig. 3. Internal Schematic of Type KF Relay with D.C. Operated Auxiliary Time Delay Unit.

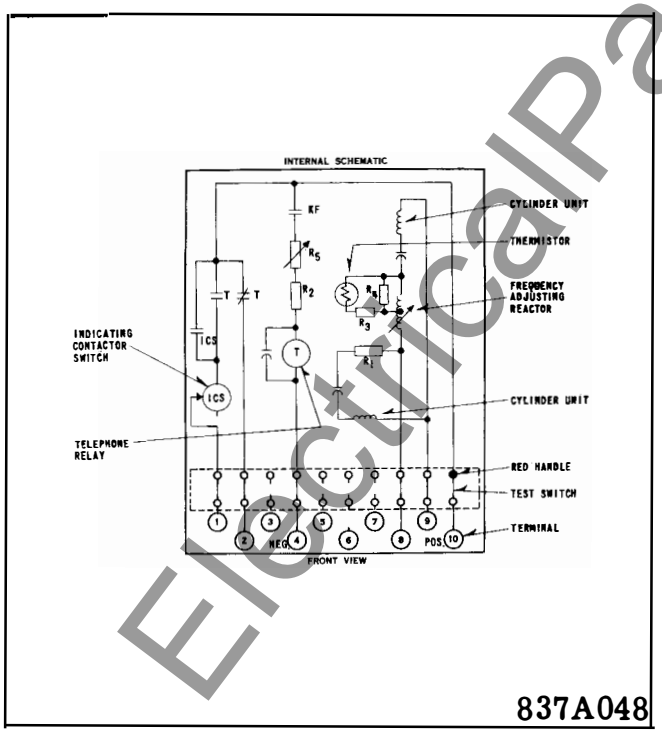


Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

1. A.C. operation - This slugged telephone type unit in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-ups when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

2. D.C. operation - This telephone unit in conjunction with resistor, potentiometer, and parallel capacitor provides various time delays (i.e. 6 cycle, 15 to 20 cycle adjustable, 20 cycle and 30 cycle time delay) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applied source frequency is below a preset value. The 60 cycle voltage-frequency curve is shown in Figure 5. The operating characteristic curves for the

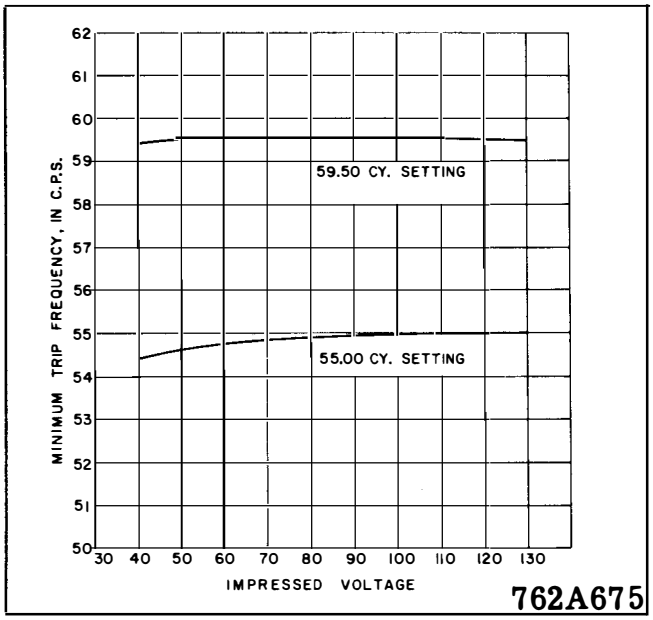


Fig. 5 Typical Voltage-Minimum Frequency Curves of the 60 cycle underfrequency relay.

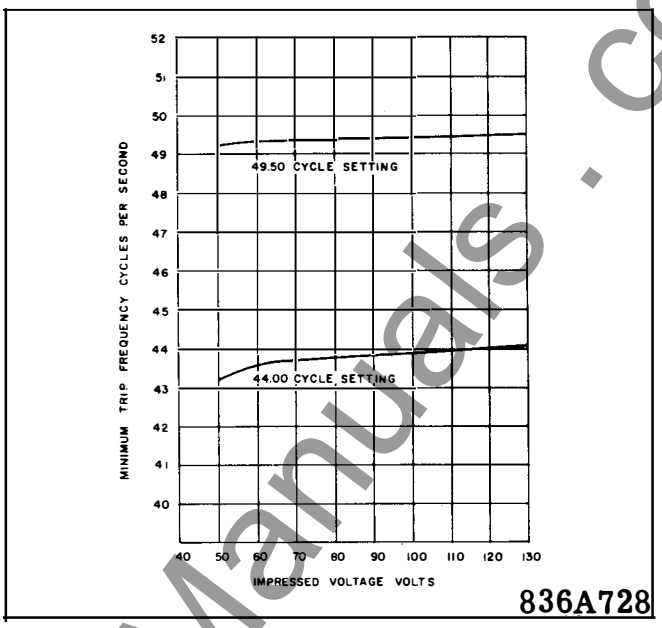


Fig. 6 Typical voltage-minimum trip frequency curves of the 50 cycle KF underfrequency relay.

various auxiliary time delay units for changing frequency conditions is shown in Figure 7. The 50 cycle voltage-frequency curve is shown in Figure 6.

Rating

The type KF underfrequency relay is rated 120 volts at 60 cycles, or 120 volts at 50 cycles. The adjustable range of frequency is 55 to 59.5 cycles for the 60 cycle relay and 44 to 49.5 cycles for the 50 cycle relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

The burden of the KF relay is 12.6 VA at 120 volts for the 60 cycle relay, and 13.4 VA at 120 volts for the 50 cycle relay.

SETTINGS

The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ cycle below rated frequency unless otherwise specified. Turning either of screws in a clockwise direction decreases the frequency at which the relay trips. The rate of change of frequency per second versus cycles below trip frequency is shown in Figure 5 for various time delays.

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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

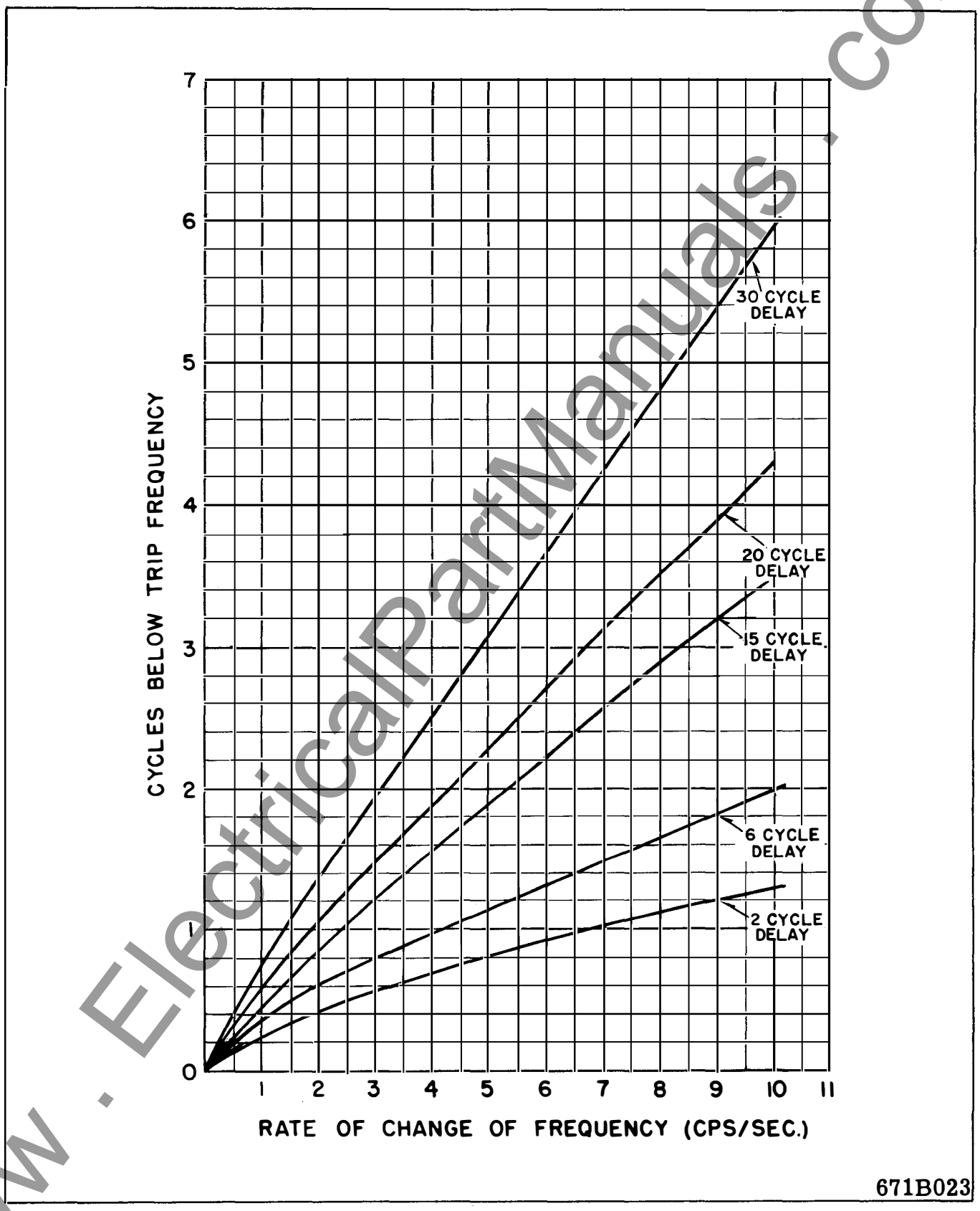


Fig. 7. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.

vertically by means of the mounting stud 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 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

Contact Gap - The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.

B. Frequency Adjusting Reactor

Minimum trip - Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 cycles, for the 60 cycle relay and 49.5 cycles for the 50 cycle relay.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

1. A.C. operation - Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from telephone relay should be per table 1.

2. D.C. operation - Block cylinder unit contacts closed. Energize terminals 10 and 4 with rated d.c. voltage. The time delay obtained from telephone relay should be per table 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See "Acceptance Check").

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock

TABLE I

Relay Style Number	Time Delay Cycles	Rated Voltage Time Delay Circuit	Voltage VAC	Frequency CPS
293B235A10	15 to 20	125 VDC	120	60
293B235A11	6	125 VDC	120	60
293B235A13	6	120 VAC	120	60
293B235A14	△ 2	120 VAC	120	60
293B235A15	15 to 20	48 VDC	120	60
293B235A16	20	48/125 VDC	120	60
293B235A17	30	48/125 VDC	120	60
293B235A18	△ None	—	120	60

△ These style relays must be used with external time delay units so that minimum time delay would be 6 cycles.

nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

   With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

   The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

   The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver of similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster ¼ of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to the desired value and adjust the screws in the reactor (see Figure 1) until the cylinder unit contact closes to the left.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

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.

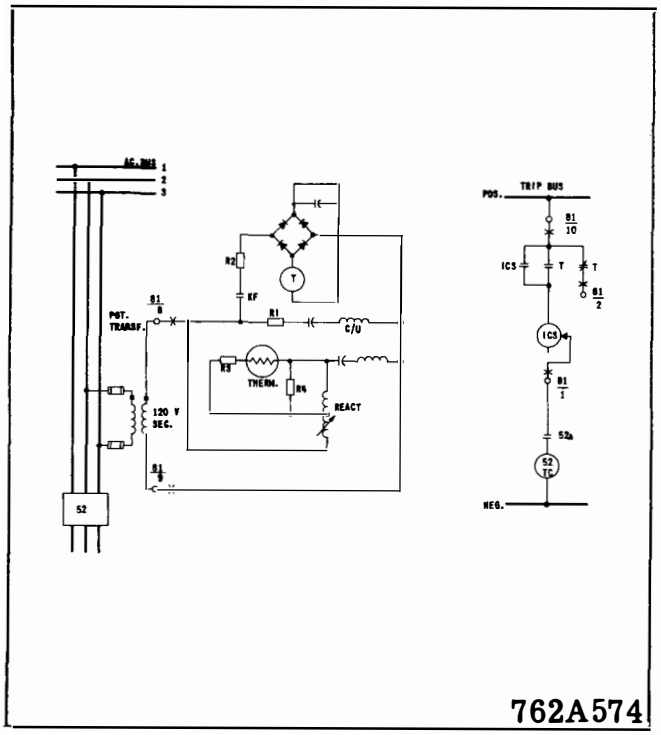


Fig. 8. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.

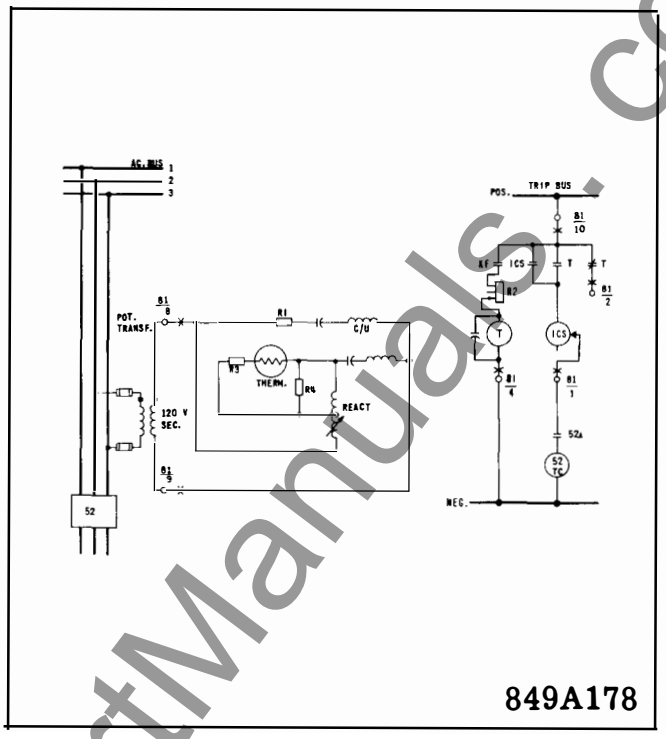


Fig. 9. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.

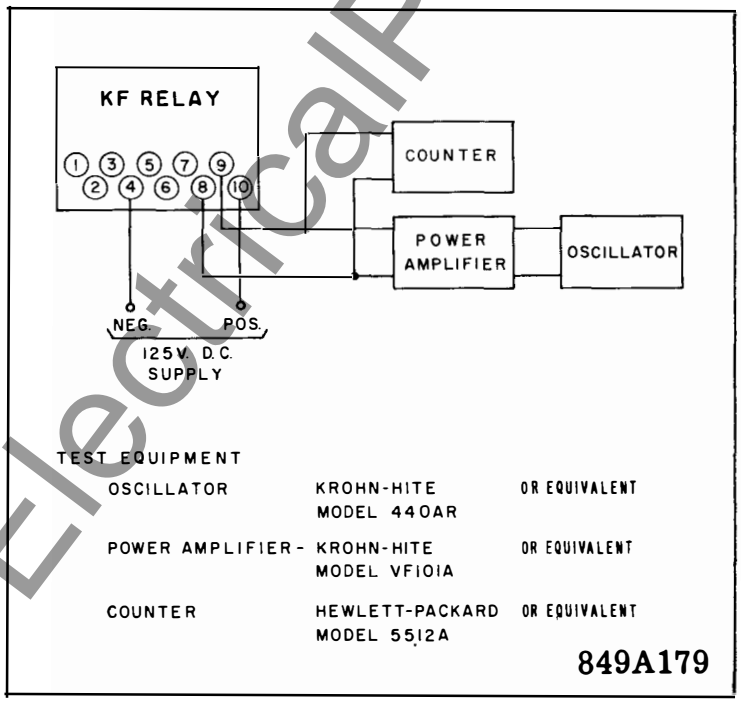


Fig. 10. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.

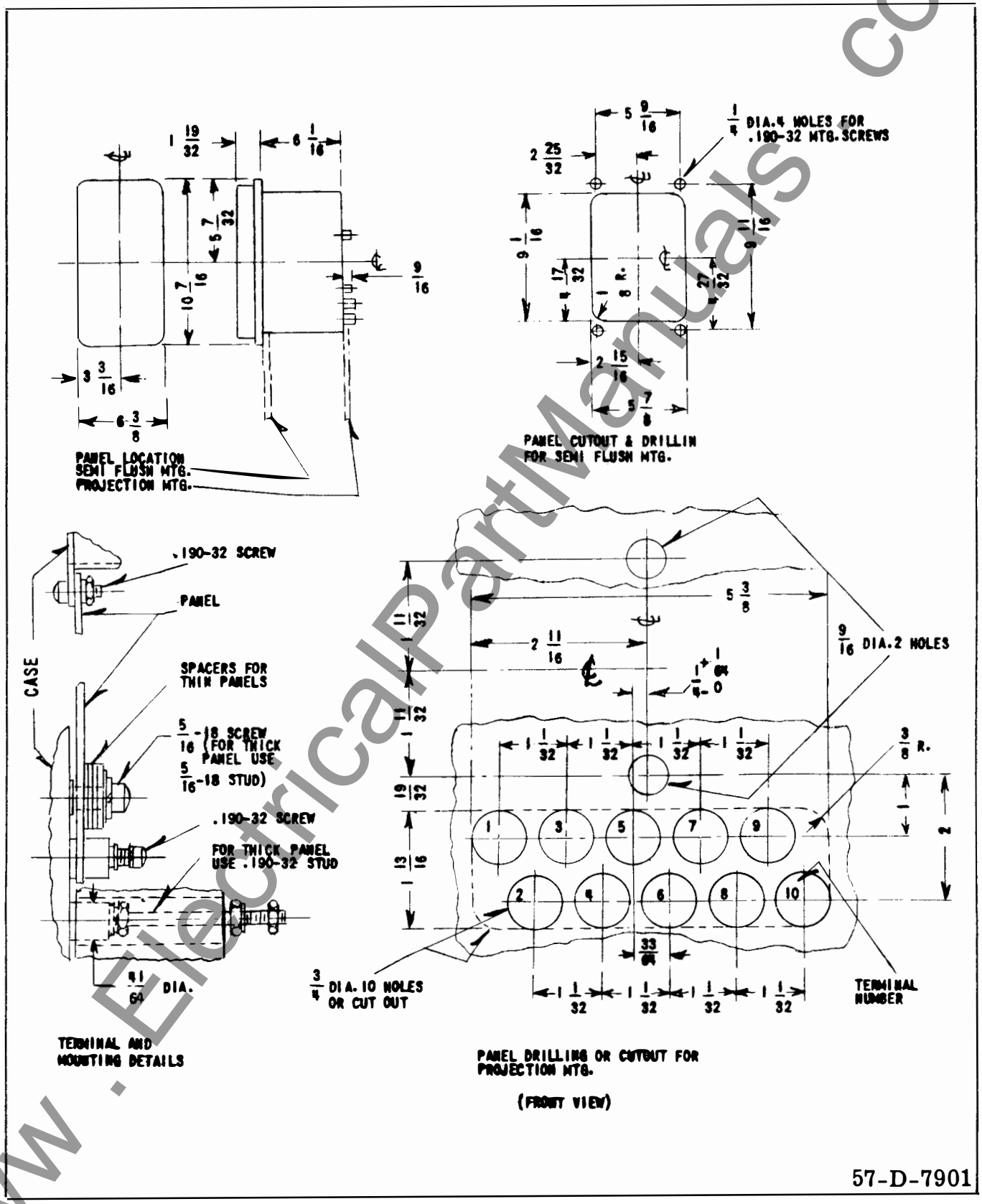
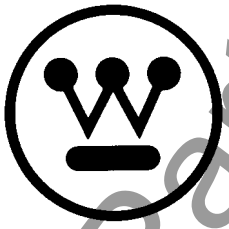


Fig. 11 Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.



WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

* The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, and auxiliary time delay unit (T). The principal parts of the relay can be seen in Figure 1.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

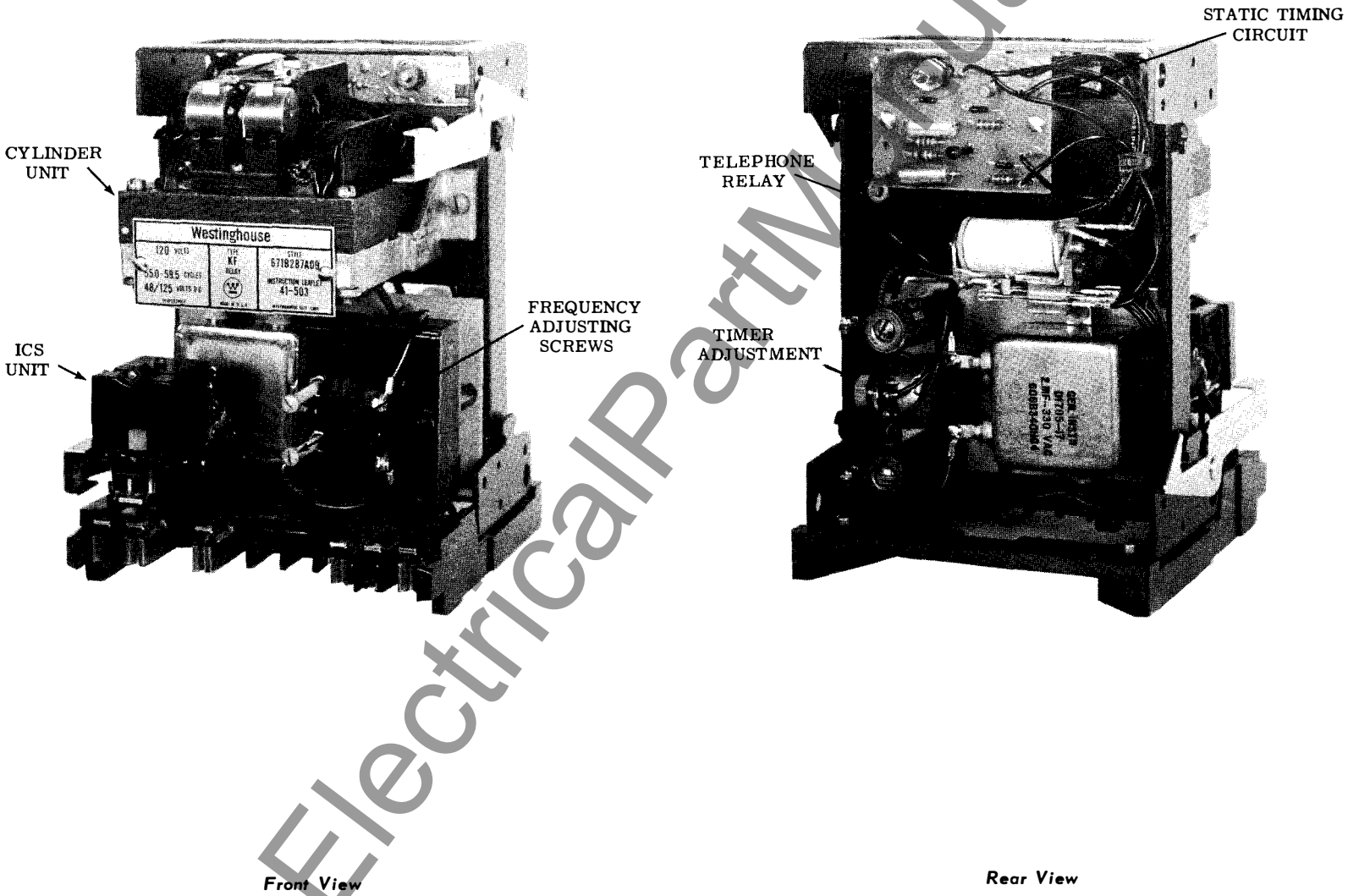
The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

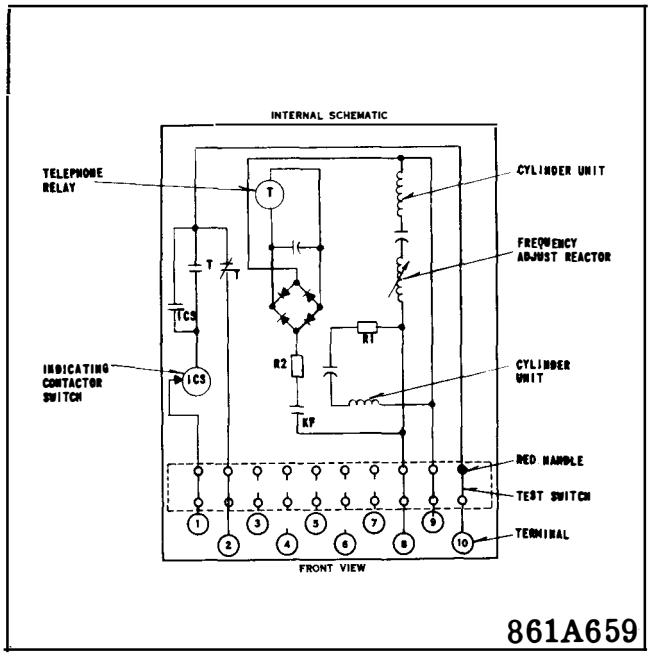
The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

SUPERSEDES I.L. 41-503D
*Denotes change from superseded issue.

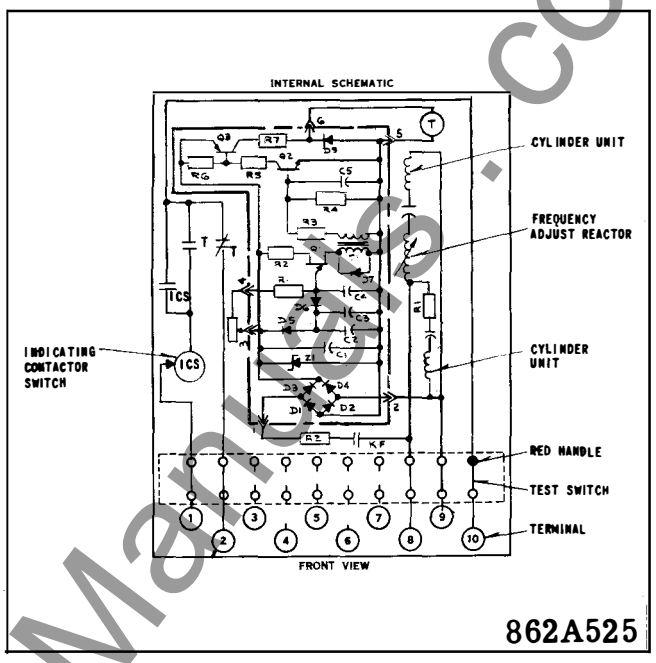
EFFECTIVE DECEMBER 1967



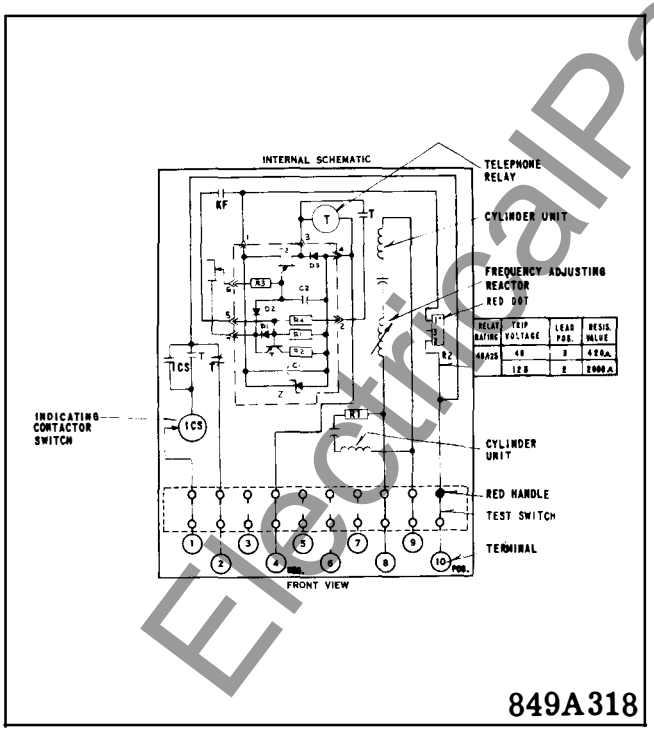
* *Fig. 1. Type KF Relay for 60 Cycles Without Case. (Front & Rear View)*



** Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.*



** Fig. 3. Internal Schematic of Type KF Relay with A.C. Operated Adjustable Auxiliary Time Delay Unit.*



** Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.*

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

* 1. A.C. Operation – Non-Adjustable
This slugged telephone type relay in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-ups when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

* 2. A.C. Operation – Adjustable
This telephone relay in conjunction with a static timing circuit and full wave bridge provides adjustable time delays (i.e. 6 cycles to 30 cycles) or pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

* 3. D.C. Operation
This telephone relay in conjunction with a static timing circuit provides adjustable time delays (i.e. 6 cycles to 30 cycles) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

* The KF relay operates to close its contacts when the applies source frequency is below a preset value. The operating characteristic curves for the various auxiliary time delay settings for changing frequency conditions is shown in Figure 5.

Rating

The type KF underfrequency relay is rated 120 volts at 60 cycles, or 120 volts at 50 cycles. The adjustable range of frequency is 55 to 59.5 cycles for the 60 cycle relay and 44 to 49.5 cycles for the 50 cycle relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Trip Circuit Constants

Indicating Contactor Switch —

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

The burden of the KF relay is 12.6 VA at 120 volts for the 60 cycle relay, and 13.4 VA at 120 volts for the 50 cycle relay.

SETTINGS

* The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ cycle below rated frequency unless otherwise specified. Turning either of the adjusting screws in a clockwise direction decreases the frequency at which the relay trips. The rate of change of frequency per second versus cycles below trip frequency is shown in Figure 5 for various time delays.

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

Contact Gap - The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.

B. Frequency Adjusting Reactor

Minimum trip - Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 cycles, for the 60 cycle relay and 49.5 cycles for the 50 cycle relay.

