Type "STA" Synchronous Motor Field Application Unit

General

The type STA unit is a combination speed limit acceleration, and time limit field application control unit. Approximately the first 90% of the motor acceleration range is under control of the speed responsive element, and the last 10% under control of the time element. The time element device is mechanically interlocked with the current device, so that both function together to apply excitation at an instant when the motor rotor poles are situated favorably with respect to the stator poles.

Current Element

This is a simple current relay of the type where movement of the magnet armature which carries the moving contact, is opposed by spring tension. The magnet is of the direct current type, and is operated by the rectified current from the secondary of a current transformer, connected in the primary circuit of the motor. The calibration is such that the pull of the magnet due to high accelerating current overcomes the spring tension while the motor accelerates from 0 to about 90% full speed. Near 90% speed, the motor accelerating current drops off rapidly, with the result that magnetic pull falls to the point where it is overcome by the spring tension, and the armature drops. The current relay makes two complete operations (armature "up and down") during one motor starting period, the first as mentioned above, the second as explained below.

Time Element

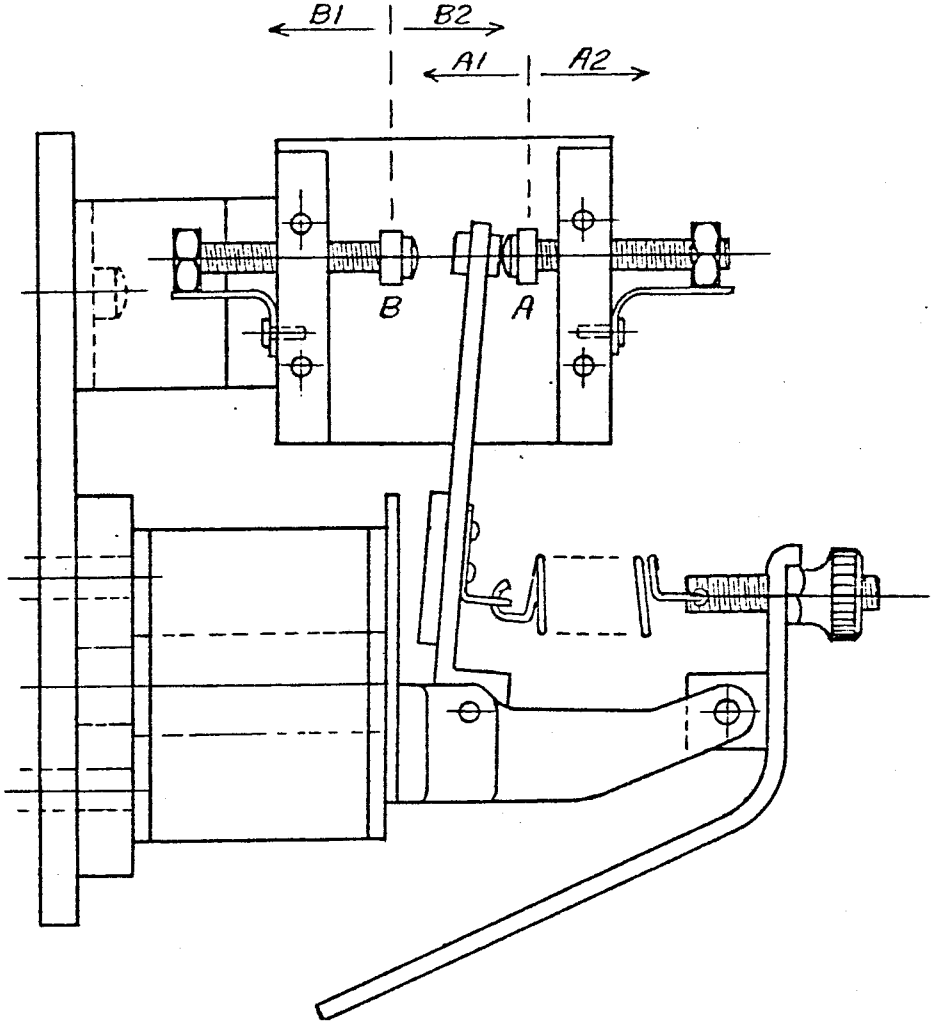
While the current relay armature is "up" for the first time during motor acceleration, the time element of the unit is blocked out. Dropping of the current relay armature at 90% motor speed, completes a circuit to the time-sequence drum pilot motor, to cause it to proceed through one complete revolution. During the revolution, new circuits are established and the calibration of the current relay goes through a cycle of change by virtue of the movement of a cam operating calibrating lever. During the early part of the rotation the current relay spring tension is abruptly released, then gradually restored to the original value as the drum completes the revolution. The relay armature moves up for the second time when the spring tension is released, and while up, the drum sets up new circuits, so that when the armature drops for the second time, the field contactor closes to apply excitation. The second drop occurs some time during the revolution of the time drum, whenever the spring tension has increased sufficiently to overcome the existing motor current. Before this last operation occurs, time will have elapsed to permit the motor to reach its maximum speed as an induction motor. From the instant the time drum goes into operation at 90% motor speed, ordinarily about 5 seconds will elapse before excitation is applied.