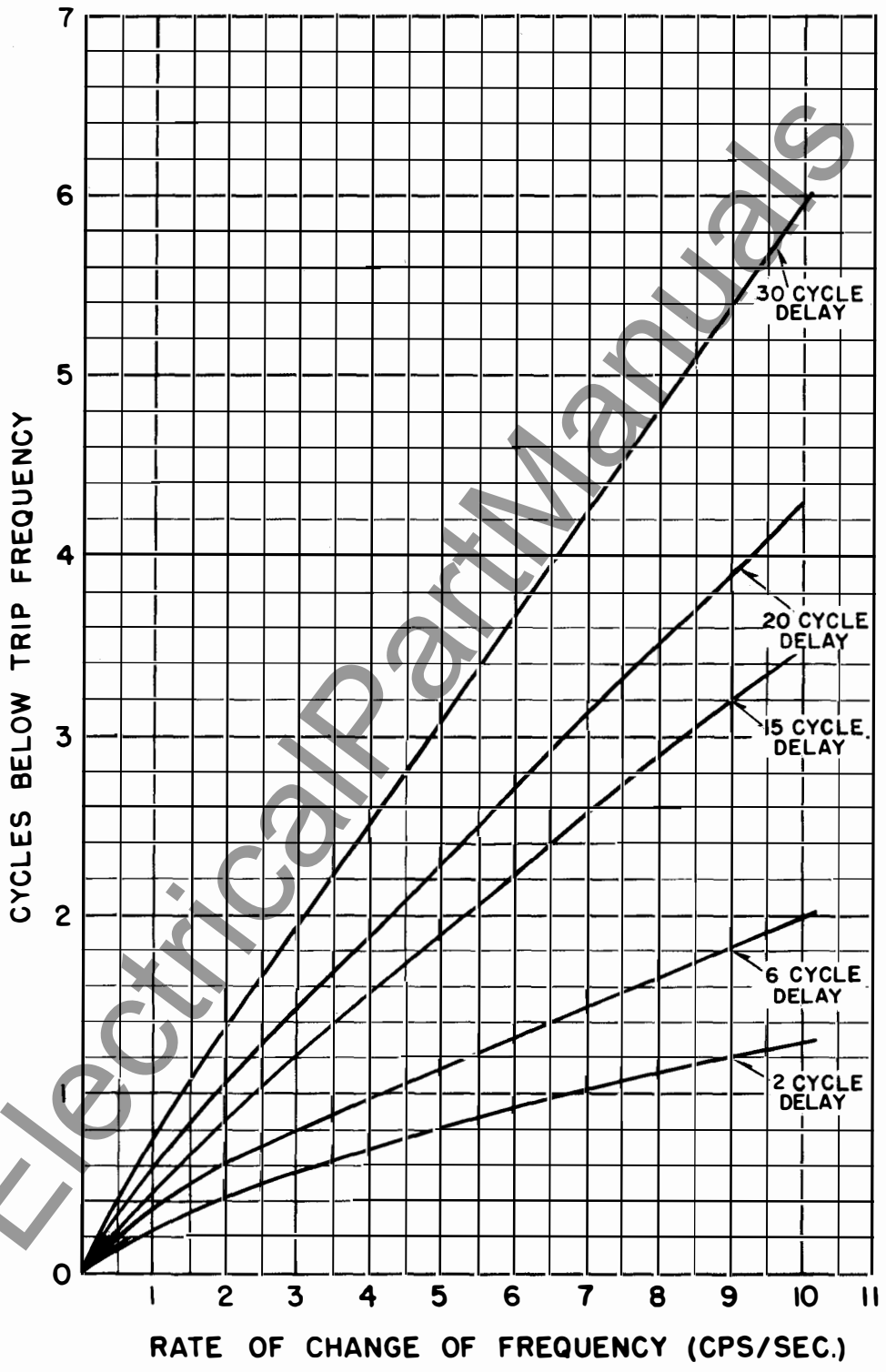


Fig. 5. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047'' between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

* 1. A.C. Operation — Non-Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from the telephone relay should be 6 cycles.

* 2. A.C. Operation — Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage 30 volts a.c. and the T unit should drop out. At rated voltage the time delay obtained should be 6 cycles. The timer can be set to provide up to 30 cycles by adjusting the rheostat located on the rear sub base. See Figure 1.

* 3. D.C. Operation
Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Closing the switch will now energize the timing circuit. The time delay obtained from the telephone relay should be 6 cycles. The timer can be set to provide up to thirty cycles delay by adjusting the rheostat located at the rear of the sub base. See Fig 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See ''Acceptance Check'').

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025'' clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

   With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

   The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

   The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring

is adjusted by placing a screwdriver of similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

* The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 3/16 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to the desired value and adjust the screws in the reactor (see Figure 1) until the cylinder unit contact closes to the left.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

* D. Auxiliary Time Delay Unit

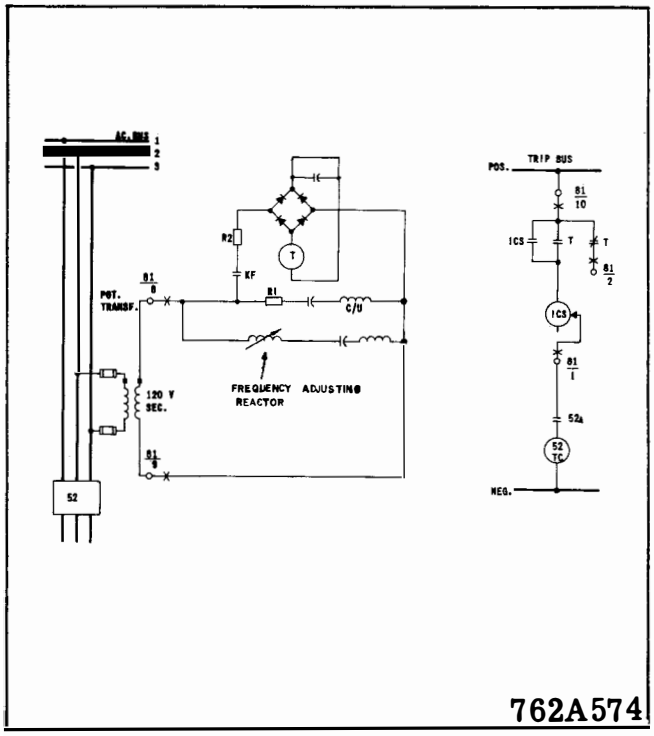
1. A.C. Operation — Non-Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time 6 cycles.

2. A.C. Operation — Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (See Figure 1).

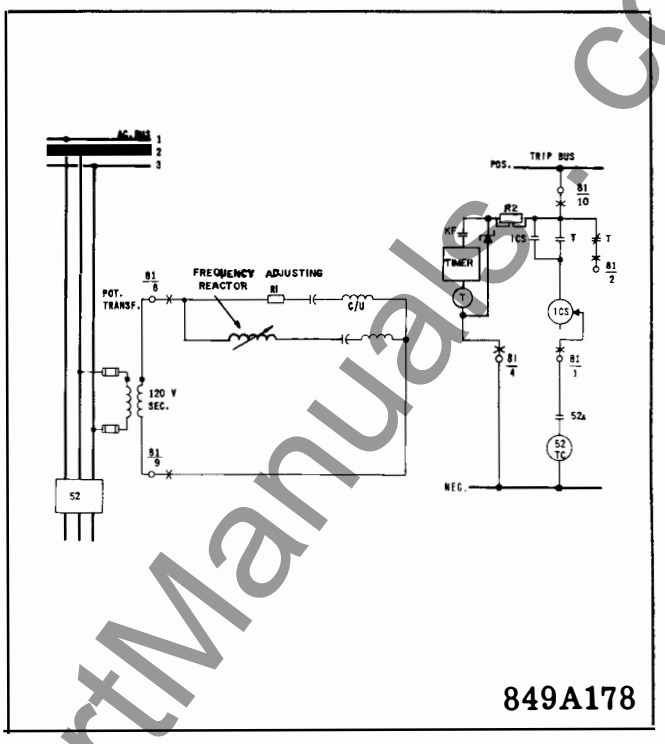
3. D.C. Operation — Adjustable
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Close switch and time the closing of the telephone relay contacts. Adjust rheostat on rear sub base, for desired time delay.

RENEWAL PARTS

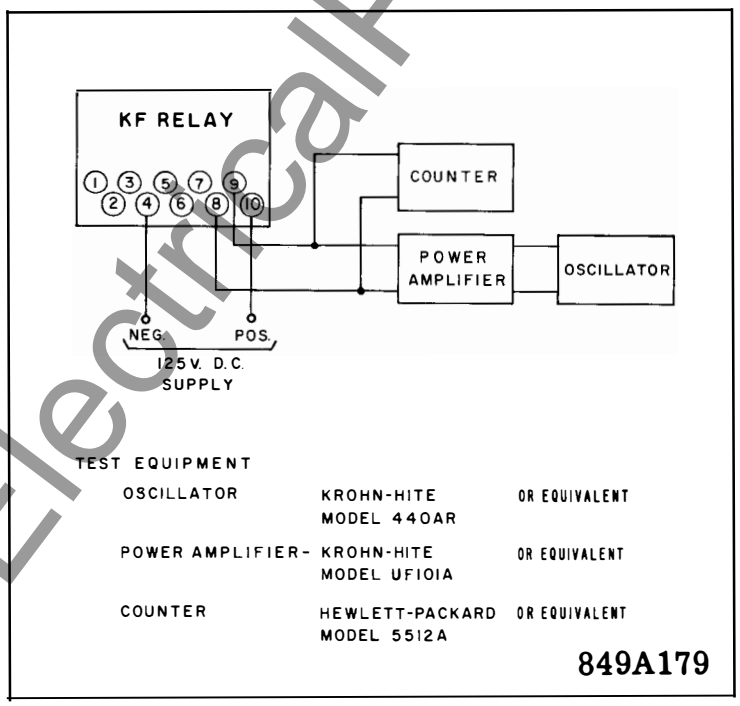
Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.



* *Fig. 6. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.*



* *Fig. 7. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.*



* *Fig. 8. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.*

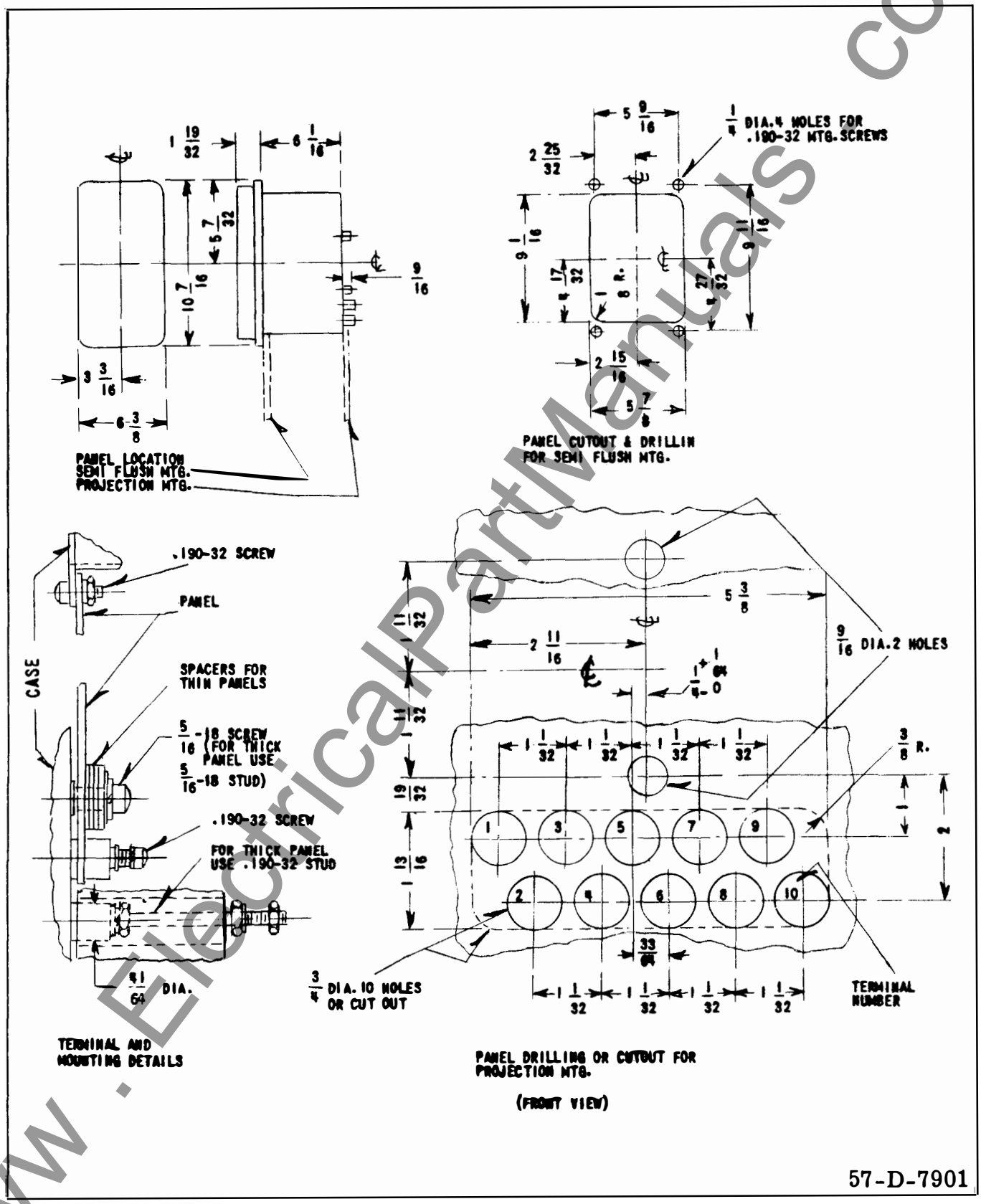


Fig. 9. Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, and auxiliary time delay unit (T). The principal parts of the relay can be seen in Figure 1.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

SUPERSEDES I.L. 41-503E
*Denotes change from superseded issue.

EFFECTIVE MAY 1968

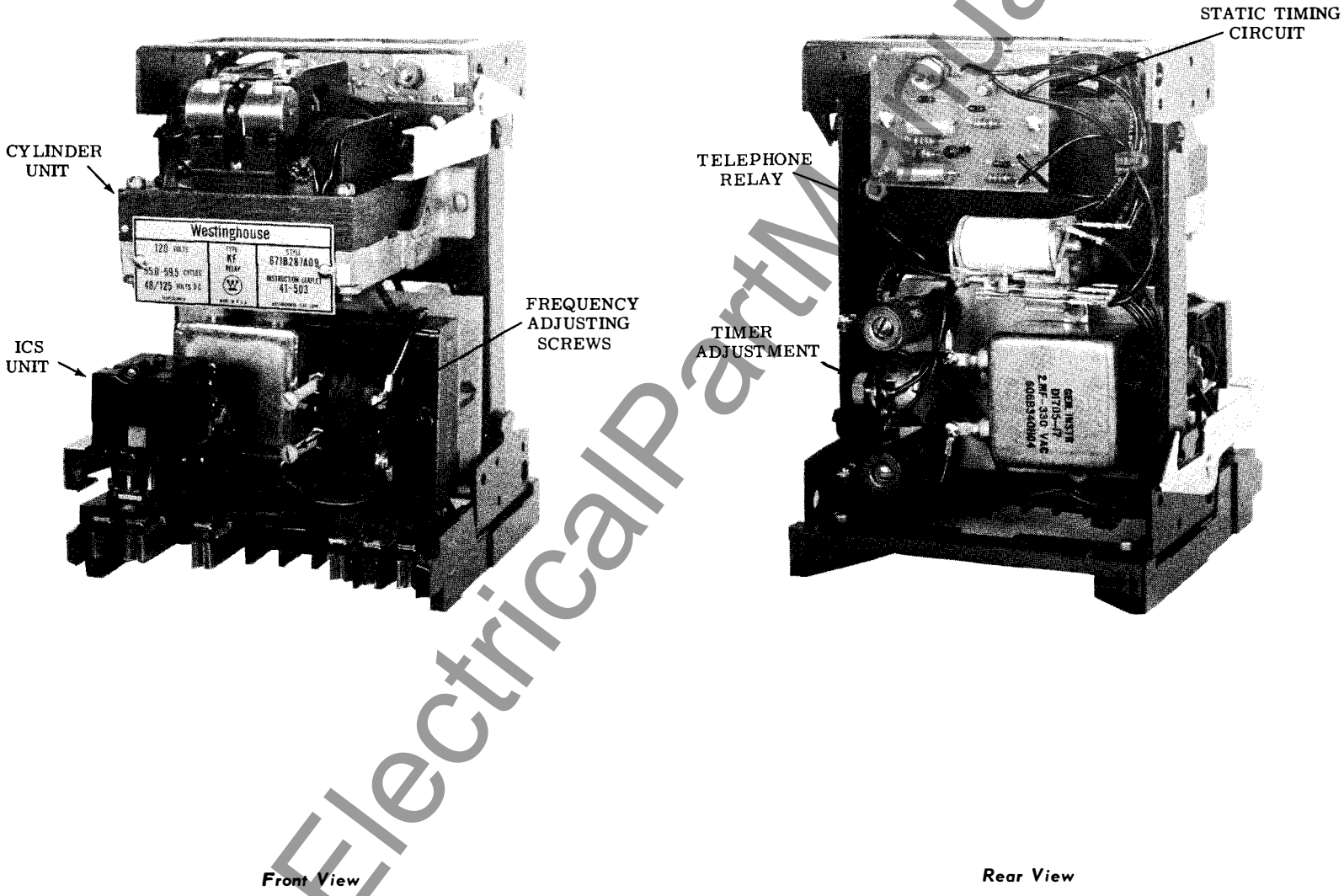


Fig. 1. Type KF Relay for 60 Cycles Without Case. (Front & Rear View)

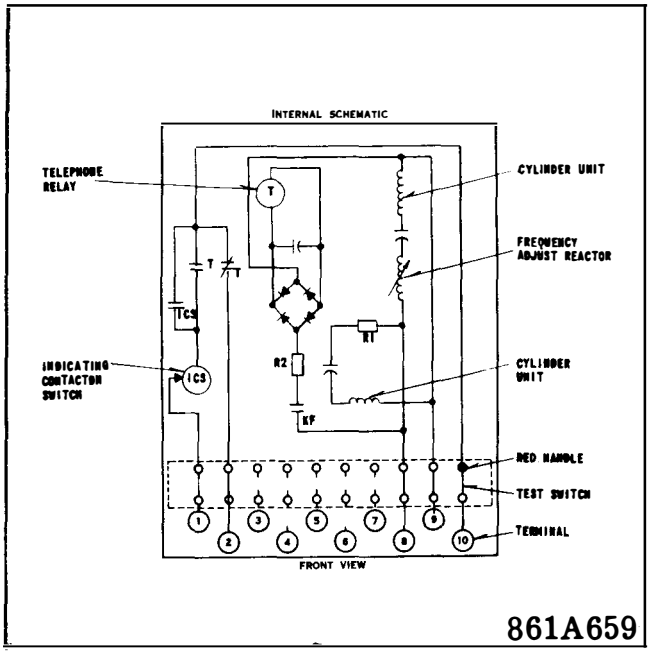


Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.

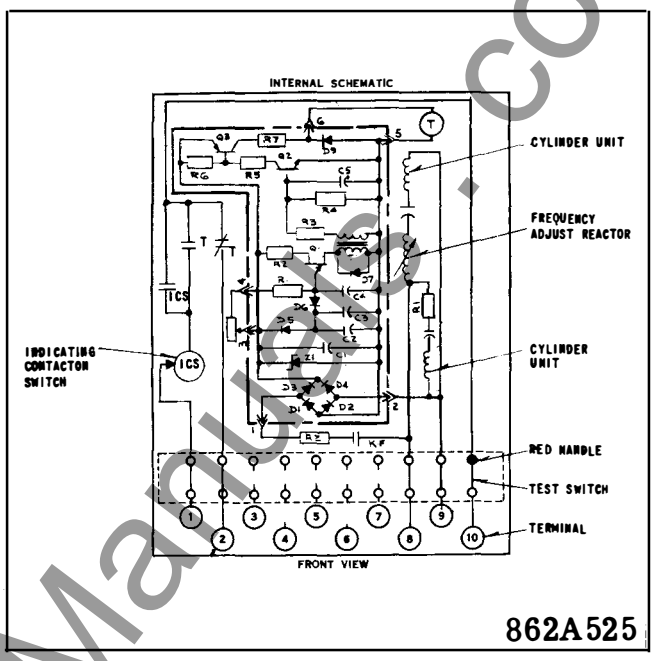


Fig. 3. Internal Schematic of Type KF Relay with A.C. Operated Adjustable Auxiliary Time Delay Unit.

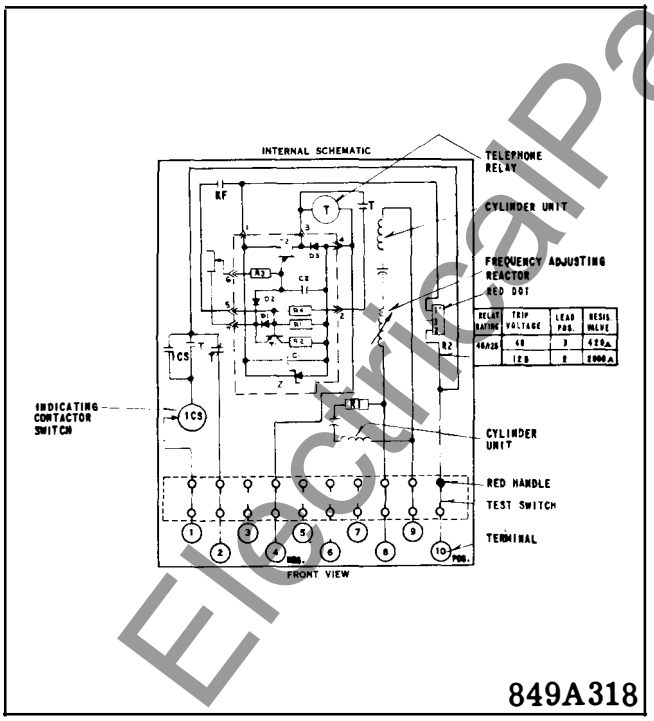


Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

1. A.C. Operation — Non-Adjustable
   This slugged telephone type relay in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-up when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

2. A.C. Operation — Adjustable
   This telephone relay in conjunction with a static timing circuit and full wave bridge provides adjustable time delays (i.e. 6 cycles to 30 cycles) or pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

3. D.C. Operation
   This telephone relay in conjunction with a static timing circuit provides adjustable time delays (i.e. 6 cycles to 30 cycles) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applies source frequency is below a preset value. The operating characteristic curves for the various auxiliary time delay settings for changing frequency conditions is shown in Figure 5.

Rating

The type KF underfrequency relay is rated 120 volts at 60 hertz, or 120 volts at 50 hertz. The adjustable range of frequency is 55 to 59.5 hertz for the 60 hertz relay and 44 to 49.5 hertz for the 50 hertz relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

The burden of the KF relay is 12.6 VA at 120 volts for the 60 hertz relay, and 13.4 VA at 120 volts for the 50 hertz relay.

Relay Type	Voltage AC 60 Hertz	Timer Condition	Burden
KF with D.C. Timer	120	N/A	14.7VA
KF with Adjustable A.C. Timer	120	Energized De-energized	29.4VA 14.7VA
KF with Non-Adjustable A.C. Timer	120	Energized De-energized	20.4VA 14.7VA

SETTINGS

The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ hertz below rated frequency unless otherwise specified. Turning either of the adjusting screws in a clockwise direction decreases the frequency at which the relay trips. The rate of change of frequency per second versus hertz below trip frequency is shown in Figure 5 for various time delays.

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

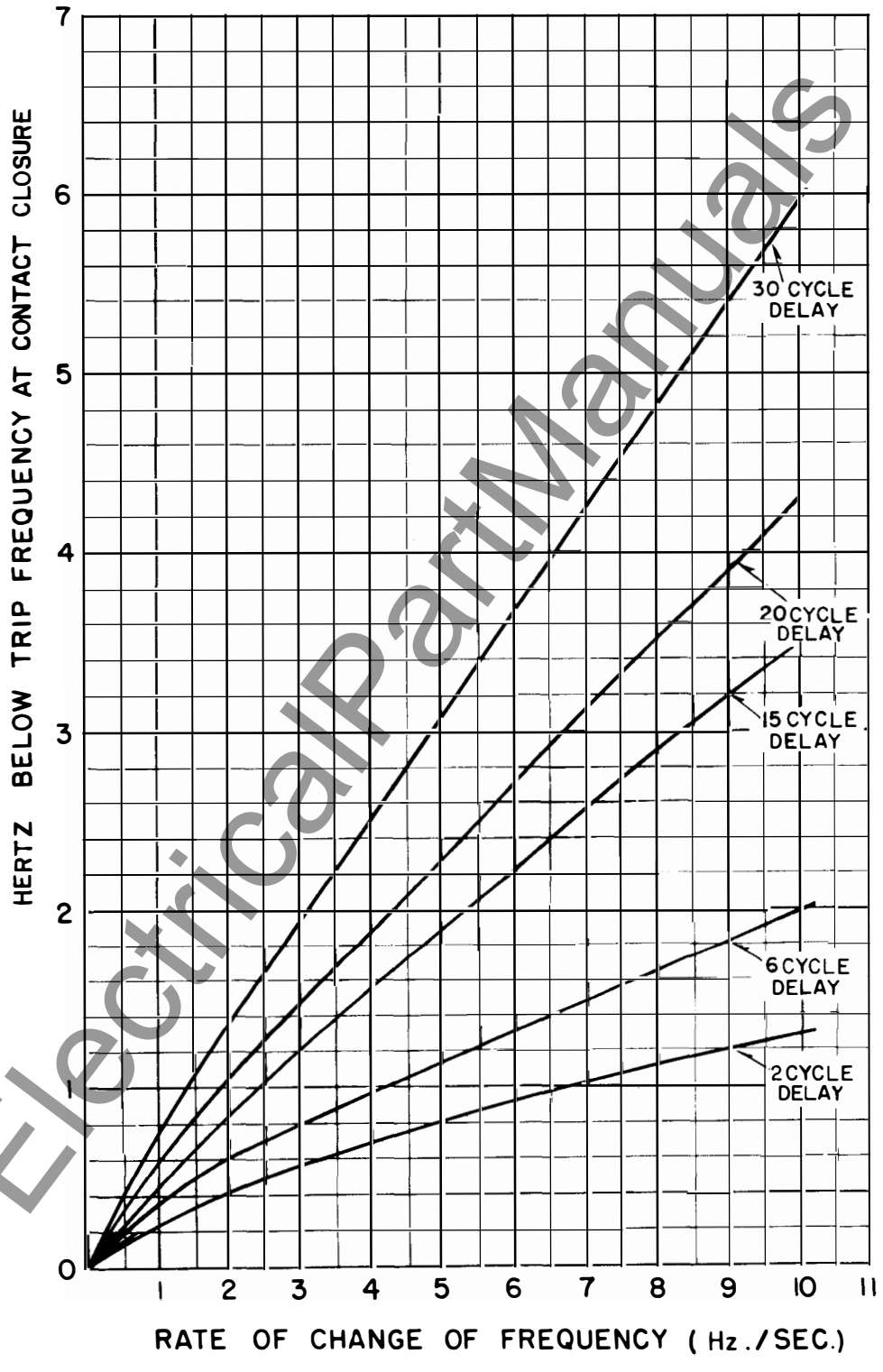
The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

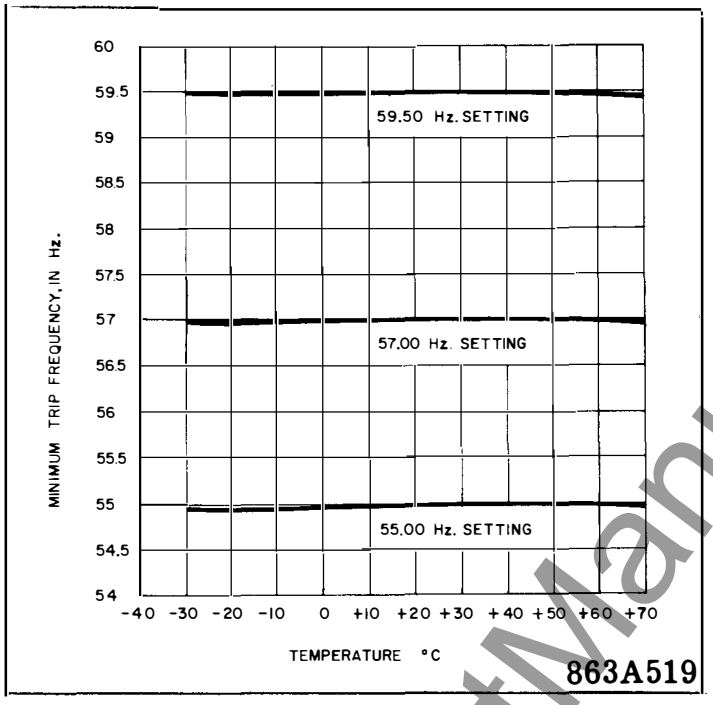
The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

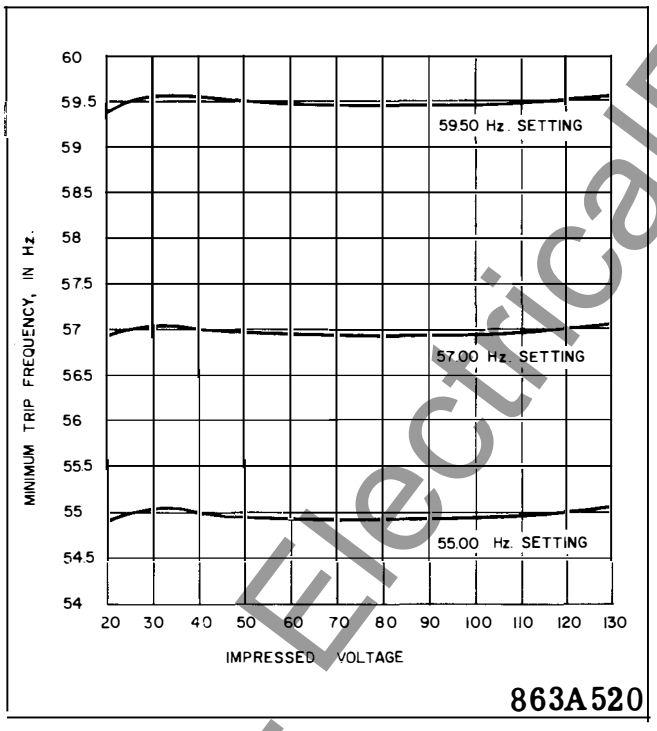
Contact Gap - The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.



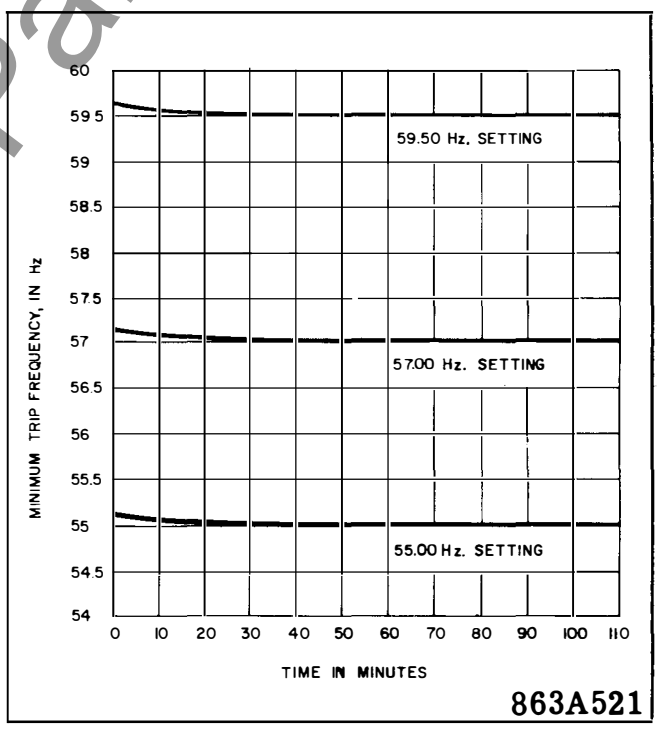
* *Fig. 5. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.*



* *Fig. 6. Typical Temperature vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay*



* *Fig. 7. Typical Voltage vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay*



* *Fig. 8. Warm-Up Curve 60 Hertz KF Underfrequency Relay*

B. Frequency Adjusting Reactor

* 1. Minimum Trip — Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 hertz, for the 60 hertz relay and 49.5 hertz for the 50 hertz relay.

* 2. Reduce voltage to 40 volts. Check calibration. The cylinder unit contacts should close .06 to .08 hertz above the trip frequency.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

1. A.C. Operation — Non-Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from the telephone relay should be 6 cycles.

2. A.C. Operation — Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce
* voltage to 30 volts a.c. and the T unit should drop out. At rated voltage the time delay obtained should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Figure 1.

3. D.C. Operation
Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Closing the switch will now energize the timing circuit. The time delay obtained from the telephone relay should be 6 cycles.
* The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Fig. 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See "Acceptance Check").

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an

inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 3/16 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to 59.5 hertz and adjust the frequency adjusting screws (see Fig. 1) until the cylinder unit contact closes to the left. Reduce voltage to 40 volts and raise frequency to 59.57 hertz. Adjust control spring so that cylinder unit contact just closes to the left. Raise voltage to 120 volts and recheck 59.5 settings. Adjust frequency adjusting screws if necessary. Recheck 40 volt setting, it should be between 59.56 and 59.58 hertz. Repeat above procedure if necessary until relay contacts is made between the frequency limits.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

D. Auxiliary Time Delay Unit

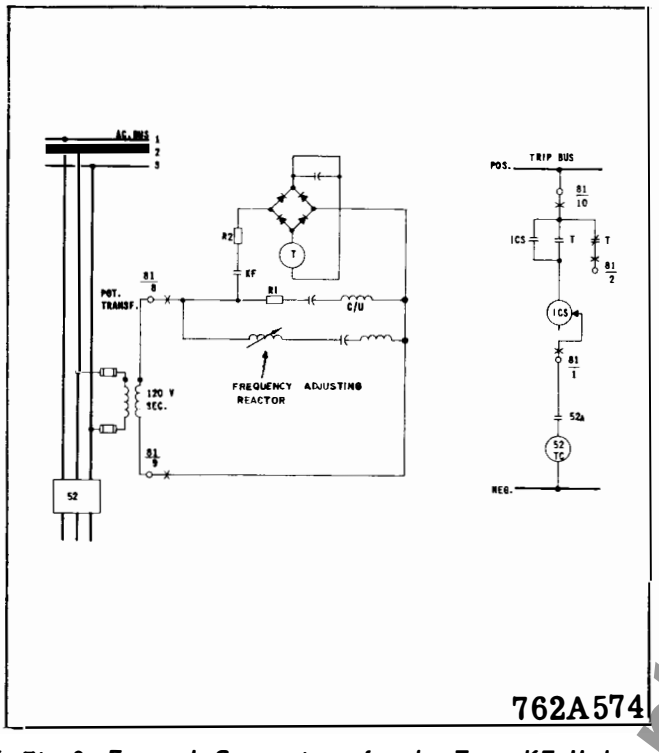
1. A.C. Operation – Non-Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time should be 6 cycles.

2. A.C. Operation – Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (See Figure 1).

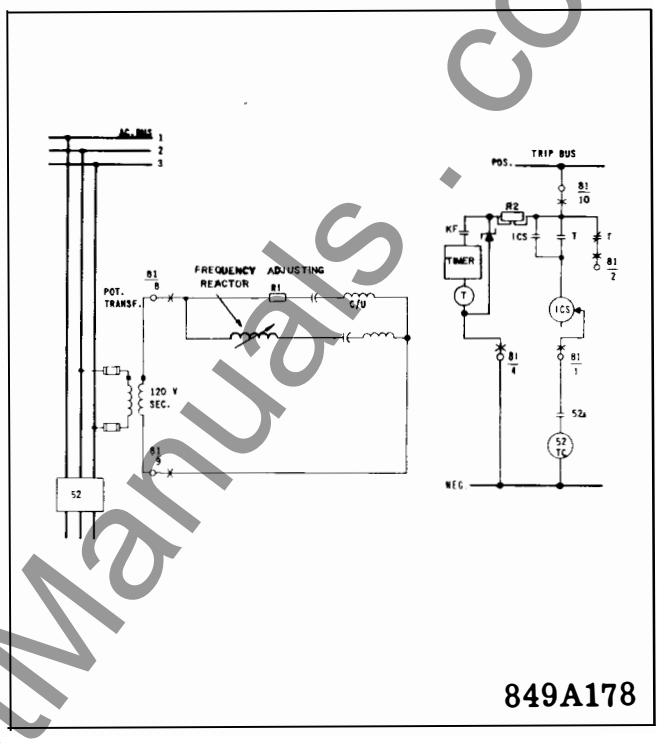
3. D.C. Operation – Adjustable
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Close switch and time the closing of the telephone relay contacts. Adjust rheostat on rear sub base for desired time delay. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (see Fig. 1).

RENEWAL PARTS

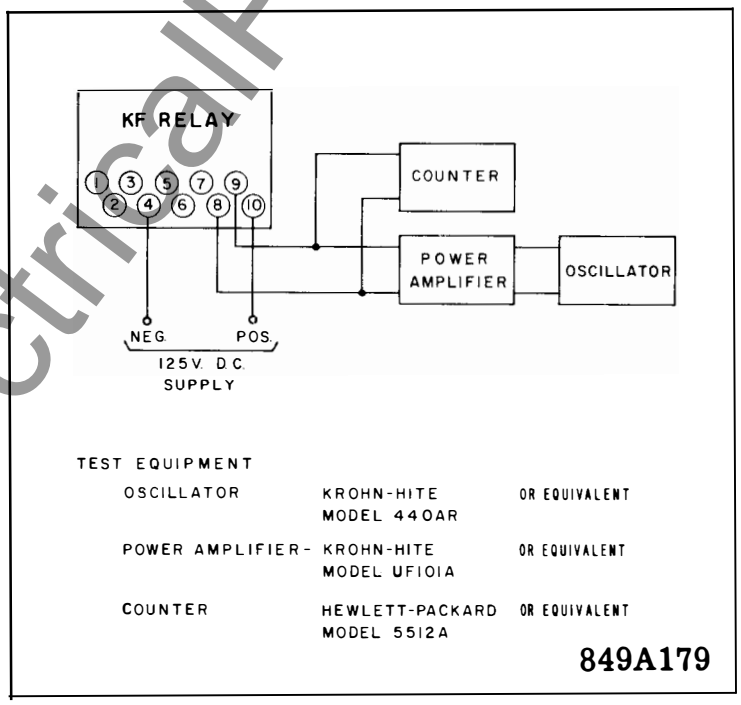
Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.



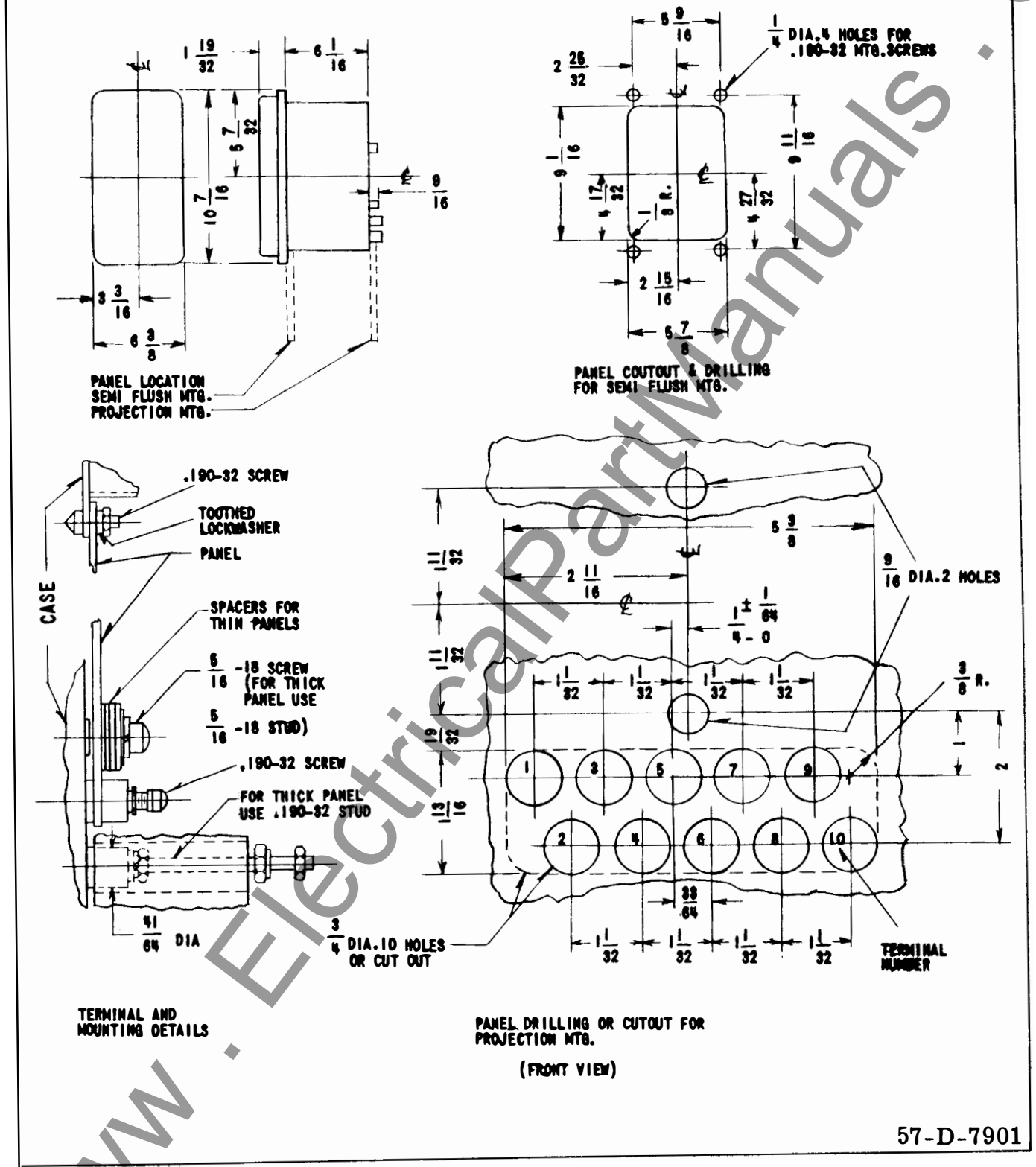
* *Fig. 9. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.*



* *Fig. 10. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.*



* *Fig. 11. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.*



* *Fig. 12. Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.*

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, and auxiliary time delay unit (T). The principal parts of the relay can be seen in Figure 1.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

SUPERSEDES I.L. 41-503F
*Denotes change from superseded issue.

EFFECTIVE JANUARY 1969

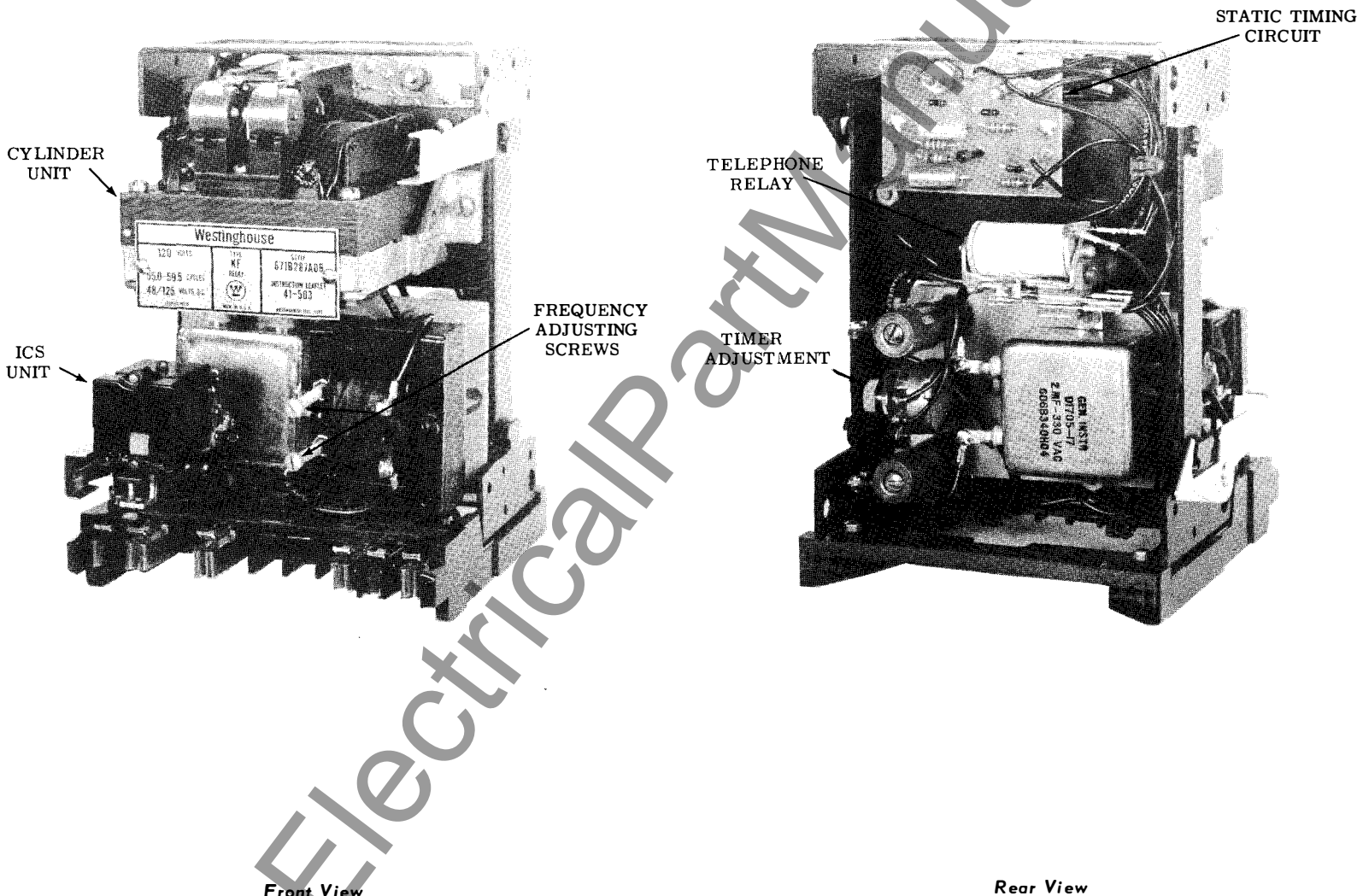


Fig. 1. Type KF Relay for 60 Cycles Without Case. (Front & Rear View)

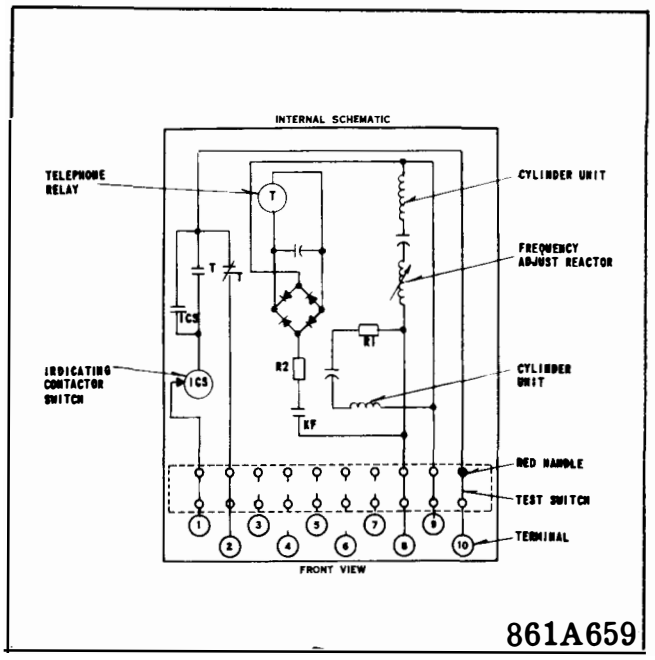


Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.

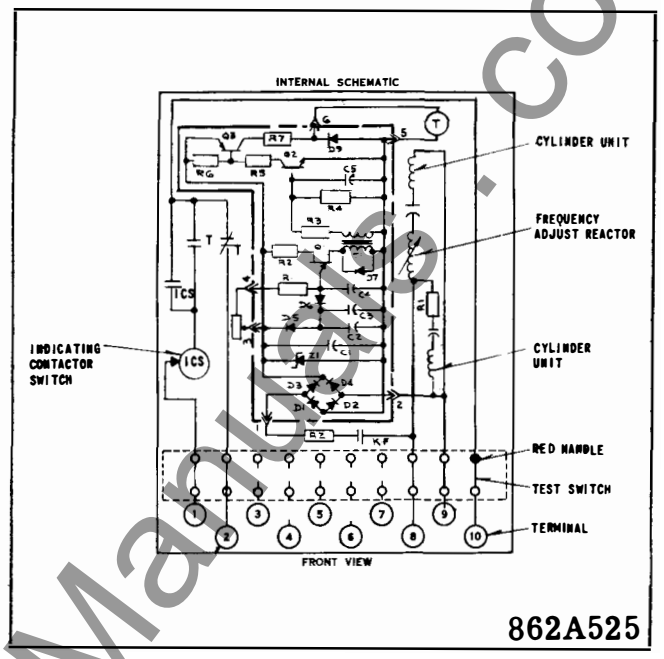


Fig. 3. Internal Schematic of Type KF Relay with A.C. Operated Adjustable Auxiliary Time Delay Unit.

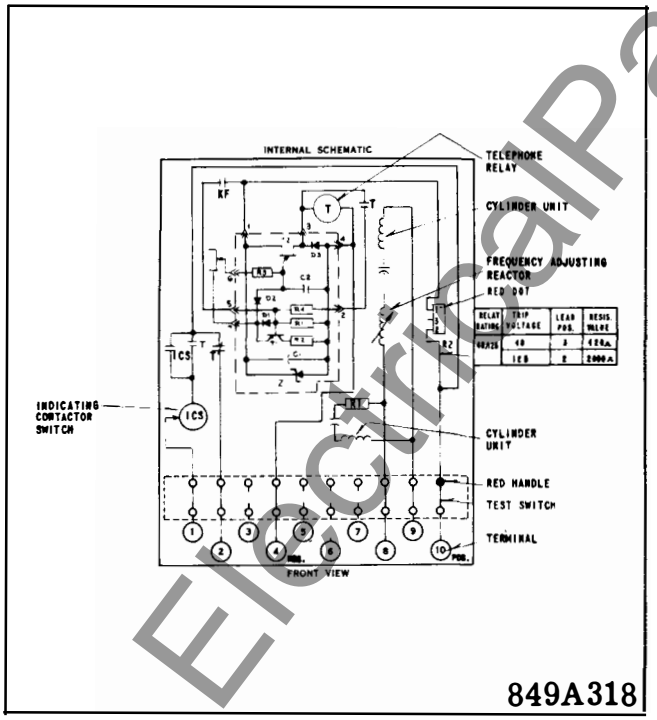


Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

1. A.C. Operation — Non-Adjustable
   This slugged telephone type relay in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-up when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
2. A.C. Operation — Adjustable
   This telephone relay in conjunction with a static timing circuit and full wave bridge provides adjustable time delays (i.e. 6 cycles to 30 cycles) or pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
3. D.C. Operation
   This telephone relay in conjunction with a static timing circuit provides adjustable time delays (i.e. 6 cycles to 30 cycles) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applies source frequency is below a preset value. The operating characteristic curves for the various auxiliary time delay settings for changing frequency conditions is shown in Figure 5.

Rating

The type KF underfrequency relay is rated 120 volts at 60 hertz, or 120 volts at 50 hertz. The adjustable range of frequency is 55 to 59.5 hertz for the 60 hertz relay and 44 to 49.5 hertz for the 50 hertz relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

* **Time Delay**

KF with DC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 cycles (non-adjustable)

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

* The burden of the FK relay is 14.7 VA at 120 volts for the 60 hertz relay, and 15.1 VA at 120 volts for the 50 hertz relay.

Relay Type	Voltage AC 60 Hertz	Timer Condition	Burden
KF with D.C. Timer	120	N/A	14.7VA
KF with Adjustable A.C. Timer	120	Energized De-energized	29.4VA 14.7VA
KF with Non-Adjustable A.C. Timer	120	Energized De-energized	20.4VA 14.7VA

SETTINGS

The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ hertz below rated frequency unless otherwise specified. Turning either of the adjusting screws in a clockwise direction decreases the frequency at which the relay trips. The rate of change of frequency per second versus hertz below trip frequency is shown in Figure 5 for various time delays.

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

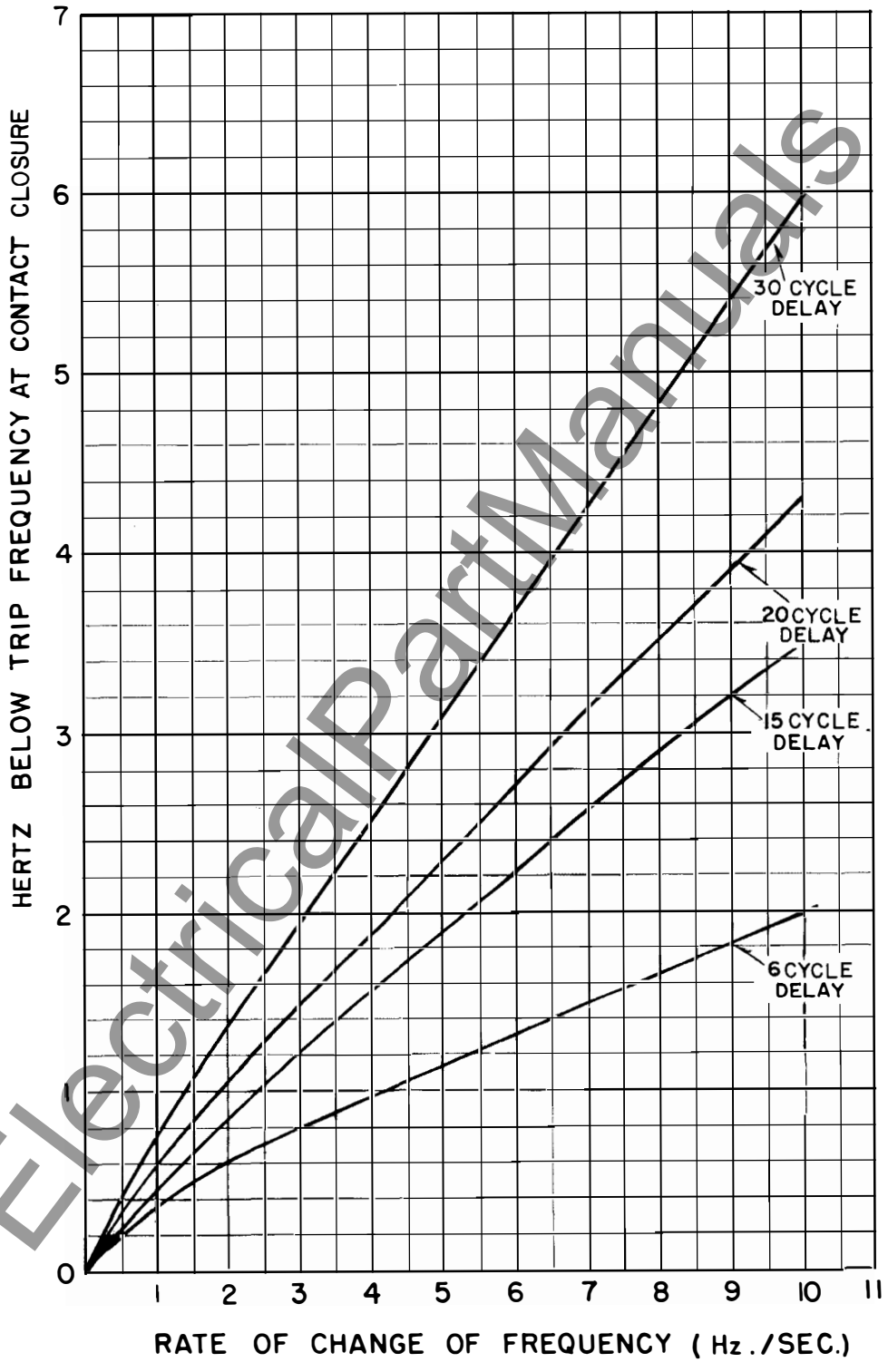
The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

Contact Gap - The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.



* *Fig. 5. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.*

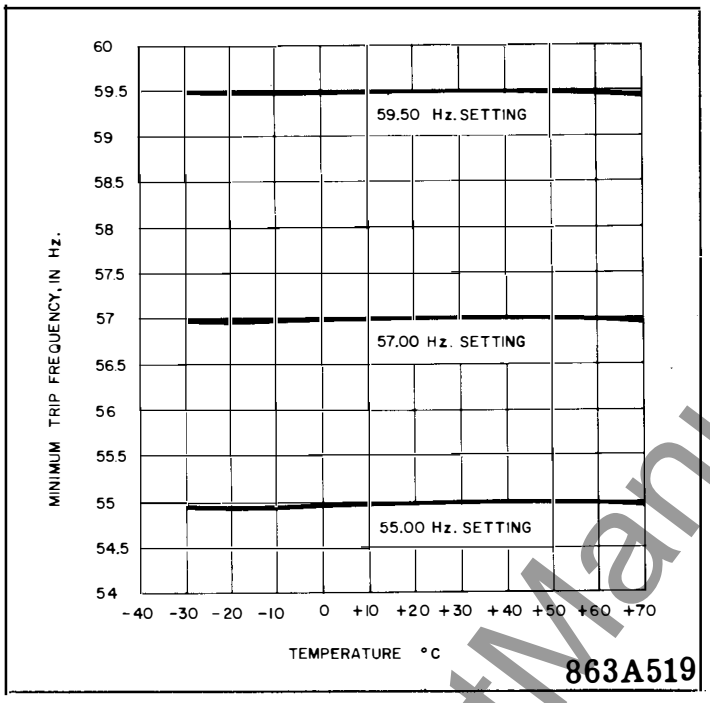


Fig. 6. Typical Temperature vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

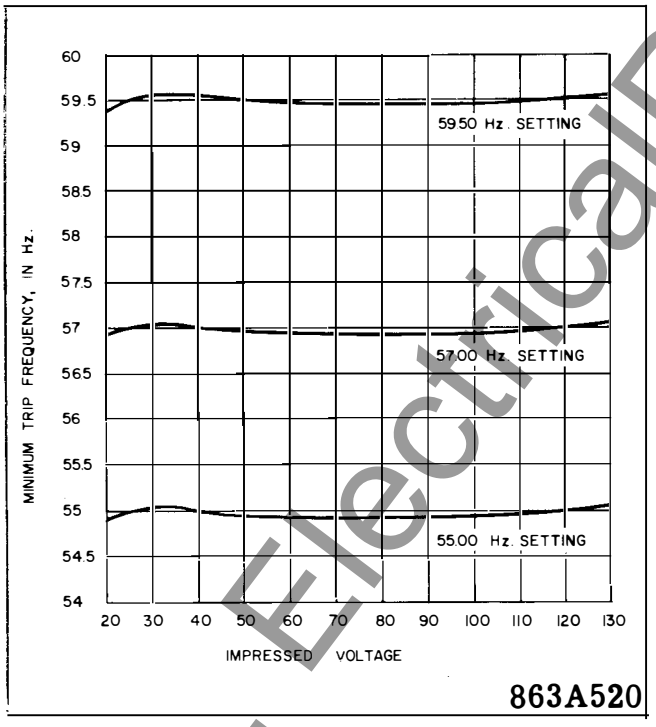


Fig. 7. Typical Voltage vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

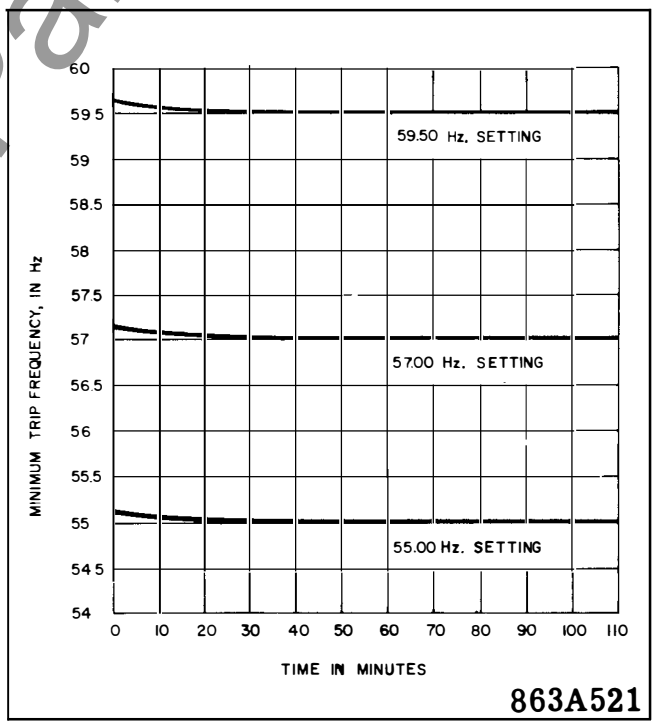


Fig. 8. Warm-Up Curve 60 Hertz KF Underfrequency Relay

B. Frequency Adjusting Reactor

1. Minimum Trip — Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 hertz, for the 60 hertz relay and 49.5 hertz for the 50 hertz relay.