Mounting

The unit can be supplied for front or rear connection. The front connected version (Fig. 2) is adapted for mounting within steel cubicles. There is no cover, and all connections are made at the front. The unit may be mounted directly against steel, no insulation is required. The rear connected version is for front panel mounting. It includes a steel cover, and with terminal studs at the rear for all connections.

Westinghouse Electric Corporation
East Pittsburgh, Pa.

(Reprint 2-48)



CURRENT RELAY ADJUSTMENTS

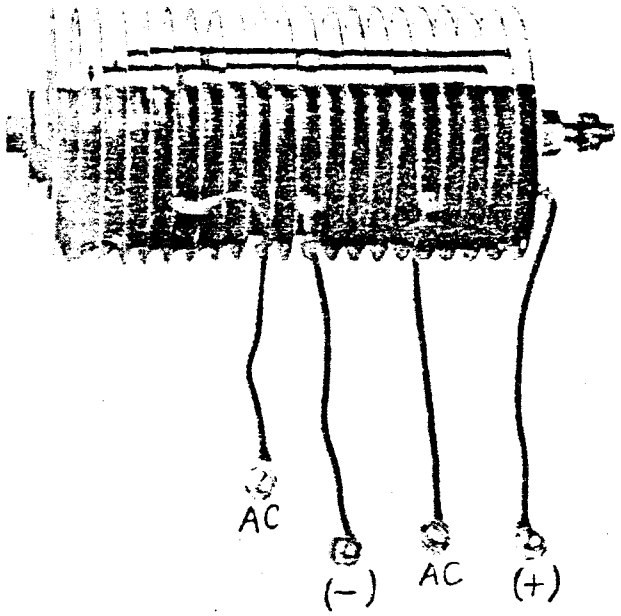
The current element will be adjusted at the factory for the particular motor to which the relay applies. The adjustment provides for drop out at approximately 90% motor speed, with pickup set at about 20% greater current. When placing the equipment in service for the first time it is only necessary that the operator be certain that the current relay picks up instantly when the motor line breaker closes, and drops out not more than four or five seconds before the motor reaches maximum speed with field contactor open. If the motor is already near full speed where the STA unit is cut in as may be the case for reduced voltage starters, the current element may not pick up and the time element will proceed at once with its sequence.

The relay pickup setting will usually be well under the motor inrush, and therefore is not critical. Particular attention should be paid to the dropout. If an adjustment is deemed necessary the dropout point may be raised or lowered by adjustment of spring tension. If the thumb nut is adjusted to increase the spring tension, the relay will drop out earlier, that is with motor at lower speed. If the tension is decreased, the relay will drop out later, that is, with motor nearer synchronous speed. It will be understood that change of spring tension varies both pickup and dropout simultaneously, but since the pickup is not critical, the pickup performance will not be seriously disturbed.

It is possible to vary the pickup and dropout values independently of each other, but this should rarely be necessary. Refer to the sketch and note that to decrease the pickup without disturbing the dropout, move contact A in the direction of arrow A1, and to increase the pickup move in the direction of arrow A2. To cause the relay to drop out with motor at lower speed without disturbing pickup, move contact B in the direction of arrow B2, and to change the dropout to higher speed, move in the direction of arrow B1. Movement of the contact B, if of any appreciable amplitude,

will require adjustment of the auxiliary spring contact support on the side of the relay. The "gap" of this auxiliary contact should be maintained at about 1/16-inch.