2. Reduce voltage to 40 volts. Check calibration. The cylinder unit contacts should close .06 to .08 hertz above the trip frequency.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047'' between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

1. A.C. Operation — Non-Adjustable
   Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from the telephone relay should be 6 cycles.

2. A.C. Operation — Adjustable
   Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. and the T unit should drop out. At rated voltage the time delay obtained should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Figure 1.

3. D.C. Operation
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Closing the switch will now energize the timing circuit. The time delay obtained from the telephone relay should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Fig. 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See ''Acceptance Check'').

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025'' clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

   With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an

inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 3/16 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to 59.5 hertz and adjust the frequency adjusting screws (see Fig. 1) until the cylinder unit contact closes to the left. Reduce voltage to 40 volts and raise frequency to 59.57 hertz. Adjust control spring so that cylinder unit contact just closes to the left. Raise voltage to 120 volts and recheck 59.5 settings. Adjust frequency adjusting screws if necessary. Recheck 40 volt setting, it should be between 59.56 and 59.58 hertz. Repeat above procedure if necessary until relay contacts are made between the frequency limits.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

D. Auxiliary Time Delay Unit

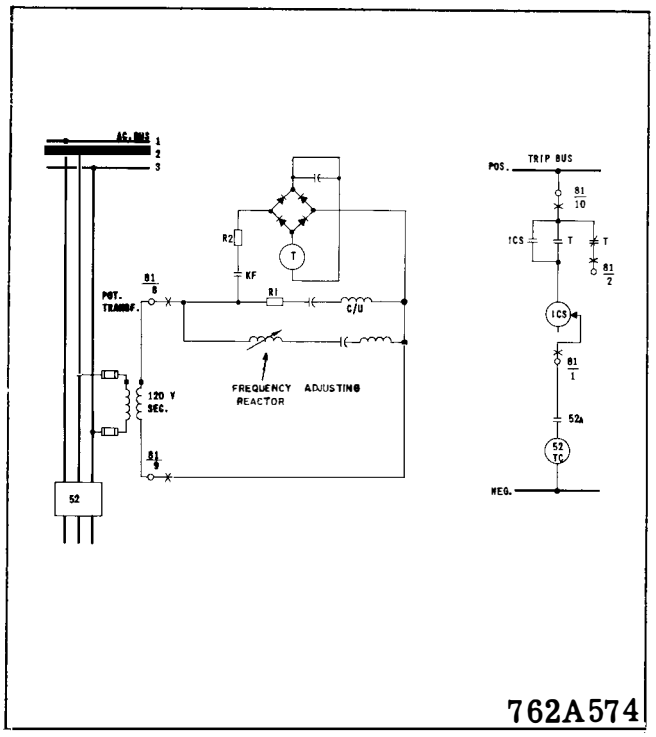
1. A.C. Operation — Non-Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time should be 6 cycles.

2. A.C. Operation — Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (See Figure 1).

3. D.C. Operation — Adjustable
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Close switch and time the closing of the telephone relay contacts. Adjust rheostat on rear sub base for desired time delay. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (see Fig. 1).

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. 9. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.*

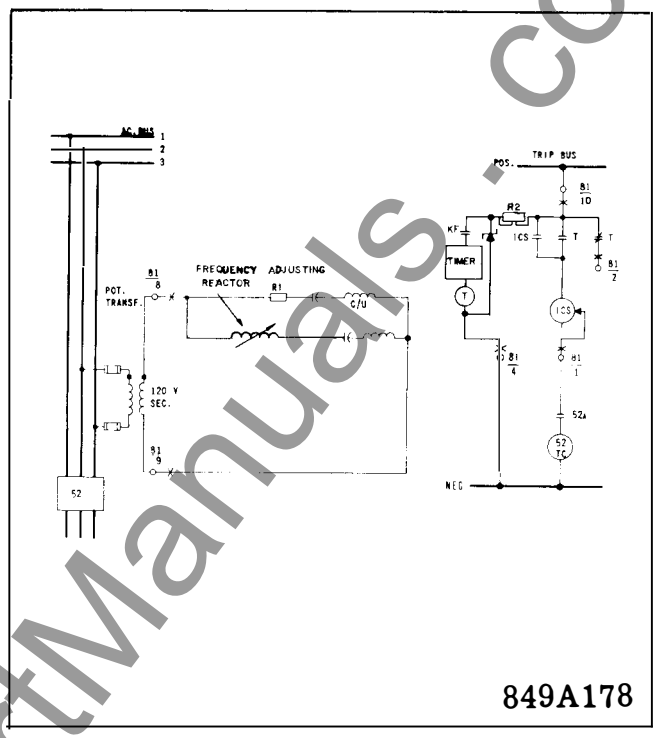


Fig. 10. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.

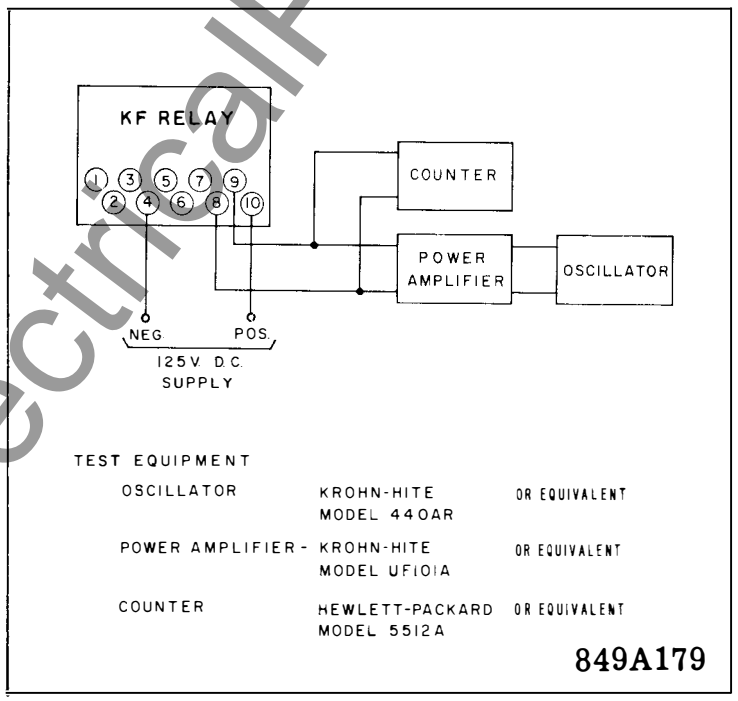


Fig. 11. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.

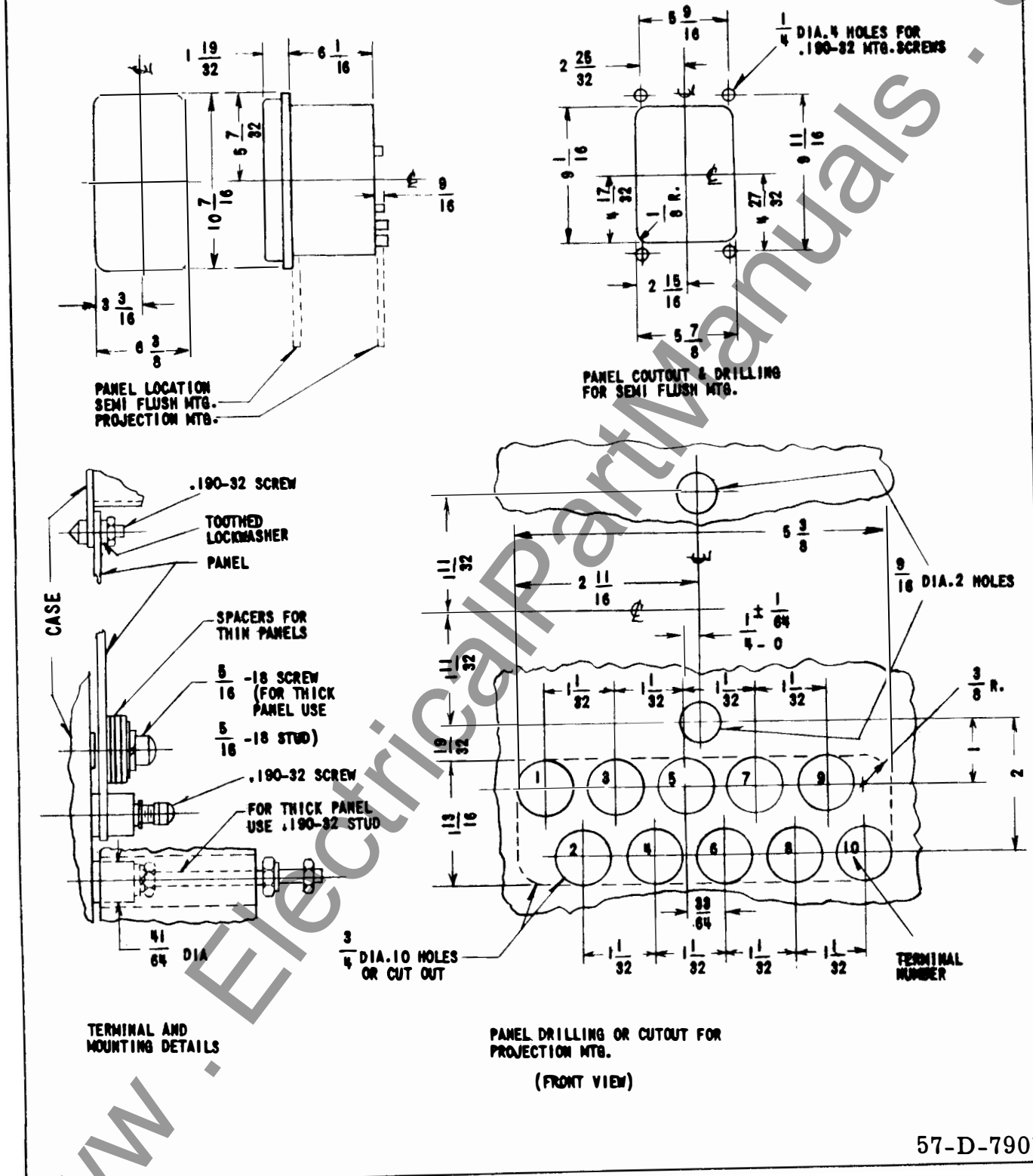
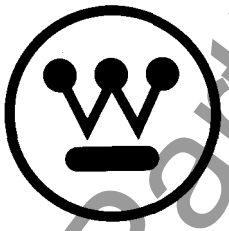


Fig. 12. Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.



WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, and auxiliary time delay unit (T). The principal parts of the relay can be seen in Figure 1.

A. Induction Cylinder Unit

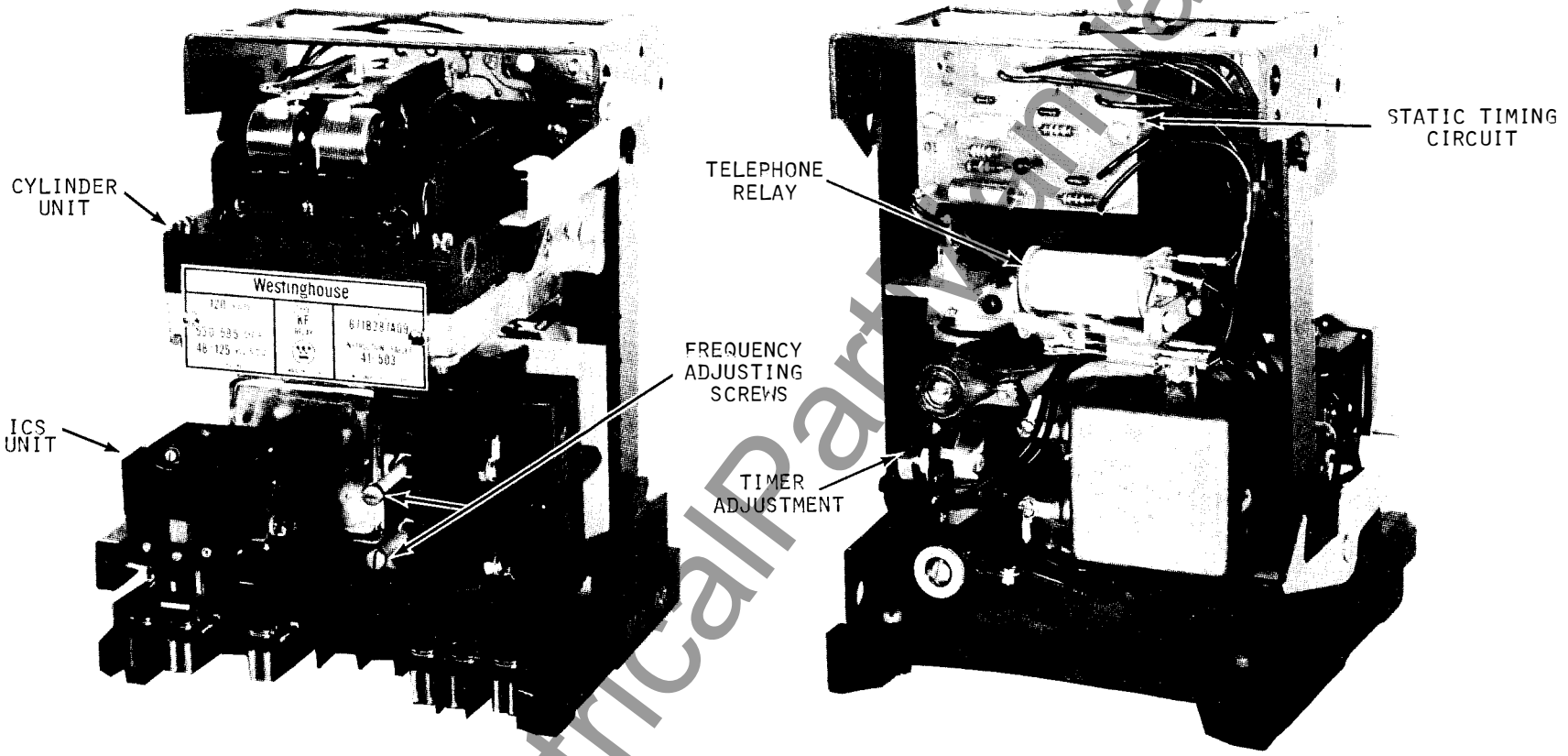
The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.



* *Fig. 1. Type KF Relay for 60 Cycles Without Case. (Front & Rear View)*

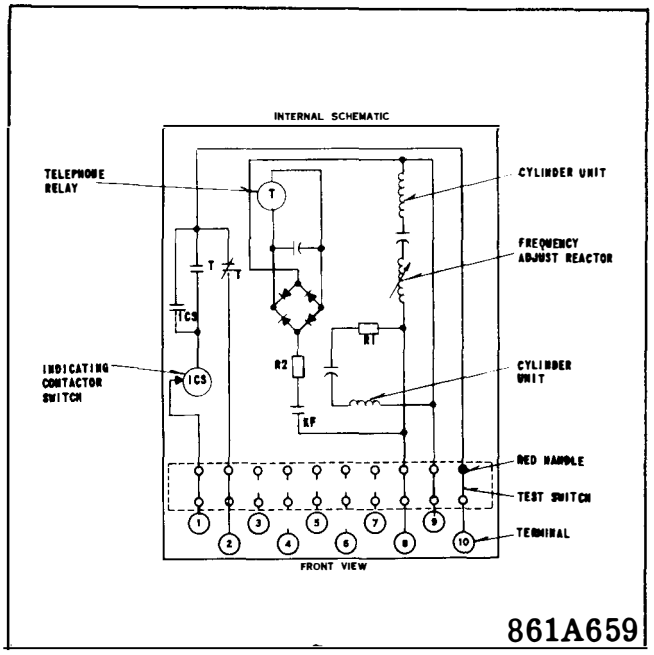


Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.

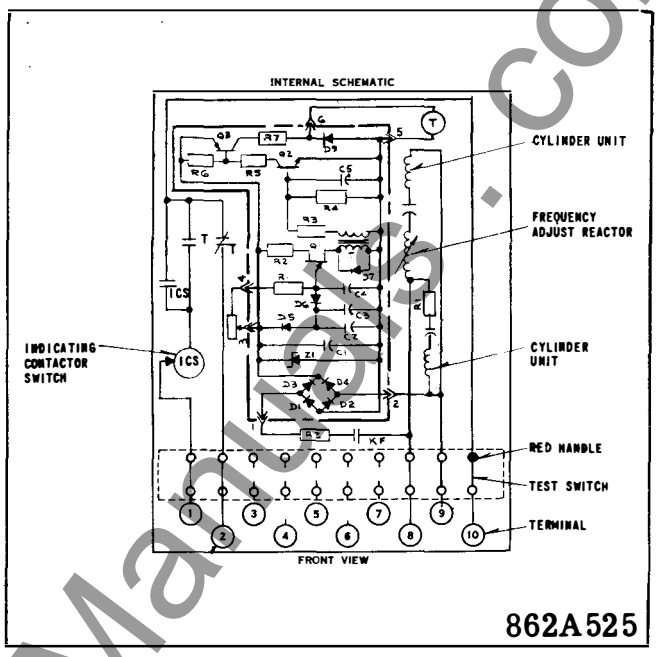
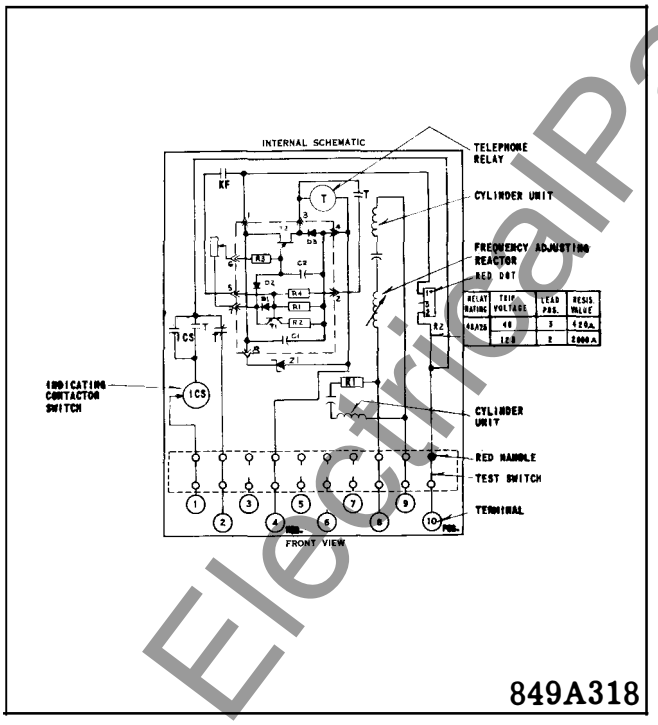


Fig. 3. Internal Schematic of Type KF Relay with A.C. Operated Adjustable Auxiliary Time Delay Unit.



✱ *Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.*

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

1. A.C. Operation — Non-Adjustable
   This slugged telephone type relay in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-up when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
2. A.C. Operation — Adjustable
   This telephone relay in conjunction with a static timing circuit and full wave bridge provides adjustable time delays (i.e. 6 cycles to 30 cycles) or pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
3. D.C. Operation
   This telephone relay in conjunction with a static timing circuit provides adjustable time delays (i.e. 6 cycles to 30 cycles) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applies source frequency is below a preset value. The operating characteristic curves for the various auxiliary time delay settings for changing frequency conditions is shown in Figure 5.

Rating

The type KF underfrequency relay is rated 120 volts at 60 hertz, or 120 volts at 50 hertz. The adjustable range of frequency is 55 to 59.5 hertz for the 60 hertz relay and 44 to 49.5 hertz for the 50 hertz relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Time Delay

KF with DC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 cycles (non-adjustable)

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

*

Relay Type	Voltage AC 60 Hertz	Timer Condition	Burden
KF with D.C. Timer	120	N/A	14.7VA
KF with Adjustable A.C. Timer	120	Energized De-energized	29.4VA 14.7VA
KF with Non-Adjustable A.C. Timer	120	Energized De-energized	20.4VA 14.7VA

SETTINGS

The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ hertz below rated frequency unless otherwise specified. Turning either of the adjusting screws in a clockwise direction decreases the frequency at which the relay trips. The rate of change of frequency per second versus hertz below trip frequency is shown in Figure 5 for various time delays

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

Contact Gap - The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.

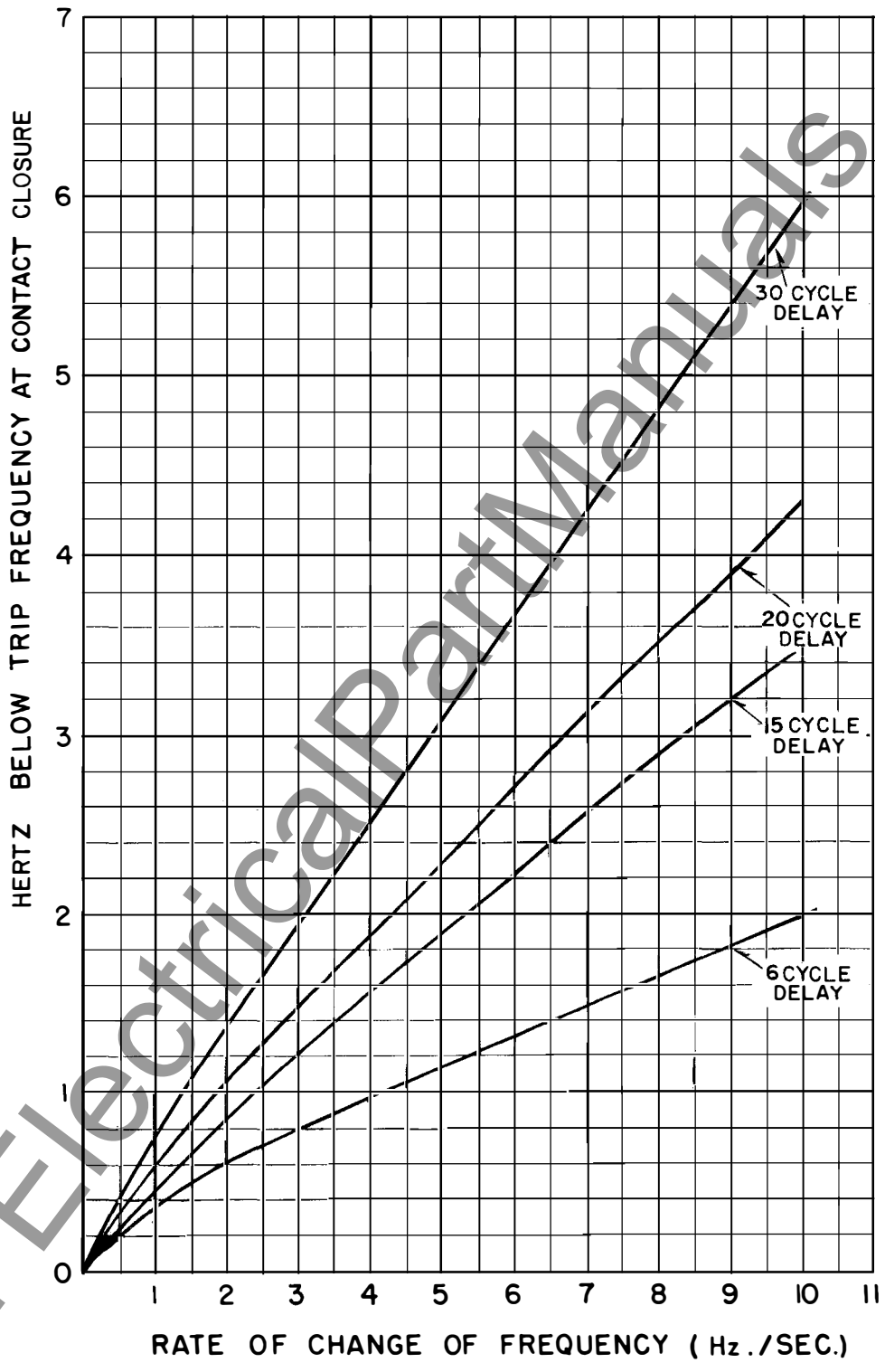


Fig. 5. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.

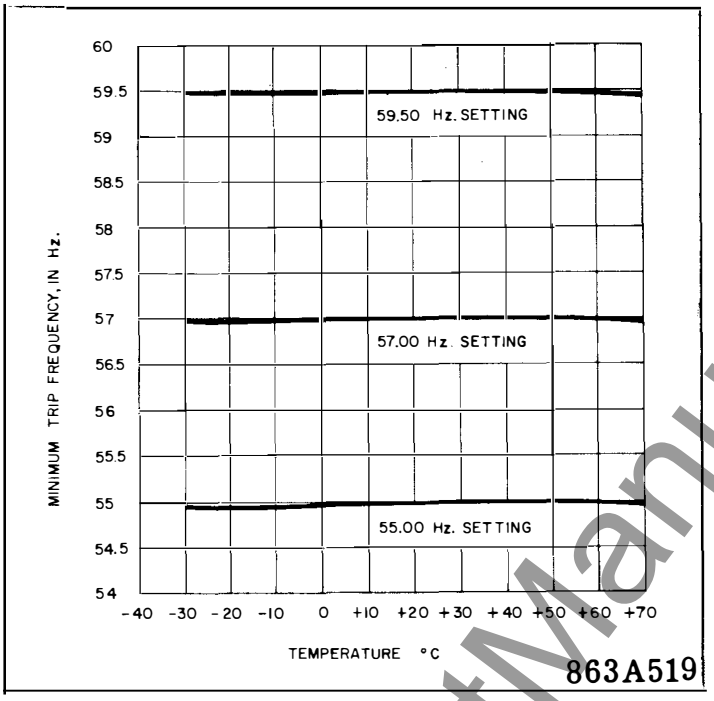


Fig. 6. Typical Temperature vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

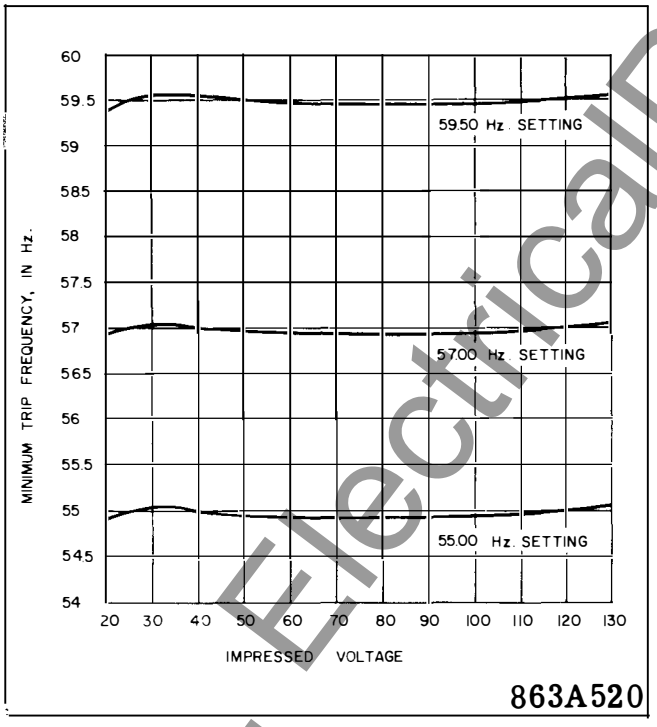


Fig. 7. Typical Voltage vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

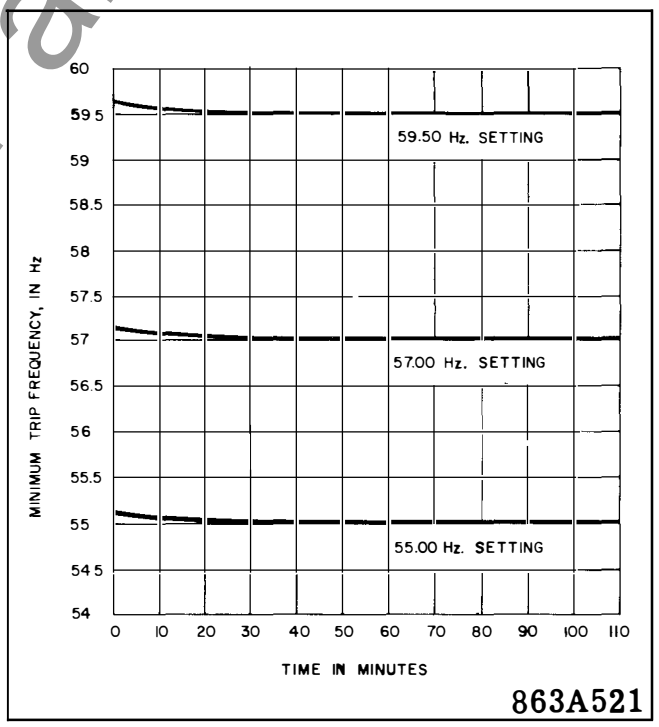


Fig. 8. Warm-Up Curve 60 Hertz KF Underfrequency Relay

B. Frequency Adjusting Reactor

1. Minimum Trip — Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 hertz, for the 60 hertz relay and 49.5 hertz for the 50 hertz relay.

2. Reduce voltage to 40 volts. Check calibration. The cylinder unit contacts should close .06 to .08 hertz above the trip frequency.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

1. A.C. Operation — Non-Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from the telephone relay should be 6 cycles.

2. A.C. Operation — Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. and the T unit should drop out. At rated voltage the time delay obtained should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Figure 1.

3. D.C. Operation
Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Closing the switch will now energize the timing circuit. The time delay obtained from the telephone relay should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Fig. 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See "Acceptance Check").

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025" clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an

inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 3/16 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to 59.5 hertz and adjust the frequency adjusting screws (see Fig. 1) until the cylinder unit contact closes to the left. Reduce voltage to 40 volts and raise frequency to 59.57 hertz. Adjust control spring so that cylinder unit contact just closes to the left. Raise voltage to 120 volts and recheck 59.5 settings. Adjust frequency adjusting screws if necessary. Recheck 40 volt setting, it should be between 59.56 and 59.58 hertz. Repeat above procedure if necessary until relay contacts are made between the frequency limits.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

D. Auxiliary Time Delay Unit

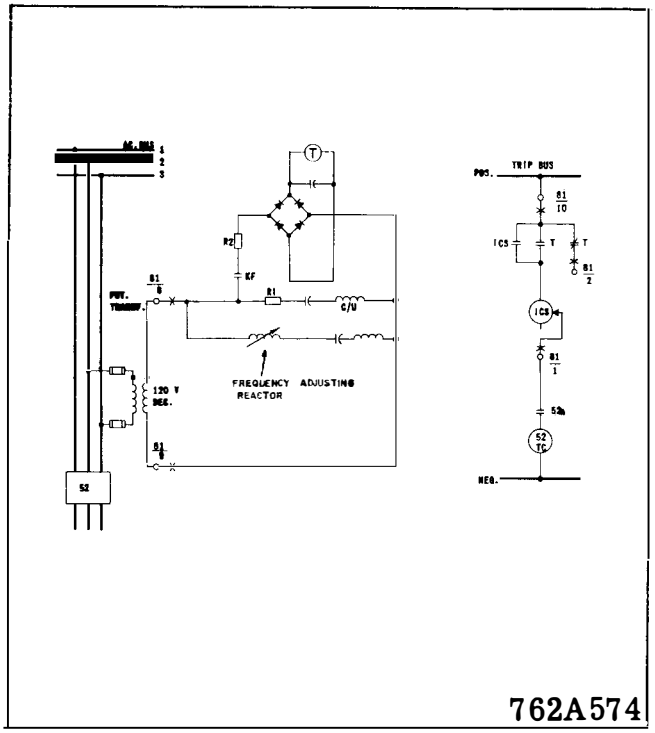
1. A.C. Operation – Non-Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time should be 6 cycles.

2. A.C. Operation – Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (See Figure 1).

3. D.C. Operation – Adjustable
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Close switch and time the closing of the telephone relay contacts. Adjust rheostat on rear sub base for desired time delay. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (see Fig. 1).

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. 9. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.*

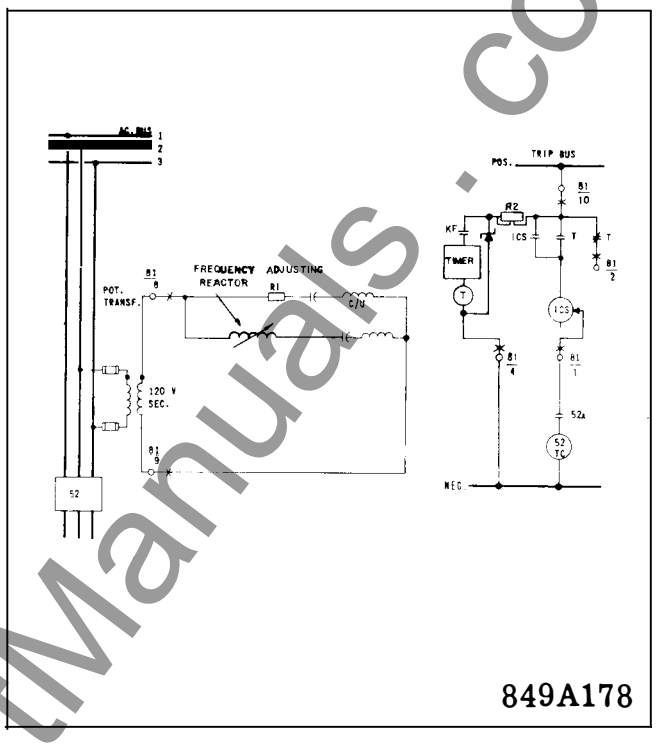


Fig. 10. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.

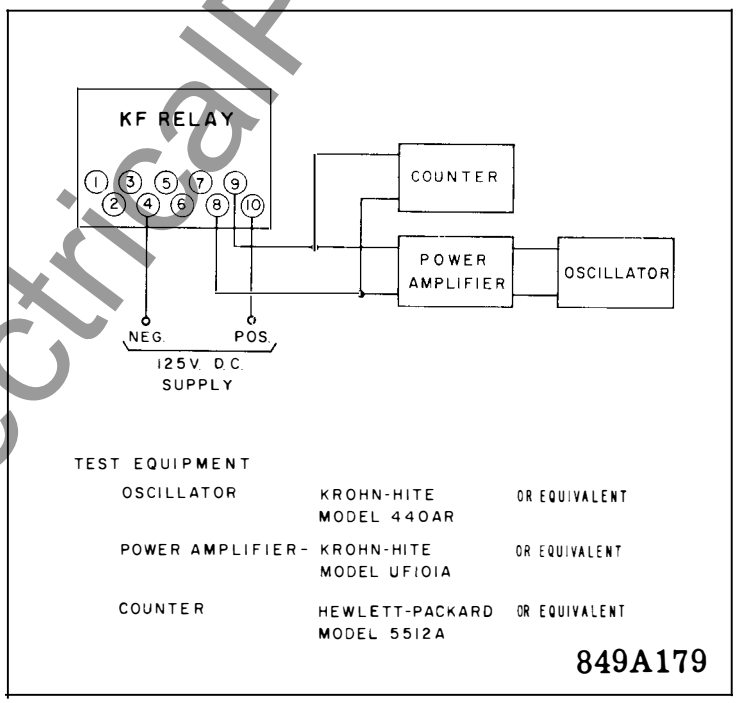


Fig. 11. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.

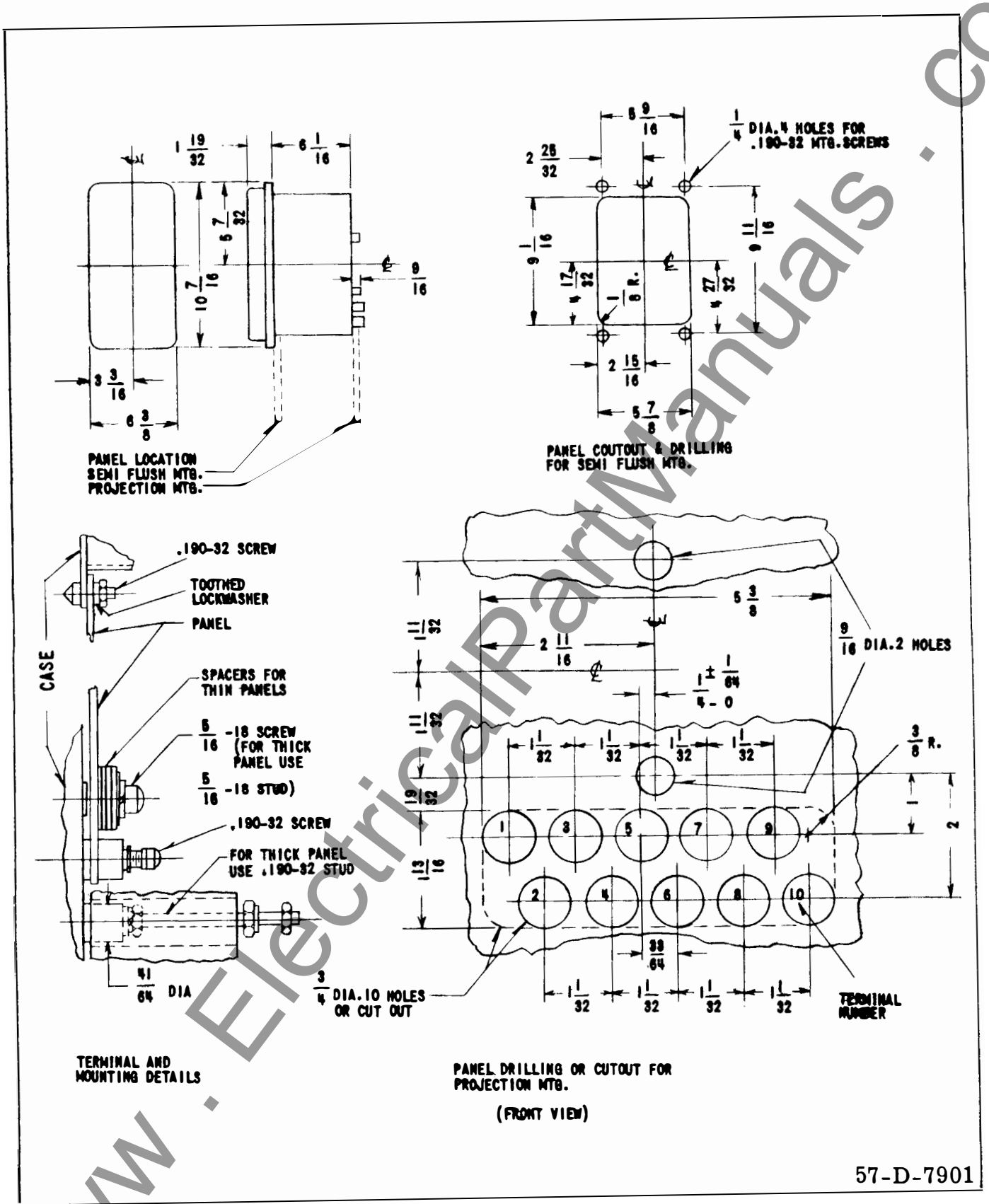


Fig. 12. Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY RELAY

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CONSTRUCTION & OPERATION

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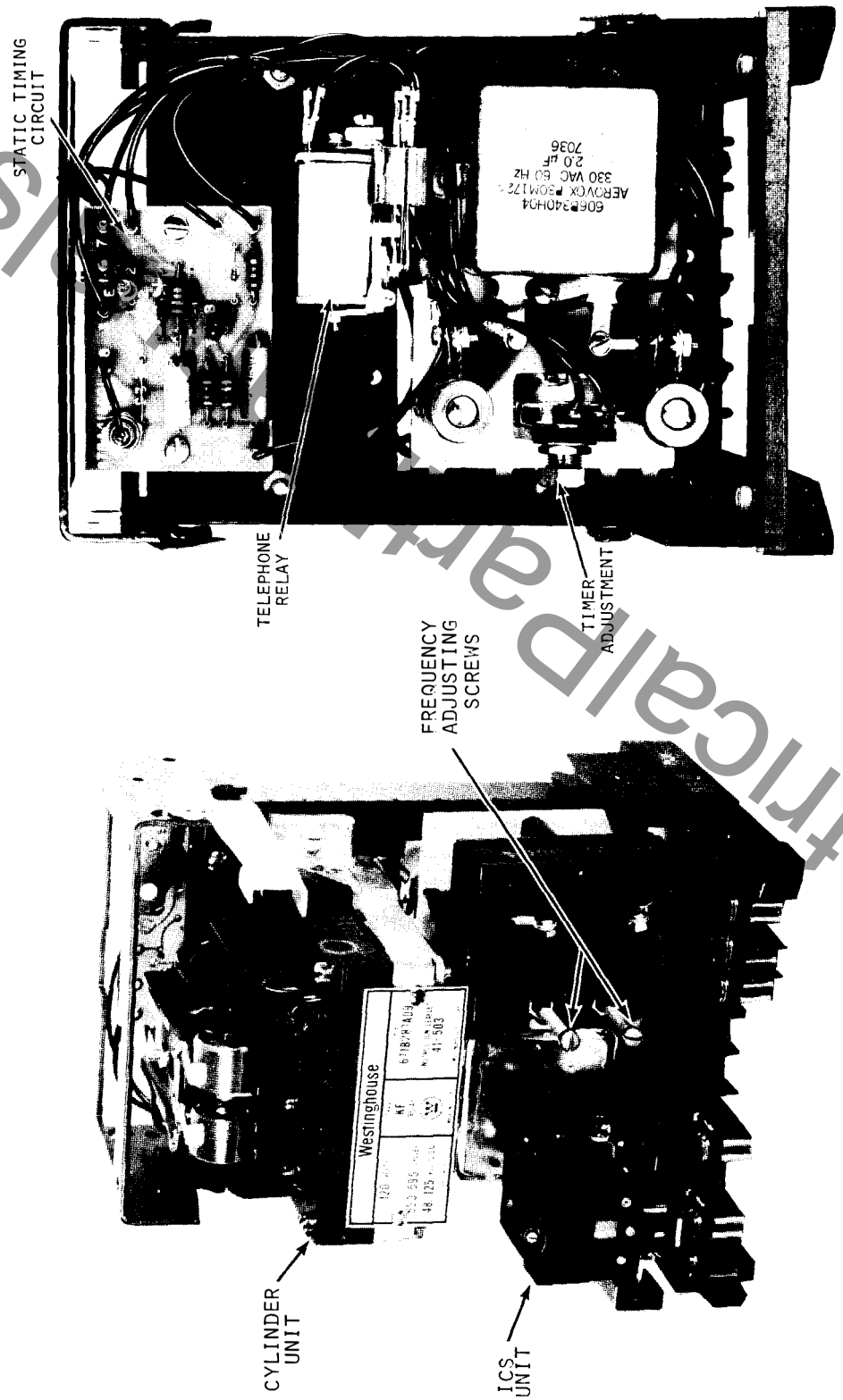
The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.



* *Fig. 1. Type KF Relay for 60 Cycles Without Case. (Front & Rear View)*

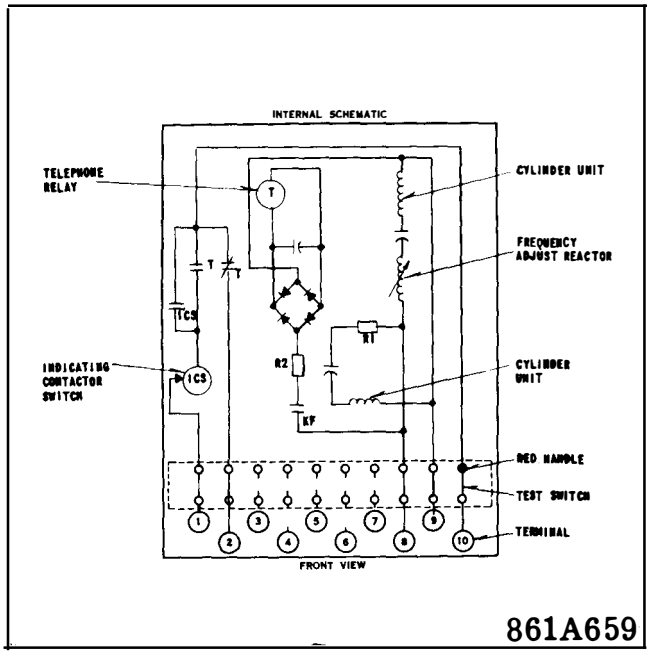


Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.

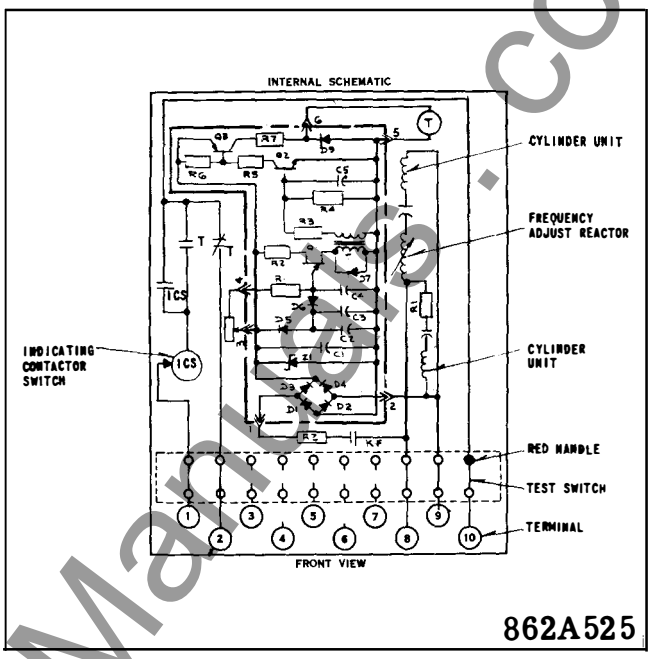
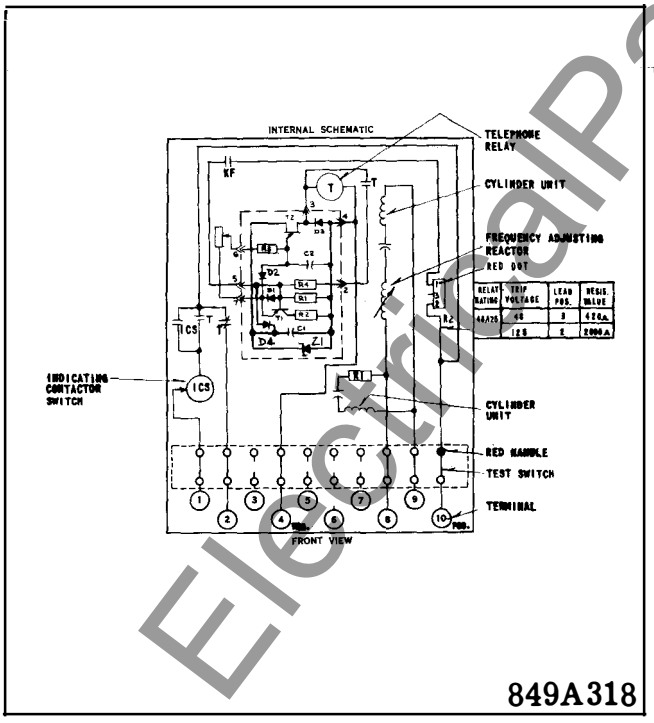


Fig. 3. Internal Schematic of Type KF Relay with A.C. Operated Adjustable Auxiliary Time Delay Unit.



** Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.*

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

1. A.C. Operation – Non-Adjustable
   This slugged telephone type relay in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-up when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
2. A.C. Operation – Adjustable
   This telephone relay in conjunction with a static timing circuit and full wave bridge provides adjustable time delays (i.e. 6 cycles to 30 cycles) or pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
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   This telephone relay in conjunction with a static timing circuit provides adjustable time delays (i.e. 6 cycles to 30 cycles) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

* The KF relay operates to close its contacts when the applied source frequency is below a preset value. The operating characteristic curves for the various auxiliary time delay settings for changing frequency conditions is shown in Figure 5.

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Trip Circuit

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Time Delay

KF with DC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 cycles (non-adjustable)

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

Relay Type	Voltage AC 60 Hertz	Timer Condition	Burden
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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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

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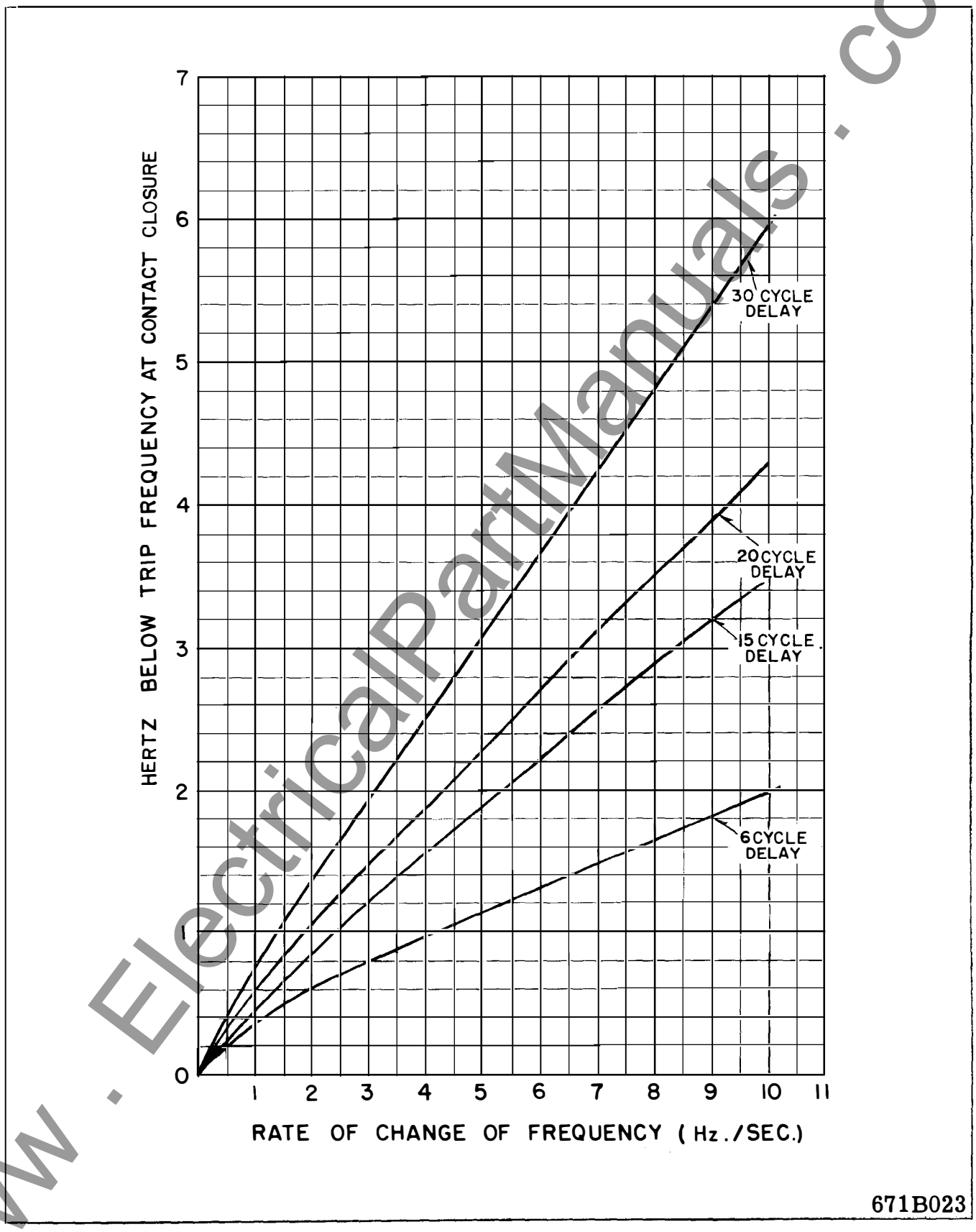


Fig. 5. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.

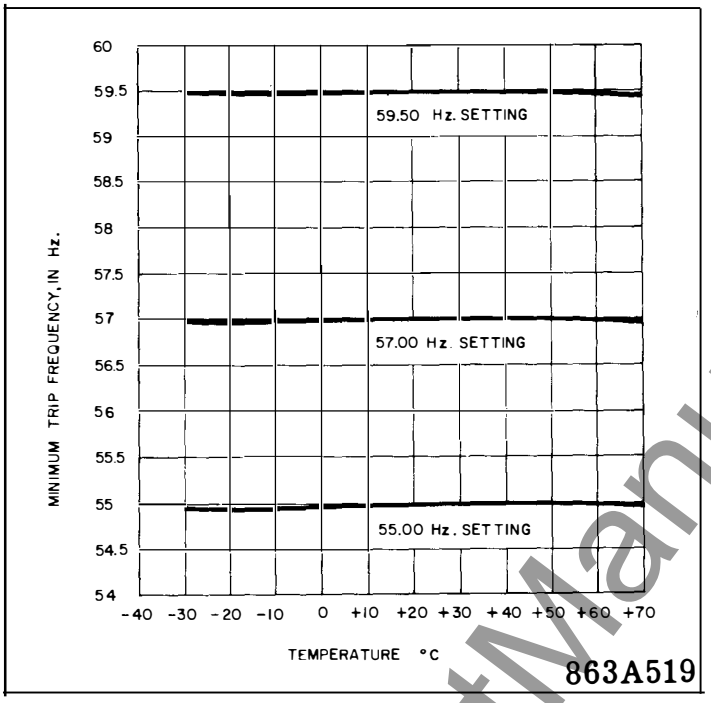


Fig. 6. Typical Temperature vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

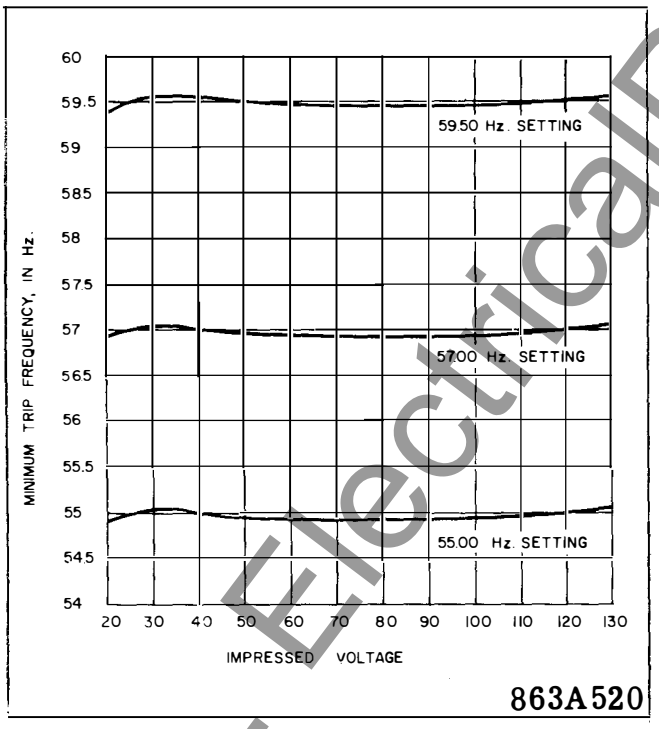


Fig. 7. Typical Voltage vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

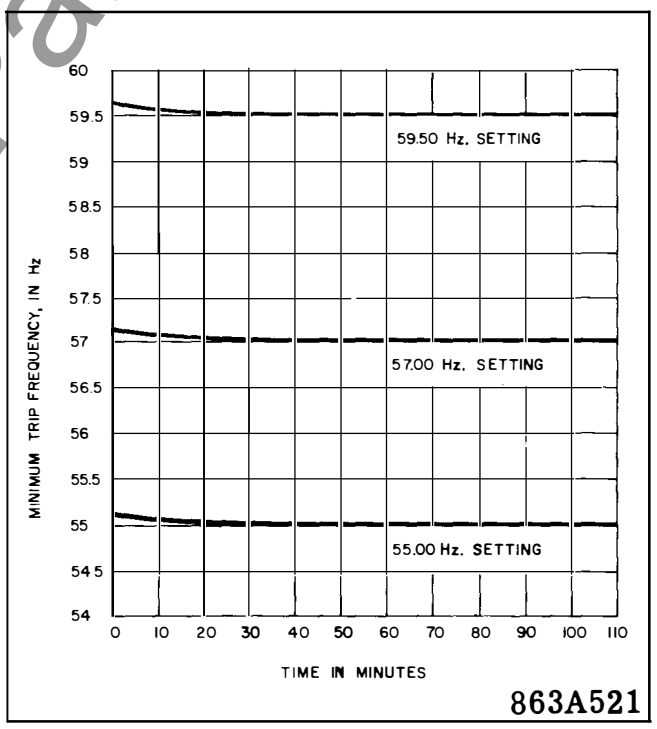


Fig. 8. Warm-Up Curve 60 Hertz KF Underfrequency Relay

B. Frequency Adjusting Reactor

1. Minimum Trip – Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 hertz, for the 60 hertz relay and 49.5 hertz for the 50 hertz relay.

2. Reduce voltage to 40 volts. Check calibration. The cylinder unit contacts should close .06 to .08 hertz above the trip frequency.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047'' between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

1. A.C. Operation – Non-Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from the telephone relay should be 6 cycles.