As adjusted at the factory, the relay may be slightly oversensitive in regard to pull out tripping. If there is a tendency to trip due to load fluctuations or line transients not accompanied by pull out, increase the pickup of the current element somewhat.



RECTOX UNIT

Rating

The Rectox unit is rated at 2-1/2 amperes direct current output continuously, based on ambient temperatures not exceeding 35°C. (95°F), and on units being given adequate ventilation. This rating is based on aged unit characteristics. Where the equipment is to operate in ambient temperature higher than above, two Rectox units should be used, and connected in parallel.

Installation

The Rectox is mounted separately from the type STA unit. The Rectox unit should be mounted with bolts horizontal so that cooling fins are in a vertical plane. Free ventilation should be provided if unit is in an enclosure, and it should not be mounted in close proximity to other heat producing apparatus.

Wiring

The D-C. terminal fins are marked by small decalcomania labels, indicating either (+) or (-). The current element coil should be connected to these without respect to polarity.

Arrangement

The unit is arranged as a full wave "bridge" type which rectifies both polarities of the A-C. input. Each of the four paths of the bridges has two discs in series, and there are five bridges in parallel. The unit includes cross wiring for paralleling the bridges.

Test for Disc Condition

A failed unit may usually be detected by a simple resistance test. Remove the paralleling cross wiring, and apply 2-1/2 volts between adjacent

fins, with the positive terminal of the test voltage applied to the positive fin. The room temperature for testing should be (20° - 25°C), (68°- 77°F). Back current at this voltage and temperature should not exceed 5 milliamperes.

Maintenance

The unit should be inspected frequently to see that no impairment of electrical or mechanical functioning occurs in service.

Remove accumulations of dust with a dry cloth or a compressed air jet. Avoid oily cloths as an oil film quickly attracts dust.

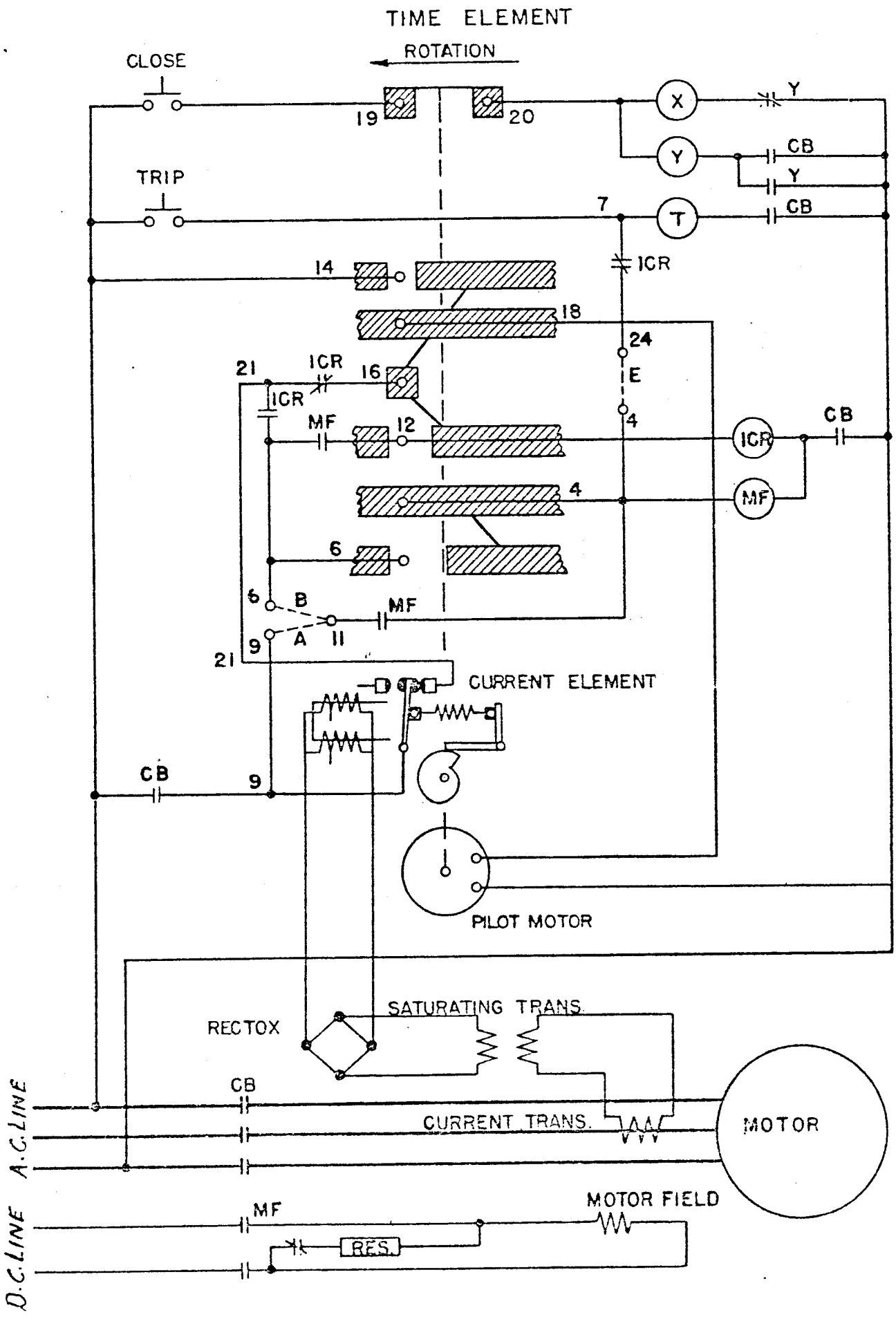
Examine contacts to see that they are not burned away beyond their useful values. Contacts of the current element may require adjustment with wear in order to retain the original settings. Oil or lubrication should not be used on the current relay, or the four pole shunt relay contacts. The drum switch segments may be lubricated with a thin film of vaseline. The contacts should not require any filing or dressing, as they are made of silver and even though they become blackened, they still give good contact. The only attention that should be necessary is replacement of the contacts after they have worn down to somewhat less than one-third of their original thickness.