2. A.C. Operation – Adjustable
Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. and the T unit should drop out. At rated voltage the time delay obtained should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Figure 1.

3. D.C. Operation
Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Closing the switch will now energize the timing circuit. The time delay obtained from the telephone relay should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Fig. 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See ''Acceptance Check'').

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025'' clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an

inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 3/16 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to 59.5 hertz and adjust the frequency adjusting screws (see Fig. 1) until the cylinder unit contact closes to the left. Reduce voltage to 40 volts and raise frequency to 59.57 hertz. Adjust control spring so that cylinder unit contact just closes to the left. Raise voltage to 120 volts and recheck 59.5 settings. Adjust frequency adjusting screws if necessary. Recheck 40 volt setting, it should be between 59.56 and 59.58 hertz. Repeat above procedure if necessary until relay contacts are made between the frequency limits.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

D. Auxiliary Time Delay Unit

1. A.C. Operation – Non-Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time should be 6 cycles.

2. A.C. Operation – Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (See Figure 1).

3. D.C. Operation – Adjustable
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Close switch and time the closing of the telephone relay contacts. Adjust rheostat on rear sub base for desired time delay. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (see Fig. 1).

* 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 and styles from the Electrical Parts List.

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	REFERENCE	STYLE
FREQUENCY SENSING CIRCUIT – FIG. 2, 3, 4		
RESISTOR – R1	750 ohm, 25 N, ±5%	1267285
CAPACITORS – Reactor Leg	.225 MFD, 750 VAC, ±3%	606B340H07
Resistor Leg	2.0 MFD, 330 VAC, ±3%	606B340H04
Reactor		290B179G04
AC FIXED 6 CYCLE TIMER – FIG. 2		
RESISTOR (R2)	1600 ohm, 24 W, ±5%	1267294
CAPACITORS – (3 In Parallel)	68 MFD, 35 V, ±20%	187A508H02
DIODES – (Bridge)	1N4821	188A342H16
TELEPHONE RELAY (T)		541D231H14
AC ADJUSTABLE 6 TO 30 CYCLE TIMER – FIG. 3		
RESISTOR – (R2)	750 ohm, 25 w, ±5%	1267285
POTENTIOMETER	25 K ohm, 2 w, ±10%	185A067H03
TELEPHONE RELAY (T)		541D514H10
CIRCUIT BOARD ASSEMBLY – STYLE 691B182G01		
CAPACITORS – C1	47 MFD, 35 V, ±20%	184A661H03
C2, C3, C5	6.8 MFD, 35 V, ±5%	184A661H21
C4	0.1 MFD, 50 V, ±20%	184A663H04
DIODES – D1, D2, D3, D4	1N5053	188A342H12
D5, D6, D7, D8, D9	7155	183A790H09
RESISTORS – R1	1.8 K ohm, ½ w, ±5%	184A763H33
R2	100 ohm, ½ w, ±5%	184A763H03
R3	33 Ohm, ½ w, ±5%	187A290H13
R4	15 K ohm, ½ w, ±5%	184A763H55
R5, R6	10 K ohm, ½ w, ±5%	184A763H51
R7	470 ohm, ½ w, ±5%	184A763H19
TRANSFORMERS – T1	H62, UTC	629A453H01
TRANSISTORS – Q1	2N2647, UJT	629A435H01
Q2	2N3417, NPN	848A851H02
Q3	2N3645, PNP	849A441H01
ZENER DIODES – Z1	1N2986B, 24 V, ±5%	629A798H03
DC ADJUSTABLE 16 TO 30 CYCLE TIMER – FIG. 4		
RESISTOR (R2)	420-2000 ohm, 25 w, ±5%	11D9511H08
POTENTIOMETER	10 K ohm, 2 w, ±10%	185A067H02
TELEPHONE RELAY (T)		541D514H10
CIRCUIT BOARD ASSEMBLY – STYLE 878A418G01		
CAPACITORS – C1	47 MFD, 35 V, ±20%	184A661H03
C2	47 MFD, 35 V, ±10%	187A508H13
DIODES – D1, D2, D3, D4	T155	183A790H09
RESISTORS – R1	10 K ohm, ½ w, ±5%	184A763H51
R2	1.2 K ohm, ½ w, ±5%	184A763H29
R3	680 ohm, ½ w, ±5%	184A763H23
R4	1.5 K ohm, ½ w, ±5%	184A763H31
TRANSISTORS – Q1	2N4249, PNP	849A441H03
Q2	2N2647, UJT	629A435H01
ZENER DIODES – Z1	1N298B, 30 V, ±5%	629A798H01

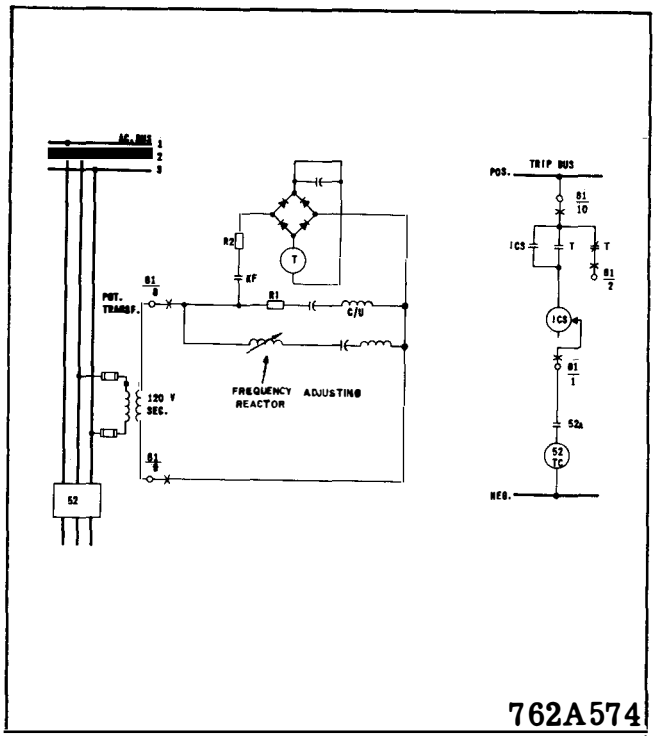
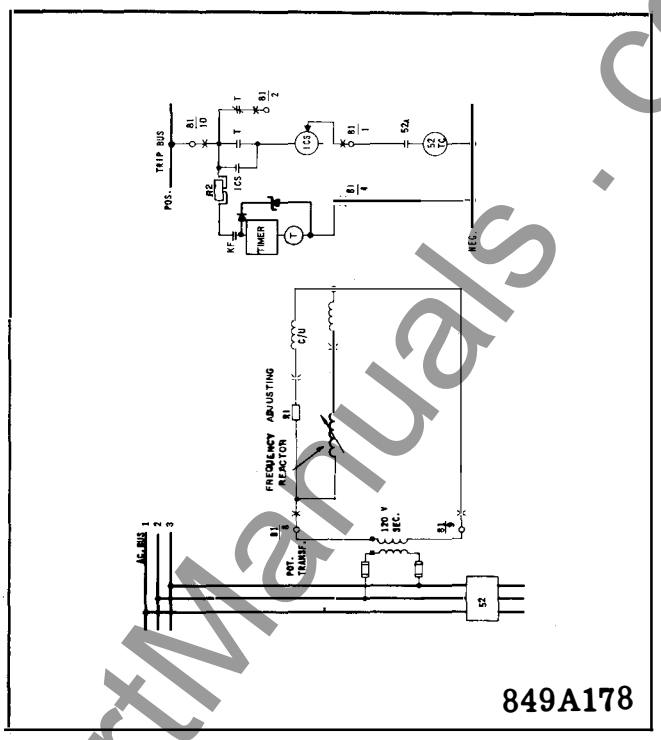


Fig. 9. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.



** Fig. 10. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.*

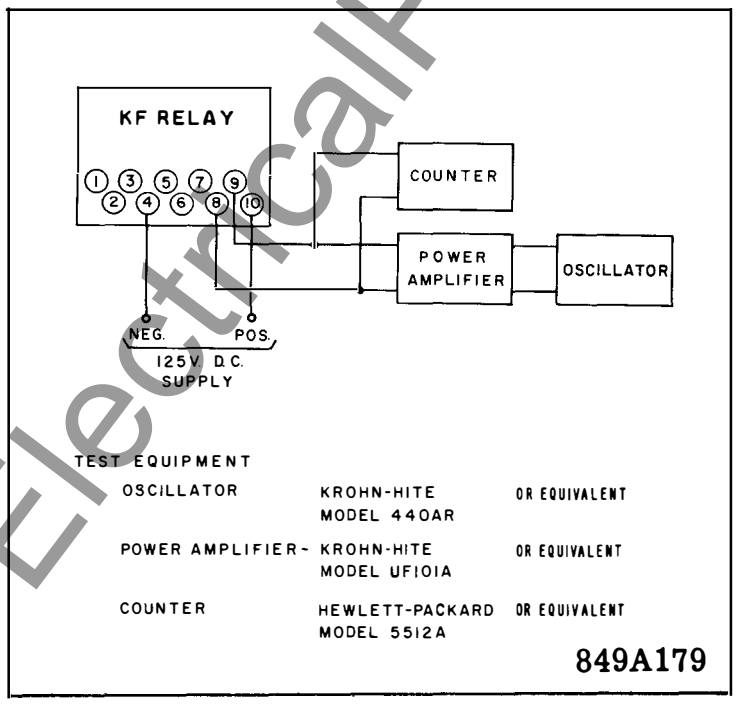


Fig. 11. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.

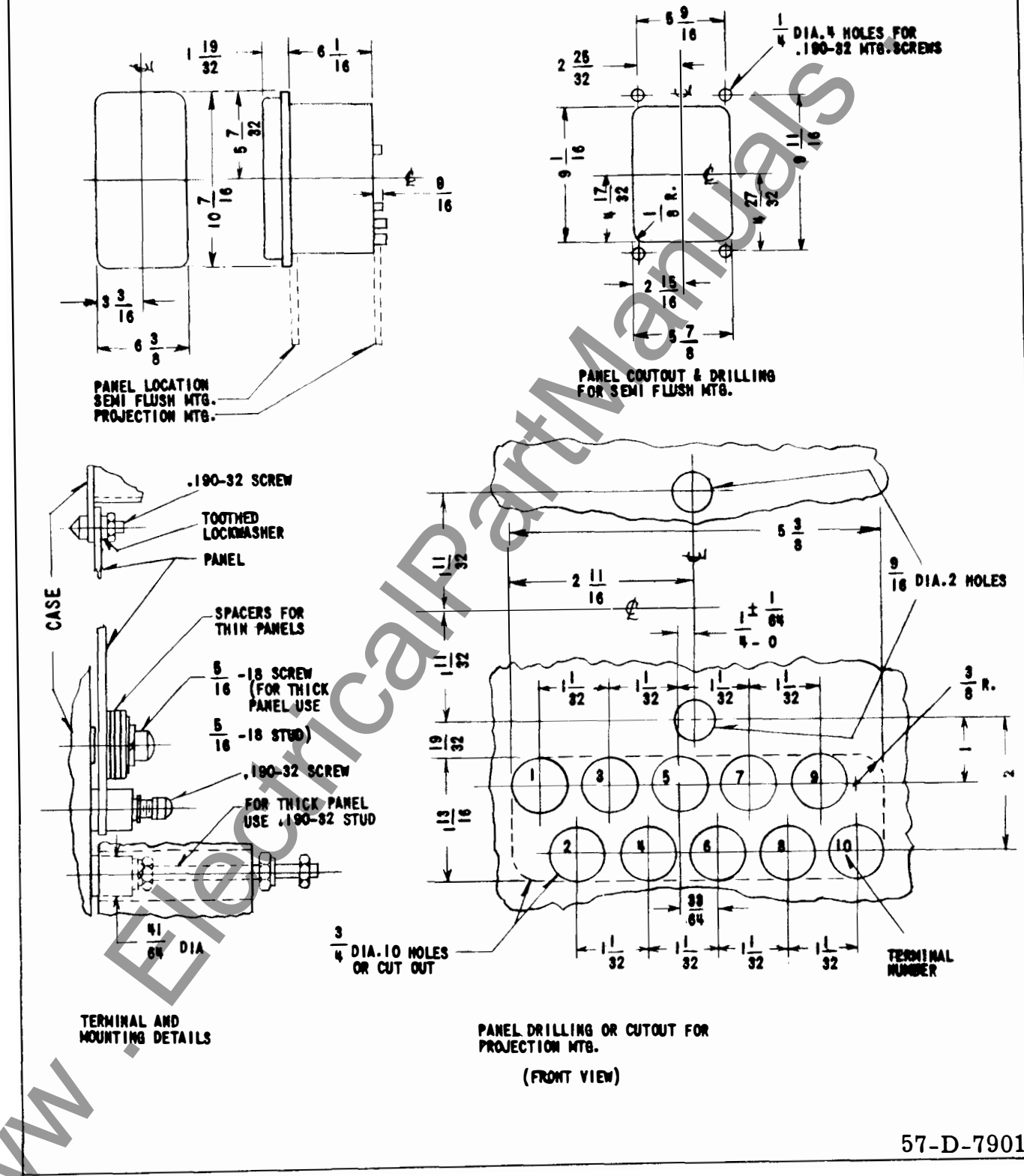
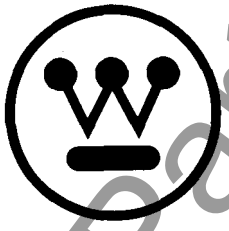


Fig. 12. Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.



WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, and auxiliary time delay unit (T). The principal parts of the relay can be seen in Figure 1.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

SUPERSEDES I.L. 41-503J
*Denotes change from superseded issue.

EFFECTIVE JUNE 1972

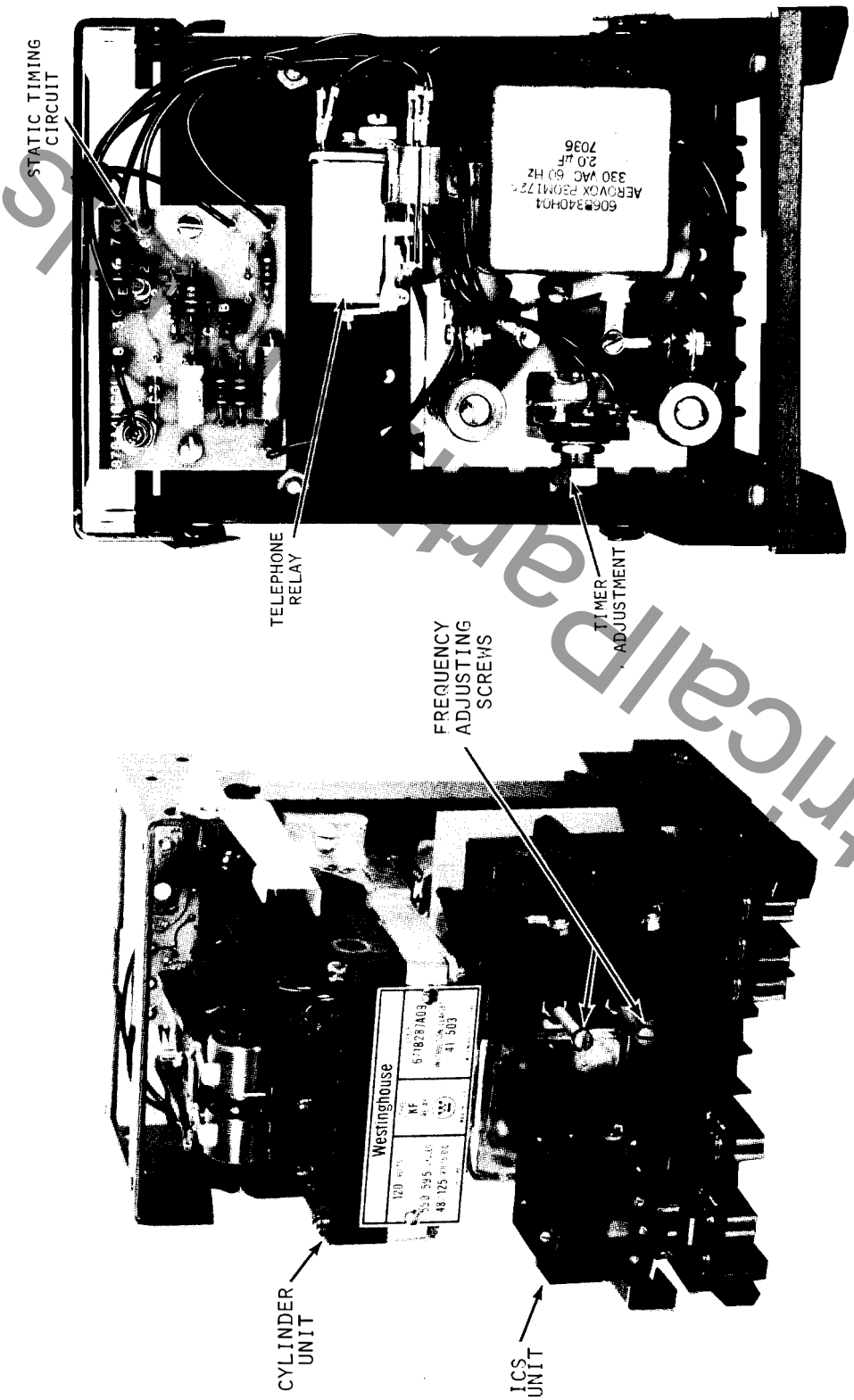


Fig. 1. Type KF Relay for 60 Cycles Without Case. (Front & Rear View)

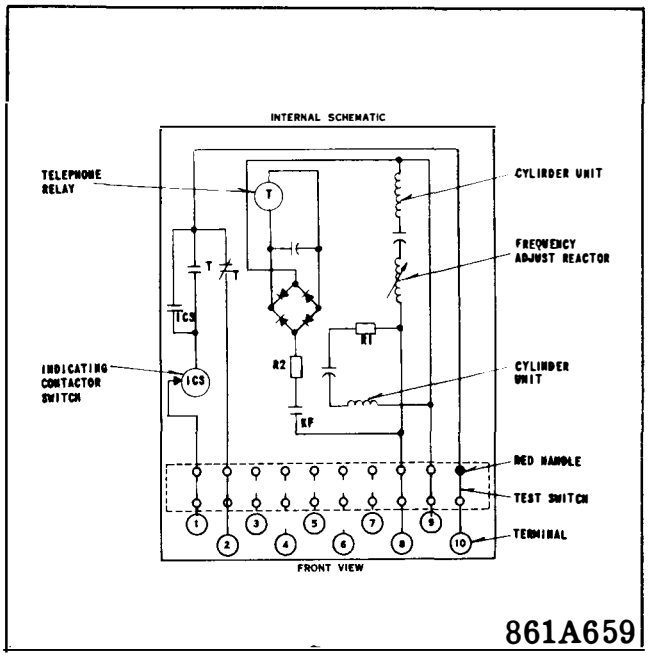


Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.

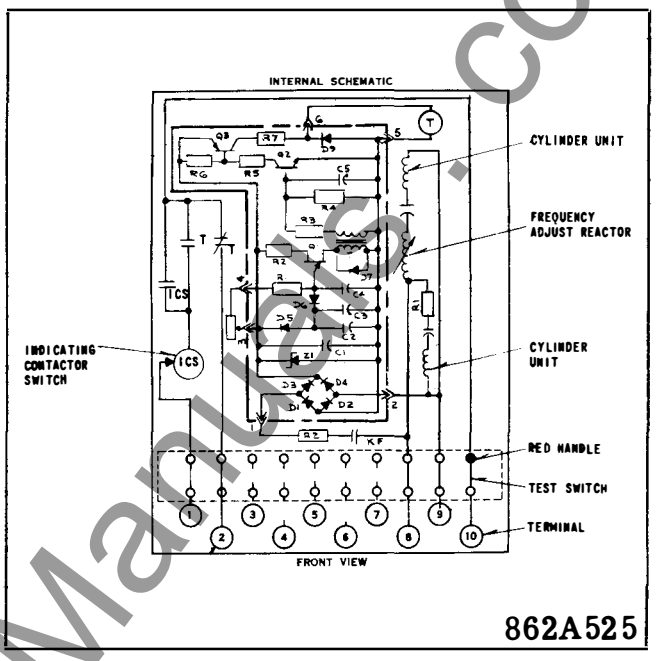


Fig. 3. Internal Schematic of Type KF Relay with A.C. Operated Adjustable Auxiliary Time Delay Unit.

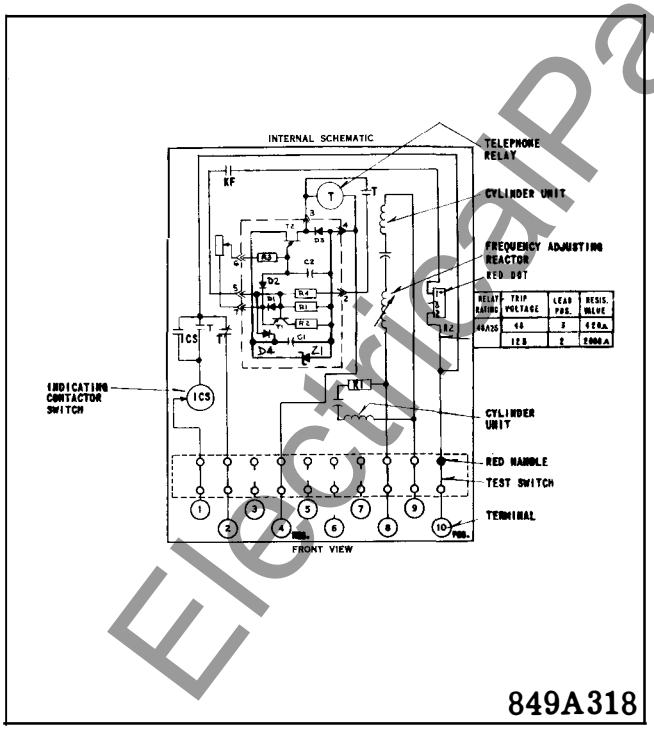


Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

1. A.C. Operation — Non-Adjustable
   This slugged telephone type relay in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-up when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
2. A.C. Operation — Adjustable
   This telephone relay in conjunction with a static timing circuit and full wave bridge provides adjustable time delays (i.e. 6 cycles to 30 cycles) or pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
3. D.C. Operation
   This telephone relay in conjunction with a static timing circuit provides adjustable time delays (i.e. 6 cycles to 30 cycles) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applied source frequency is below a preset value. The operating characteristic curves for the various auxiliary time delay settings for changing frequency conditions is shown in Figure 5.

Rating

The type KF underfrequency relay is rated 120 volts at 60 hertz, or 120 volts at 50 hertz. The adjustable range of frequency is 55 to 59.5 hertz for the 60 hertz relay and 44 to 49.5 hertz for the 50 hertz relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Time Delay

KF with DC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 cycles (non-adjustable)

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

Relay Type	Voltage AC 60 Hertz	Timer Condition	Burden
KF with D.C. Timer	120	N/A	14.7VA
KF with Adjustable A.C. Timer	120	Energized De-energized	29.4VA 14.7VA
KF with Non-Adjustable A.C. Timer	120	Energized De-energized	20.4VA 14.7VA

SETTINGS

The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ hertz below rated frequency unless otherwise specified. Turning either of the adjusting screws in a clockwise direction decreases the frequency at which the relay trips. The rate of change of frequency per second versus hertz below trip frequency is shown in Figure 5 for various time delays.

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

Contact Gap - The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.

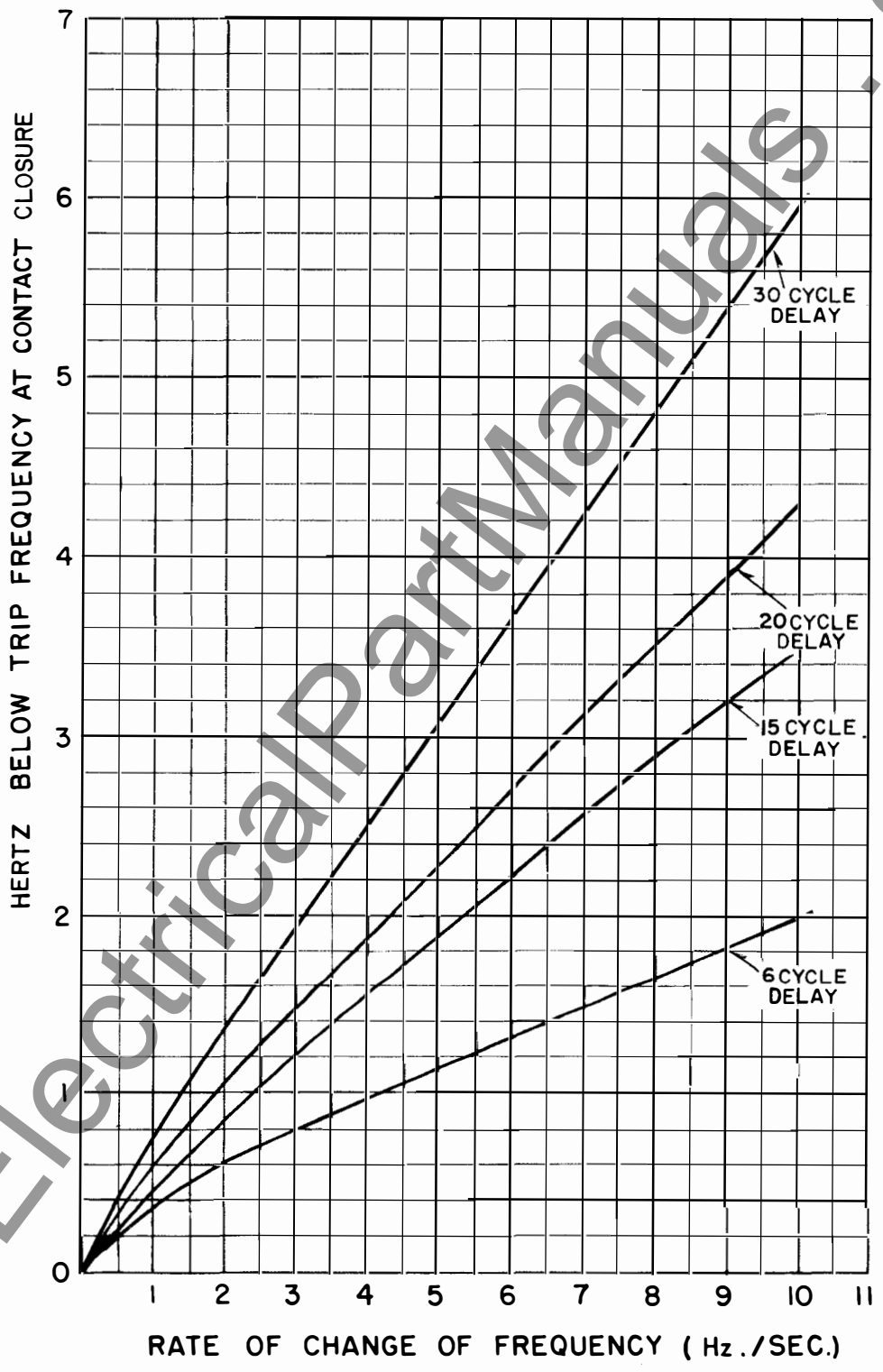


Fig. 5. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.

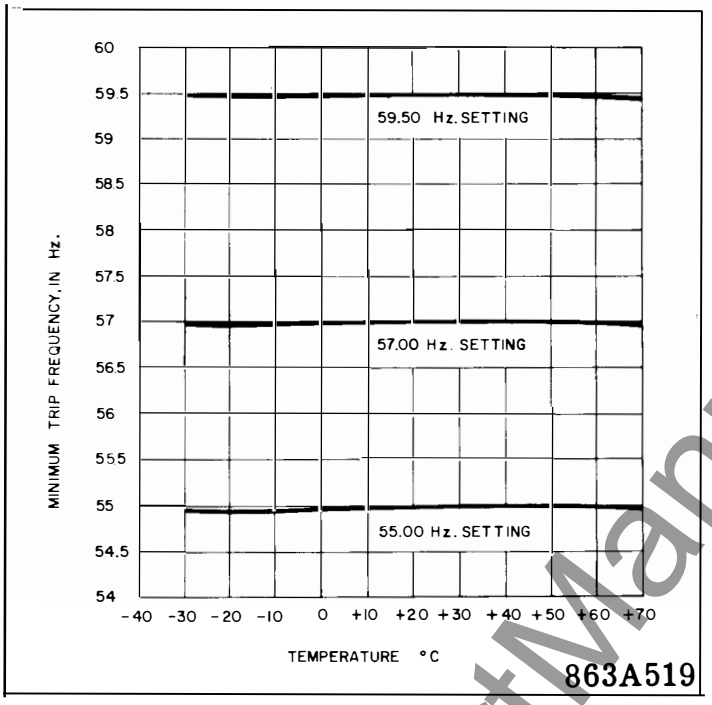


Fig. 6. Typical Temperature vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

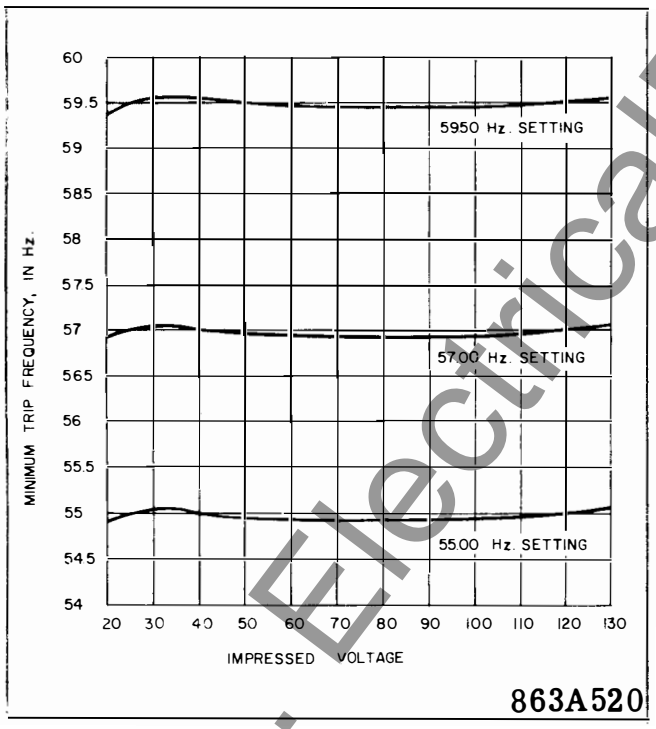


Fig. 7. Typical Voltage vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

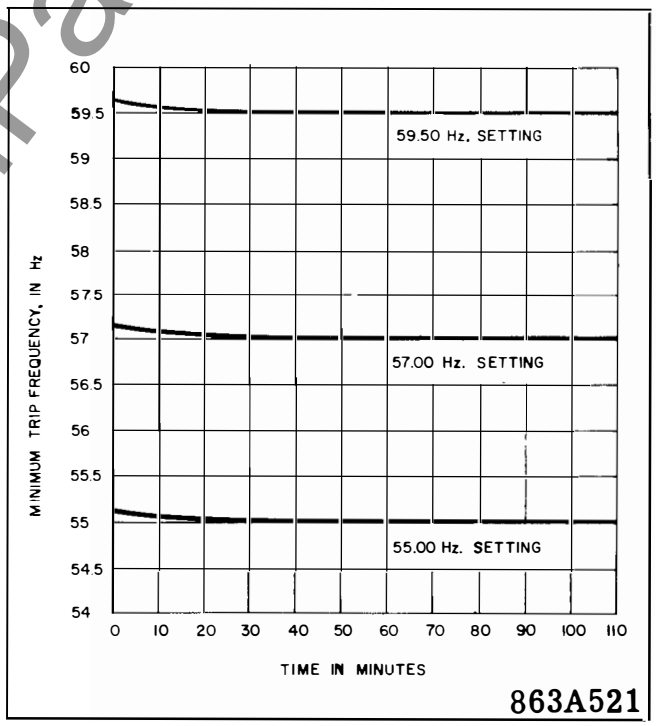


Fig. 8. Warm-Up Curve 60 Hertz KF Underfrequency Relay

B. Frequency Adjusting Reactor

1. Minimum Trip – Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 hertz, for the 60 hertz relay and 49.5 hertz for the 50 hertz relay.

2. Reduce voltage to 40 volts. Check calibration. The cylinder unit contacts should close .06 to .08 hertz above the trip frequency.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047'' between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

1. A.C. Operation – Non-Adjustable
   Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from the telephone relay should be 6 cycles.

2. A.C. Operation – Adjustable
   Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to 30 volts a.c. and the T unit should drop out. At rated voltage the time delay obtained should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Figure 1.

3. D.C. Operation
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Closing the switch will now energize the timing circuit. The time delay obtained from the telephone relay should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Fig. 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See ''Acceptance Check'').

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025'' clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

   With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an

inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 3/16 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to 59.5 hertz and adjust the frequency adjusting screws (see Fig. 1) until the cylinder unit contact closes to the left. Reduce voltage to 40 volts and raise frequency to 59.57 hertz. Adjust control spring so that cylinder unit contact just closes to the left. Raise voltage to 120 volts and recheck 59.5 settings. Adjust frequency adjusting screws if necessary. Recheck 40 volt setting, it should be between 59.56 and 59.58 hertz. Repeat above procedure if necessary until relay contacts are made between the frequency limits.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

D. Auxiliary Time Delay Unit

1. A.C. Operation — Non-Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time should be 6 cycles.

2. A.C. Operation — Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (See Figure 1).

3. D.C. Operation — Adjustable
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Close switch and time the closing of the telephone relay contacts. Adjust rheostat on rear sub base for desired time delay. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (see Fig. 1).

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 and styles from the Electrical Parts List.

* ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	REFERENCE	STYLE
FREQUENCY SENSING CIRCUIT – FIG. 2, 3, 4		
RESISTOR – R1	750 ohm, 25W, ± 5%	1267285
CAPACITORS – Reactor Leg	.225 MFD, 750 VAC, ± 3%	606B340H07
Resistor Leg	2.0 MFD, 330 VAC, ± 3%	606B340H04
Reactor		290B179G04
AC FIXED 6 CYCLE TIMER – FIG. 2		
RESISTOR (R2)	1600 ohm, 25W, ± 5%	1267294
CAPACITORS – (3 In Parallel)	68 MFD, 35 V, ± 20%	187A508H02
DIODES – (Bridge)	1N4821	188A342H16
TELEPHONE RELAY (T)		541D231H14
AC ADJUSTABLE 6 TO 30 CYCLE TIMER – FIG. 3		
RESISTOR – (R2)	750 ohm, 25 w, ± 5%	1267285
POTENTIOMETER	25 K ohm, 2 w, ± 10%	185A067H03
TELEPHONE RELAY (T)		541D514H10
CIRCUIT BOARD ASSEMBLY – STYLE 691B182G01		
CAPACITORS – C1	47 MFD, 35 V, ± 20%	184A661H03
C2, C3, C5	6.8 MFD, 35 V, ± 5%	184A661H21
C4	0.1 MFD, 50 V, ± 20%	184A663H04
DIODES – D1, D2, D3, D4	1N5053	188A342H12
D5, D6, D7, D8, D9	T155	183A790H09
RESISTORS – R1	1.8 K ohm, ½ w, ± 5%	184A763H33
R2	100 ohm, ½ w, ± 5%	184A763H03
R3	33 Ohm, ½ w, ± 5%	187A290H13
R4	15 K ohm, ½ w, ± 5%	184A763H55
R5, R6	10 K ohm, ½ w, ± 5%	184A763H51
R7	470 ohm, ½ w, ± 5%	184A763H19
TRANSFORMERS – T1	H62, UTC	629A453H01
TRANSISTORS – Q1	2N2647, UJT	629A435H01
Q2	2N3417, NPN	848A851H02
Q3	2N3645, PNP	849A441H01
ZENER DIODES – Z1	1N2986B, 24 V, ± 5%	629A798H03
DC ADJUSTABLE 6 TO 30 CYCLE TIMER – FIG. 4		
RESISTOR (R2)	420-2000 ohm, 25 w, ± 5%	11D9511H08
POTENTIOMETER	10 K ohm, 2 w, ± 10%	185A067H02
TELEPHONE RELAY (T)		541D514H10
CIRCUIT BOARD ASSEMBLY – STYLE 878A418G01		
CAPACITORS – C1	47 MFD, 35 V, ± 20%	184A661H03
C2	47 MFD, 35 V, ± 10%	187A508H13
DIODES – D1, D2, D3, D4	T155	183A790H09
RESISTORS – R1	10 K ohm, ½ w, ± 5%	184A763H51
R2	1.2 K ohm, ½ w, ± 5%	184A763H29
R3	680 ohm, ½ w, ± 5%	184A763H23
R4	1.5 K ohm, ½ w, ± 5%	184A763H31
TRANSISTORS – Q1	2N4249, PNP	849A441H03
Q2	2N2647, UJT	629A435H01
ZENER DIODES – Z1	1N2989B, 30V, ± 5%	629A798H01

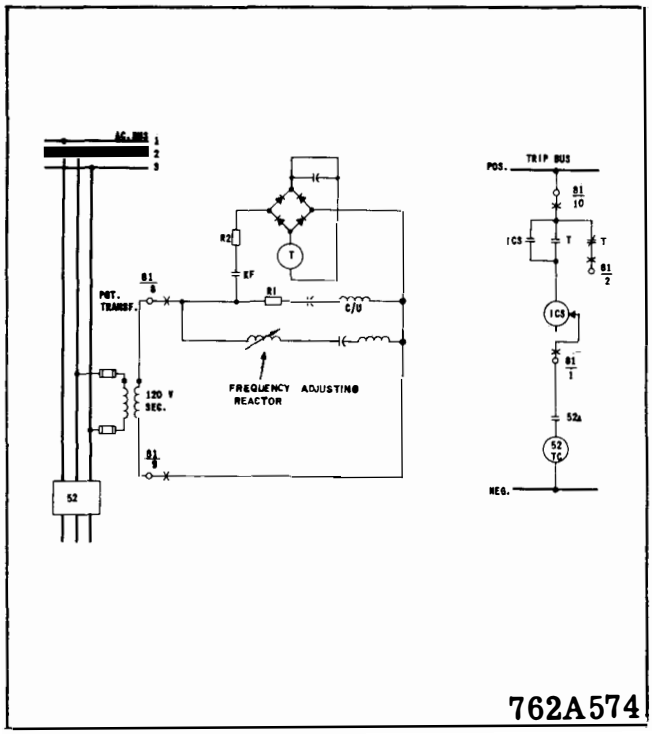


Fig. 9. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.

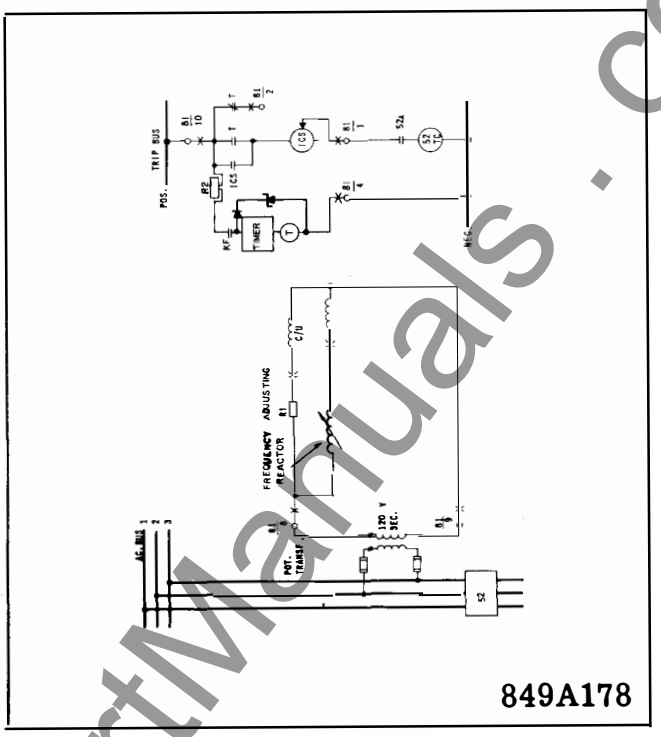


Fig. 10. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.

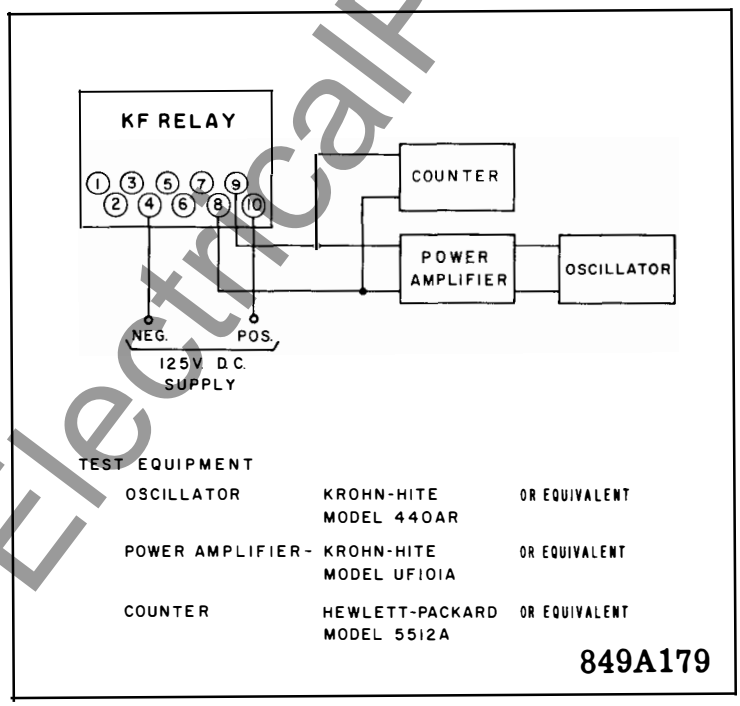


Fig. 11. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.

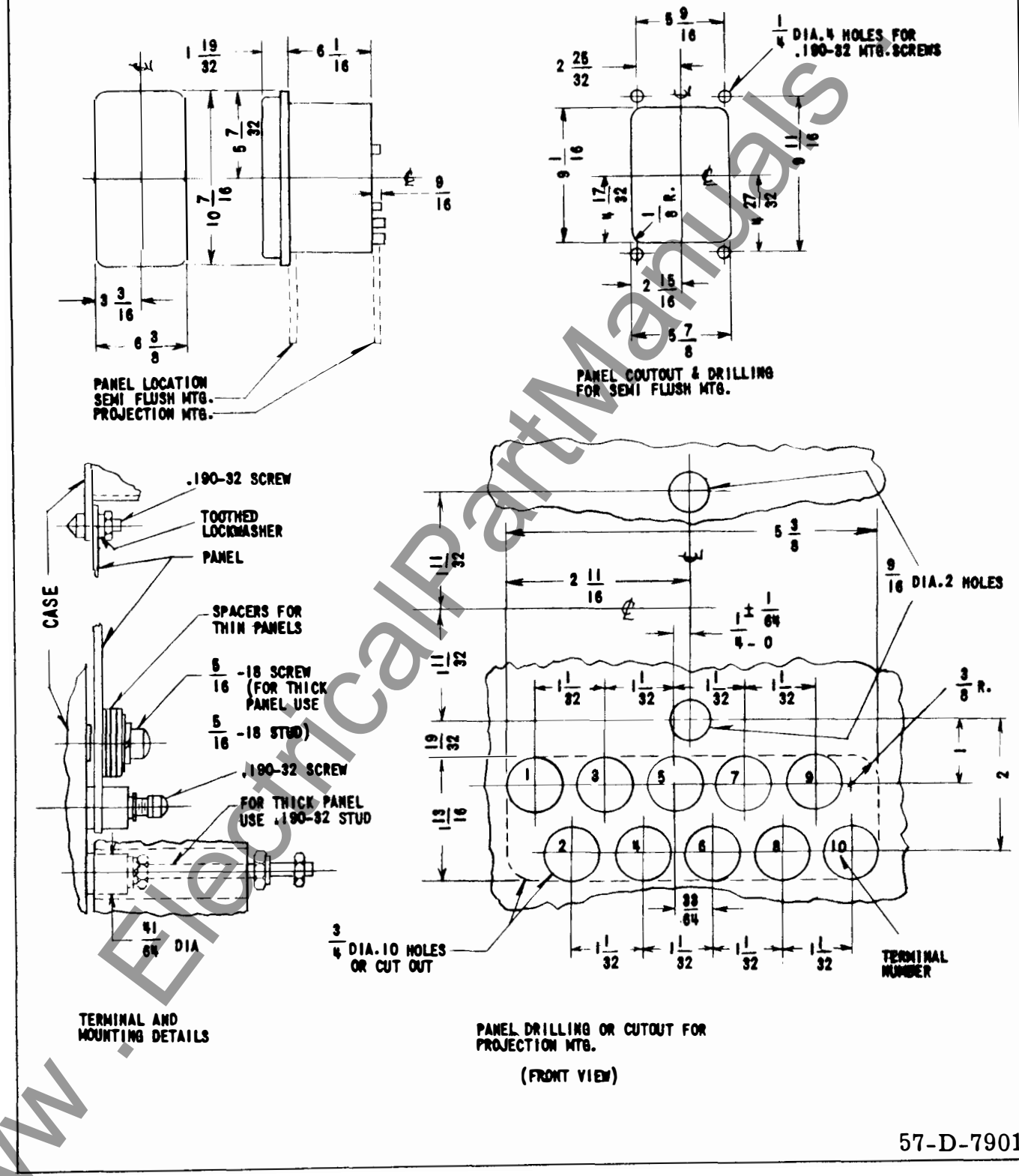


Fig. 12. Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE KF UNDERFREQUENCY 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 KF relay is a high speed underfrequency relay which provides rapid sensing of system overload so that excessive load can be shed. It is particularly suitable for relatively isolated areas where a severe overload (i.e., more than 50%) could occur due to a tie-line trip.

CONSTRUCTION & OPERATION

The relay consists of an induction cylinder unit, frequency sensitive components, indicating contactor switch, and auxiliary time delay unit (T). The principal parts of the relay can be seen in Figure 1.

A. Induction Cylinder Unit

The induction cylinder unit is a product type unit operating on the interaction between the fluxes that are produced on the four poles. Mechanically, the induction unit is composed of four basic components; a die cast aluminum frame, an electromagnet, a moving element assembly and a molded bridge. The frame serves as a mounting structure for the magnetic core. The magnetic core which houses the lower pin bearing is secured to the frame by a locking nut. The bearing can be replaced, if necessary, without having to remove the magnetic core from the frame. The electromagnet has four coils mounted on the four poles. The coils mounted diametrically opposite each other are connected in series. The locating pins of the electromagnet are used to accurately position the lower pin bearing, which is mounted on the frame, with respect to the upper pin bearing which is threaded into the bridge. The electromagnet is secured to the frame by four mounting screws.

The moving element assembly consists of a spiral spring, contact carrying member, and an aluminum cylinder assembled to a molded hub which holds the shaft. The shaft has removable top and bottom jewel bearings. The shaft rides between the bottom pin bearing and the upper pin bearing with the cylinder rotating in an air gap formed by the electromagnet and the magnetic core. The stops for the moving element contact arm are an integral part of the bridge.

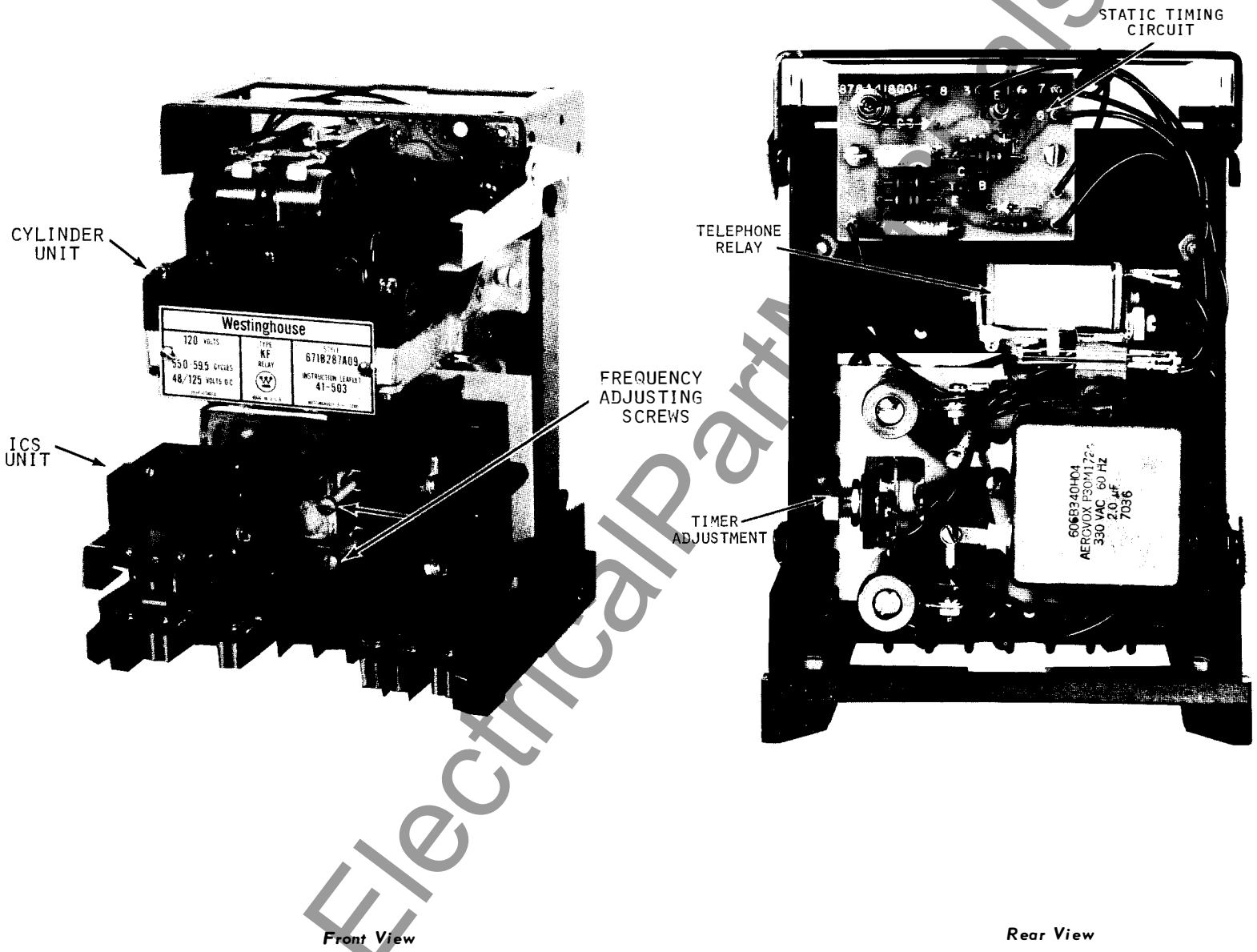
The bridge is secured to the electromagnet and frame by two mounting screws. In addition to holding the upper pin bearing, the bridge is used for mounting the adjustable stationary contact housing. The stationary contact housing is held in position by a spring type clamp. The spring adjuster is located on the underside of the bridge and is attached to the moving contact arm by a spiral spring. The spring adjuster is also held in place by a spring type clamp. With the contacts closed, the electrical connection is made through the stationary contact housing clamp, to the moving contact, through the spiral spring out to the spring adjuster clamp.

B. Indicating Contactor Switch Unit (ICS)

The indicating contactor switch is a small d-c operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

SUPERSEDES I.L. 41-503L, dated Jan. 1974
*Denotes change from superseded issue.

EFFECTIVE MAY 1975



Front View *Rear View*

***Fig. 1.** Type KF Relay for 60 Cycles Without Case. (Front & Rear View)*

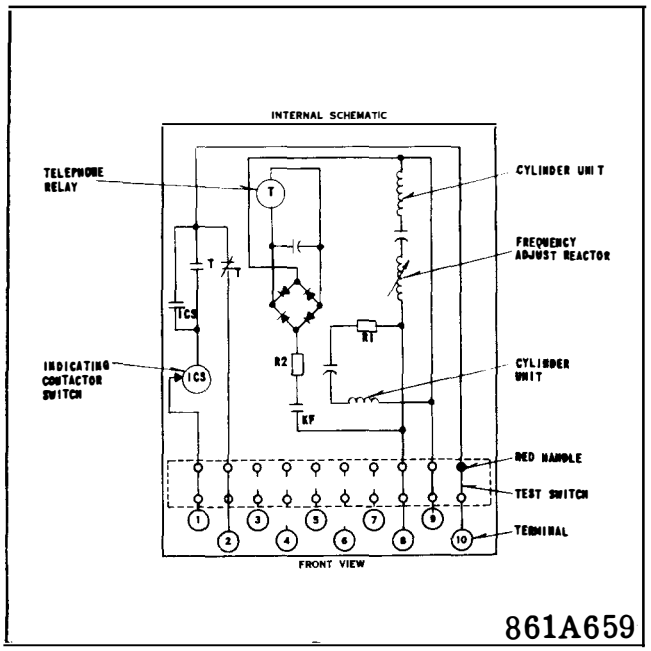


Fig. 2. Internal Schematic of Type KF Relay with A.C. Operated Auxiliary Time Delay Unit.

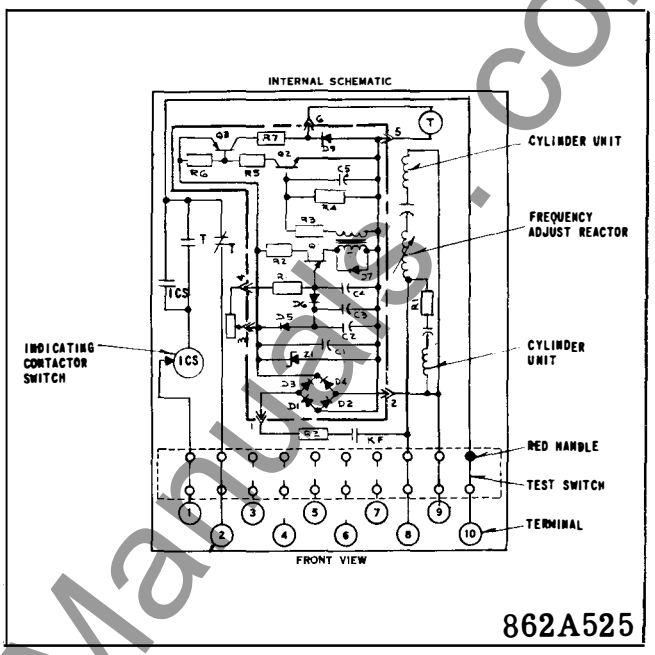
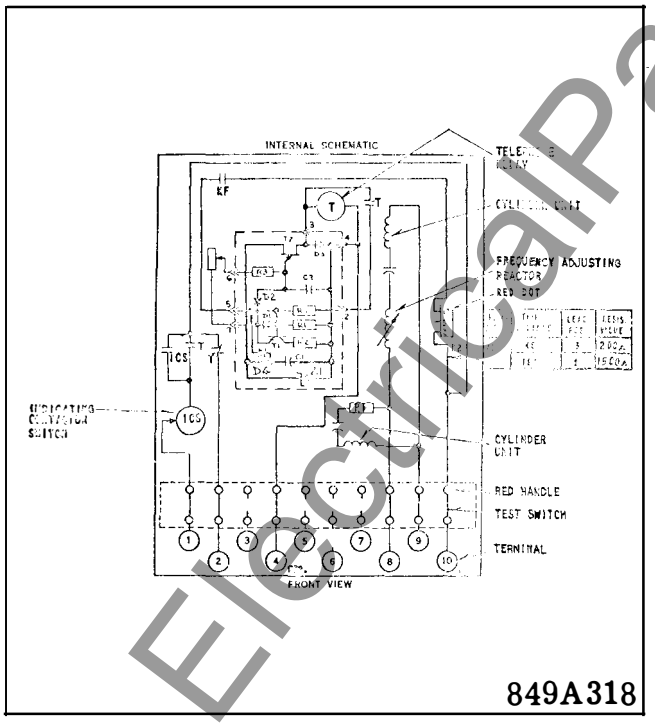


Fig. 3. Internal Schematic of Type KF Relay with A.C. Operated Adjustable Auxiliary Time Delay Unit.



** Fig. 4. Internal Schematic of Type KF Relay with D.C. Operated Adjustable Auxiliary Time Delay Unit.*

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

C. Frequency Sensitive Components:

The frequency sensitive components consist of capacitors and a variable reactor which is used for setting the relay to trip at the desired frequency.

D. Auxiliary Time Delay Unit

1. A.C. Operation — Non-Adjustable
   This slugged telephone type relay in conjunction with a resistor, capacitor and full wave bridge provides time delay on pick-up when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
2. A.C. Operation — Adjustable
   This telephone relay in conjunction with a static timing circuit and full wave bridge provides adjustable time delays (i.e. 6 cycles to 30 cycles) or pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.
3. D.C. Operation
   This telephone relay in conjunction with a static timing circuit provides adjustable time delays (i.e. 6 cycles to 30 cycles) on pickup when the KF relay contacts close. The contacts of the auxiliary time delay unit are connected in the trip circuit.

CHARACTERISTICS

The KF relay operates to close its contacts when the applied source frequency is below a preset value. The operating characteristic curves for the various auxiliary time delay settings for changing frequency conditions is shown in Figure 5.

Rating

The type KF underfrequency relay is rated 120 volts at 60 hertz, or 120 volts at 50 hertz. The adjustable range of frequency is 55 to 59.5 hertz for the 60 hertz relay and 44 to 49.5 hertz for the 50 hertz relay.

Trip Circuit

The main contacts will close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker. The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting of lead located in front of the tap block to the desired setting by means of a screw connection.

Time Delay

KF with DC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 to 30 cycles (adjustable)
KF with AC Timer – 6 cycles (non-adjustable)

Trip Circuit Constants

Indicating Contactor Switch –

0.2 amp tap 6.5 ohms d-c resistance

2.0 amp tap 0.15 ohms d-c resistance.

Energy Requirements

Relay Type	Voltage AC 60 Hertz	Timer Condition	Burden
KF with D.C. Timer	120	N/A	14.7VA
KF with Adjustable A.C. Timer	120	Energized De-energized	29.4VA 14.7VA
KF with Non-Adjustable A.C. Timer	120	Energized De-energized	20.4VA 14.7VA

SETTINGS

The relay is set for minimum trip by means of the reactor frequency adjusting screws. The relays are calibrated to trip at ½ hertz below rated frequency unless otherwise specified. Turning either of the adjusting screws in a clockwise direction decreases the frequency at which the relay trips. The rate of change of frequency per second versus hertz below trip frequency is shown in Figure 5 for various time delays.

Indicating Contactor Switch (ICS)

The only setting of the ICS unit required is the selection of the .2 or 2 ampere pick-up tap. This is accomplished by connecting the lead located in front of the tap block to the desired terminal by means of a connecting screw.

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 the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. 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 the terminal stud 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 detailed information on the FT case, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

Acceptance Check

The following check is recommended to insure that the relay is in proper working order.

A. Induction Cylinder Unit

Contact Gap - The gap between the stationary contact and the moving contact with the relay in the deenergized position should be approximately 1/16 inch.

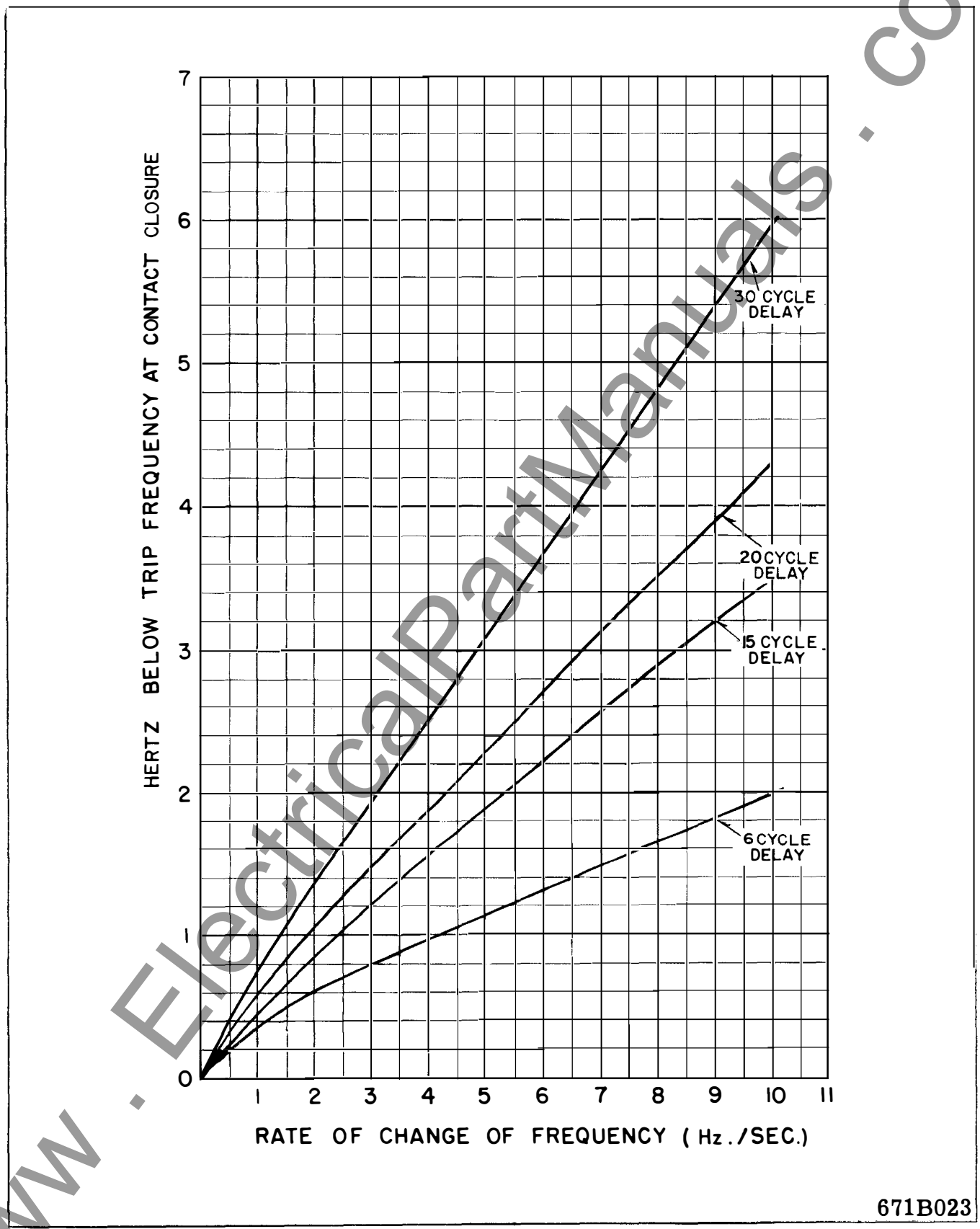


Fig. 5. Operating Characteristics of Type KF Underfrequency Relay for Changing Frequency Conditions.

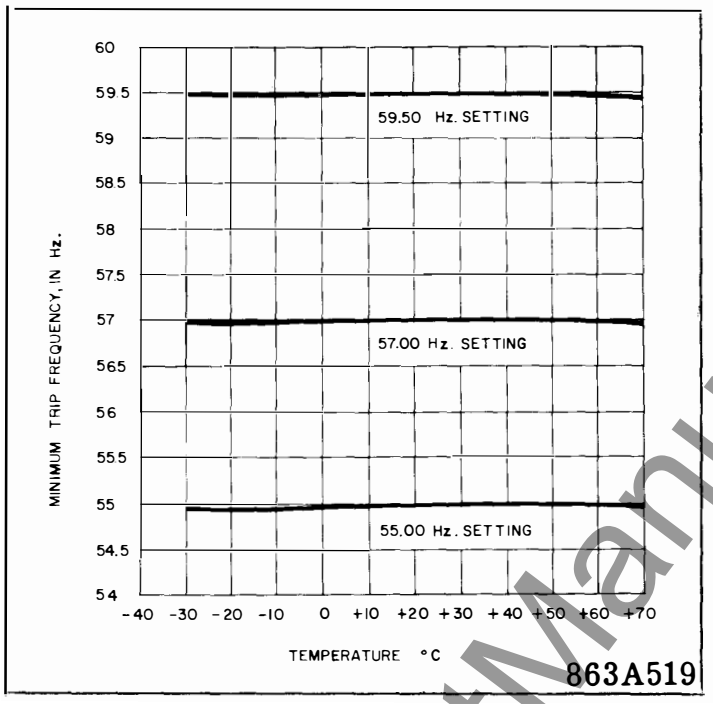


Fig. 6. Typical Temperature vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

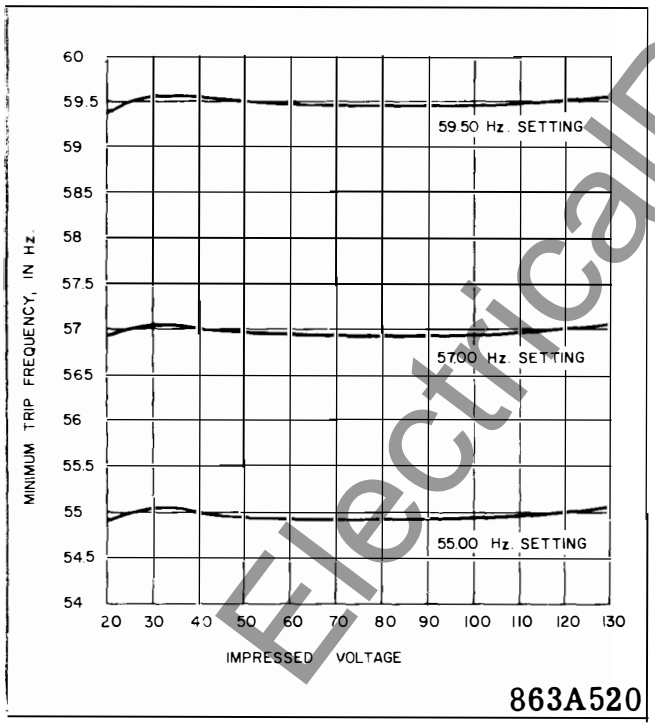


Fig. 7. Typical Voltage vs. Minimum Frequency Curves 60 Hertz KF Underfrequency Relay

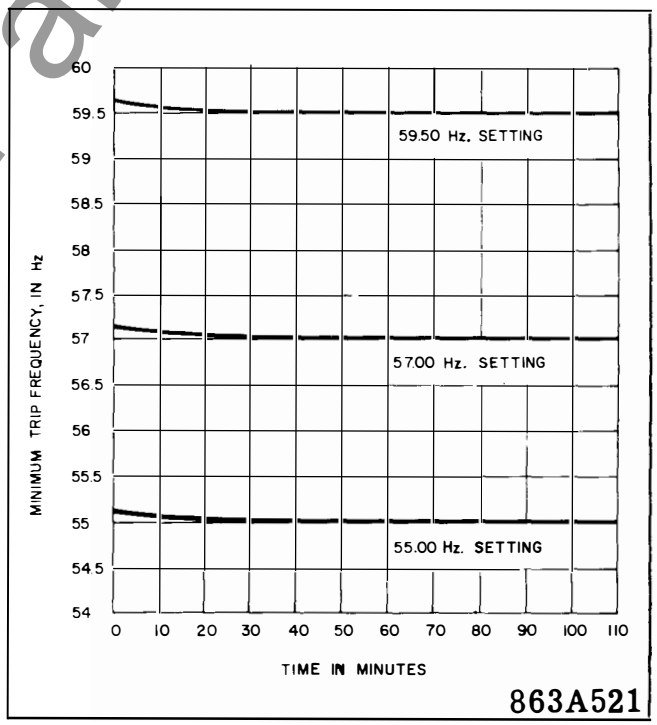


Fig. 8. Warm-Up Curve 60 Hertz KF Underfrequency Relay

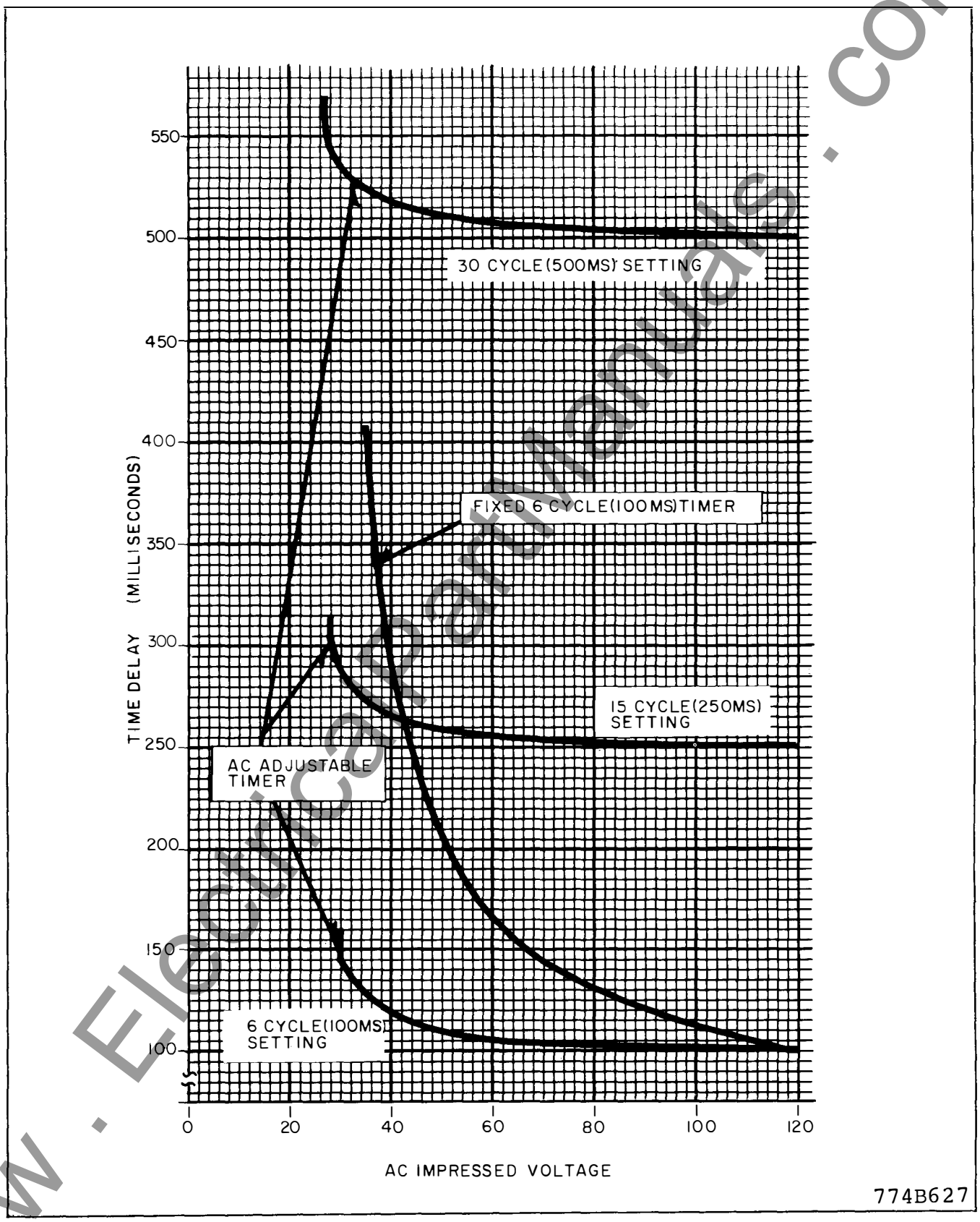


Fig. 9. Typical Time Delay vs Impressed AC Voltage

B. Frequency Adjusting Reactor

1. Minimum Trip — Using a variable frequency source apply 120V at rated frequency for 1 hour to allow the relay to reach normal operating temperature. Apply 120V at the specified trip frequency to the relay. The contacts should just close. If no other trip frequency has been specified the relays are calibrated to trip at 59.5 hertz, for the 60 hertz relay and 49.5 hertz for the 50 hertz relay.
2. Reduce voltage to 40 volts. Check calibration. The cylinder unit contacts should close .06 to .08 hertz above the trip frequency.

C. Indicating Contactor Switch

Close the auxiliary time delay unit contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

The contact gap should be approximately .047'' between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

D. Auxiliary Time Delay Unit (T)

1. A.C. Operation — Non-Adjustable
   Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to approximately 20 volts a.c. The T unit should drop out. At rated voltage the time delay obtained from the telephone relay should be 6 cycles. Time vs voltage curve is shown in Figure 9.
2. A.C. Operation — Adjustable
   Block cylinder unit contacts closed. Apply 50 volts a.c. to terminals 8 and 9 of the KF relay. The T unit should operate. Reduce voltage to approximately 15 volts a.c. and the T unit should drop out. At rated voltage the time delay obtained should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. (See Figure 1). Time vs voltage curves are shown in Figure 9.
3. D.C. Operation
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Closing the switch will now energize the timing circuit. The time delay obtained from the telephone relay should be 6 cycles. The timer can be set to provide up to 30 cycles delay by adjusting the rheostat located on the rear sub base. See Fig. 1.

Routine Maintenance

All relays should be inspected and checked periodically to assure proper operation. Generally a visual inspection should call attention to any noticeable changes. A minimum suggested check on the relay system is to close the contacts manually to assure that the breaker trips and the target drops. Then release the contacts and observe that the reset is smooth and positive.

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 soft silver and thus impairing the contact.

Calibration

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments have been disturbed. This procedure should not be used unless it is apparent that the relay is not in proper working order. (See ''Acceptance Check'').

A. Induction Cylinder Unit

1. The upper pin bearing should be screwed down until there is approximately .025'' clearance between it and the top of shaft bearing. The upper pin bearing should then be securely locked in position with the lock nut. The lower bearing position is fixed and cannot be adjusted.

2. The contact gap adjustment for the cylinder unit is made as follows:

   With the moving contact in the normally-opened position, i.e. against the right stop on the bridge, screw in the right hand stationary contacts until it just makes with the moving contact. Then advance the stationary contact an additional ¼ turn. Screw the left hand stationary contact until it just touches the moving contact then back off the stationary contact two turns for a gap of 1/16 of an

inch. The clamp holding the stationary contact need not be loosened for this adjustment, since the clamp utilizes a spring-type action in holding the stationary contact in position.

The set screw in the stationary contacts has been shop adjusted for optimum follow and this adjustment should not be disturbed.

The moving contact assembly has been factory adjusted for low contact bounce performance and should not be changed.

3. The sensitivity adjustment is made by varying the tension of the spiral spring attached to the moving element assembly. The spring is adjusted by placing a screwdriver or similar tool into one of the notches located on the periphery of the spring adjuster and rotating it. The spring adjuster is located on the underside of the bridge and is held in place by a spring type clamp that does not have to be loosened prior to making the necessary adjustments.

   The spring is to be adjusted such that when the relay is deenergized the moving contact just resets. Then move the spring adjuster 3/16 of a turn in the same direction.

B. Frequency Adjusting Reactor

The Relay should be preheated for 1 hour with 120 volts and rated frequency before calibration is attempted. A source of variable frequency is required and should be connected to terminals 8 and 9 of the relay.

Set the source frequency to 59.5 hertz and adjust the frequency adjusting screws (see Fig. 1) until the cylinder unit contact closes to the left. Reduce voltage to 40 volts and raise frequency to 59.57 hertz. Adjust control spring so that cylinder unit contact just closes to the left. Raise voltage to 120 volts and recheck 59.5 settings. Adjust frequency adjusting screws if necessary. Recheck 40 volt setting, it should be between 59.56 and 59.58 hertz. Repeat above procedure if necessary until relay contacts are made between the frequency limits.

C. Indicating Contactor Switch (ICS)

Close the auxiliary time delay unit (T) contact and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

D. Auxiliary Time Delay Unit

1. A.C. Operation — Non-Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time should be 6 cycles.

2. A.C. Operation — Adjustable
   Block the KF relay contacts closed. Energize terminals 8 and 9 of the relay with rated voltage and frequency. Time the closing of the telephone relay contacts. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (See Figure 1).

3. D.C. Operation — Adjustable
   Energize terminals 10 and 4 with rated d.c. voltage. Place switch across KF relay contacts. Close switch and time the closing of the telephone relay contacts. Adjust rheostat on rear sub base for desired time delay. This time can be set over the range of 6 to 30 cycles utilizing the rheostat located on the rear sub-base (see Fig. 1).

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 and styles from the Electrical Parts List.

* ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	REFERENCE	STYLE
FREQUENCY SENSING CIRCUIT – FIG. 2, 3, 4		
RESISTOR – R1	750 ohm, 25W, ± 5%	1267285
CAPACITORS – Reactor Leg	.225 MFD, 750 VAC, ± 3%	606B340H07
Resistor Leg	2.0 MFD, 330 VAC, ± 3%	606B340H04
Reactor		290B179G04
AC FIXED 6 CYCLE TIMER – FIG. 2		
RESISTOR (R2)	1600 ohm, 25W, ± 5%	1267294
CAPACITORS – (3 In Parallel)	68 MFD, 35 V, ± 20%	187A508H02
DIODES – (Bridge)	1N4821	188A342H16
TELEPHONE RELAY (T)		541D231H14
AC ADJUSTABLE 6 TO 30 CYCLE TIMER – FIG. 3		
RESISTOR – (R2)	750 ohm, 25 w, ± 5%	1267285
POTENTIOMETER	25 K ohm, 2 w, ± 10%	185A067H03
TELEPHONE RELAY (T)		541D514H10
CIRCUIT BOARD ASSEMBLY – STYLE 691B182G01		
CAPACITORS – C1	47 MFD, 35 V, ± 20%	184A661H03
C2, C3, C5	6.8 MFD, 35 V, ± 5%	184A661H21
C4	0.1 MFD, 50 V, ± 20%	184A663H04
DIODES – D1, D2, D3, D4	1N5053	188A342H12
D5, D6, D7, D8, D9	T155	183A790H09
RESISTORS – R1	1.8 K ohm, ½ w, ± 5%	184A763H33
R2	100 ohm, ½ w, ± 5%	184A763H03
R3	33 Ohm, ½ w, ± 5%	187A290H13
R4	15 K ohm, ½ w, ± 5%	184A763H55
R5, R6	10 K ohm, ½ w, ± 5%	184A763H51
R7	470 ohm, ½ w, ± 5%	184A763H19
TRANSFORMERS – T1	H62, UTC	629A453H01
TRANSISTORS – Q1	2N2647, UJT	629A435H01
Q2	2N3417, NPN	848A851H02
Q3	2N3645, PNP	849A441H01
ZENER DIODES – Z1	1N2986B, 24 V, ± 5%	629A798H03
DC ADJUSTABLE 6 TO 30 CYCLE TIMER – FIG. 4		
RESISTOR (R2)	420-2000 ohm, 25 w, ±5%	11D9511H08 O 11D9511H06 □
POTENTIOMETER	10 K ohm, 2 w, ±10%	185A067H02
TELEPHONE RELAY (T)		541D514H10 O 541D514H32 □
CIRCUIT BOARD ASSEMBLY – STYLE 878A418G01		
CAPACITORS – C1	47 MFD, 35 V, ±20%	184A661H03
C2	47 MFD, 35 V, ±5%	862A177H06
DIODES – D1, D2, D3, D4	T155	183A790H09
RESISTORS – R1	10 K ohm, ½ w, ±5%	184A763H51
R2	1.2 K ohm, ½ w, ±5%	184A763H29
R3	680 ohm, ½ w, ±5%	184A763H23
R4	1.5 K ohm, ½ w, ±5%	184A763H31 O
	700 ohm, 3 w, ±5%	763A127H28 □
TRANSISTORS – Q1	2N4249, PNP	849A441H03
Q2	2N2647, UJT	629A435H01
ZENER DIODES – Z1	1N2989B, 30V, ±5%	629A798H01

O = Old
□ = New

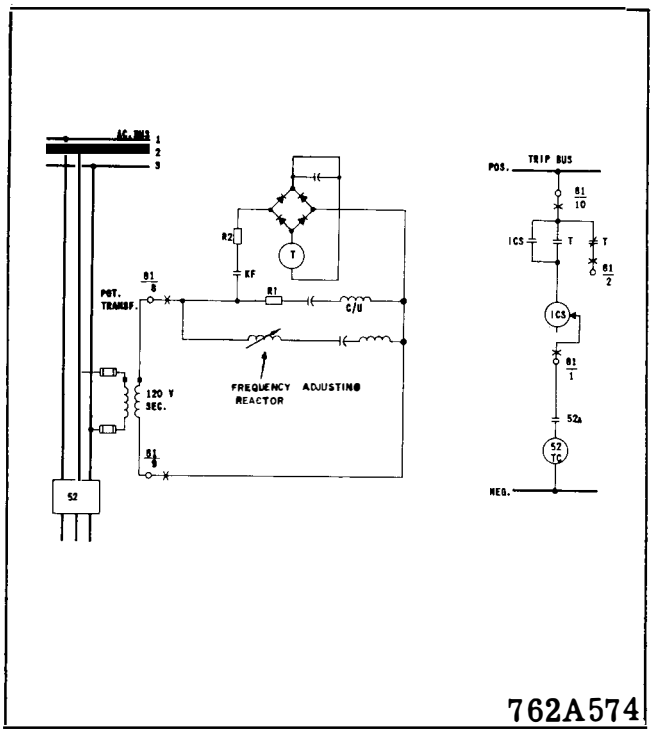


Fig. 10. External Connections for the Type KF Underfrequency Relay with A.C. Operated Auxiliary Time Delay Unit.

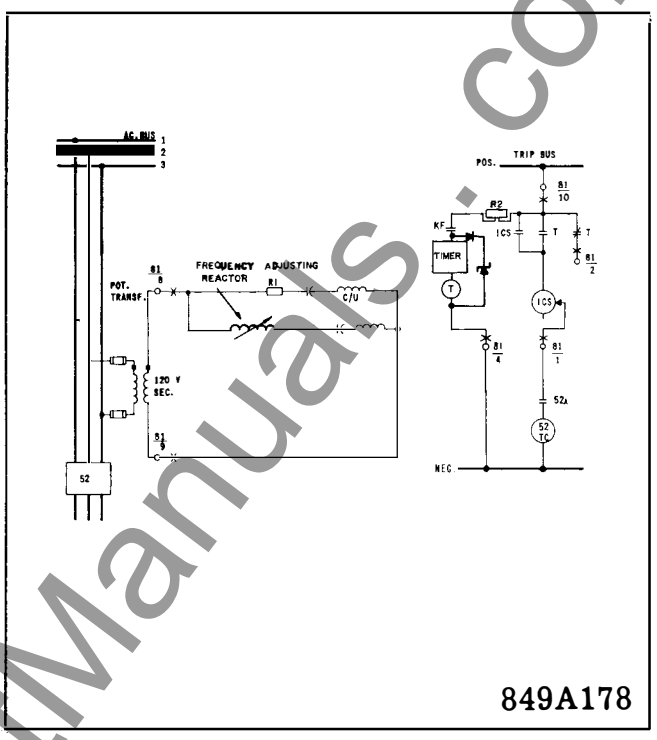


Fig. 11. External Connections for the Type KF Underfrequency Relay with D.C. Operated Auxiliary Time Delay Unit.

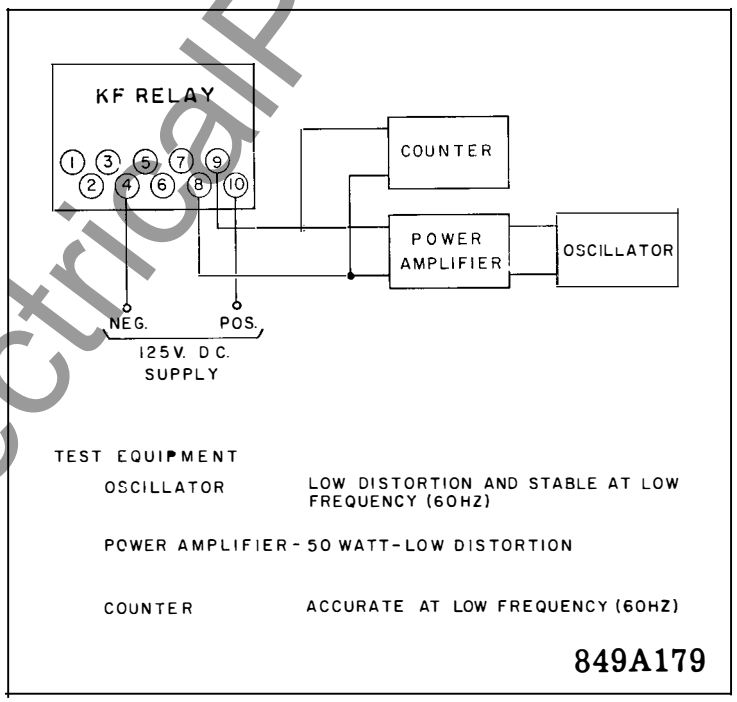


Fig. 12. Diagram of Test Connections for KF Relay with D.C. Operated Auxiliary Time Delay Unit.

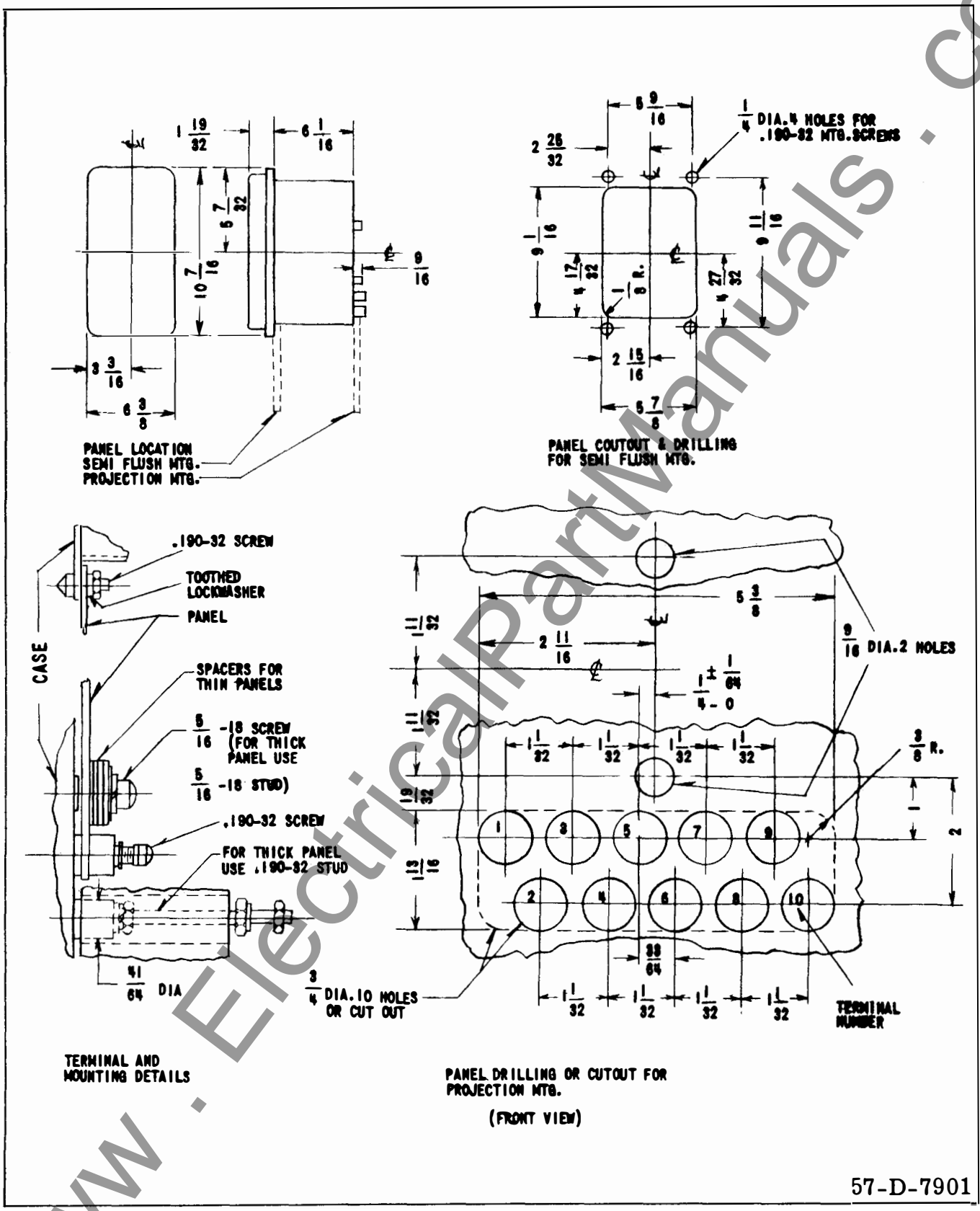


Fig. 13. Outline & Drilling Plan for the Type KF Relay in Type FT 21 Case.

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