Examine shunt and hinge pins of current element. The latter should be free to rotate, but oil should not be used.

The operating coils of the current element may be removed, by removing the counter-sunk screws in the rectangular pole faces to the cores.

The magnet and coil assembly of the shunt relay may be removed by taking out the holding screws at the top of the magnet and removal of the two screws which attach the moving armature to the cross bar. The entire magnet assembly may then be lifted out. The moving contact may be removed from the contact support saddle by tilting to approximately a 60° angle, depressing it fully against the spring, and tilting sidewise until the projecting ear clears the saddle on the inside. This may be done without removal of the cross bar. In case it is desired to remove the cross bar, it may be done by removal of the two screws which attach the moving armature to the cross bar, removal of the two arc box mounting screws, and removal of such long stationary contacts as are on the front side only. The moving armature should run free and loose in the magnet guides. In case there is any binding or friction from dirt collection or otherwise, the armature should be cleaned and freed.

The pilot motor and drum switch shaft alignment should be checked occasionally. The pilot motor will require no attention other than a rare check of lubrication. Front edges of drum switch segments may be dressed with a fine cut milled file if there is any tendency to "stub" on the fingers.


TIME ELEMENT
ROTATION
CLOSE
TRIP
19
20
X
Y
CB
Y
7
T
CB
ICR
14
18
24
E
21
ICR
16
ICR
MF
12
4
ICR
CB
MF
4
6
6
B
MF
A
11
9
21
CURRENT ELEMENT
CB
9
PILOT MOTOR
SATURATING TRANS.
RECTOX
CB
A.C.LINE
CURRENT TRANS.
MOTOR
MOTOR FIELD
MF
RES.
D.C.LINE

TYPICAL CONNECTIONS

The connections shown are for a cross line starter employing a circuit breaker in the motor primary.

With the motor running or shut down, the position of the STA elements will be as shown, that is, fingers 4-16-18-19-20 will be "made", 6-12-14 will be "open", and spring tension on the current element will be maximum. The contacts 19-20 guarantee that the primary breaker cannot be closed unless the elements are in the position shown (off position) since these contacts interrupt the circuit to the X-Y closing relays in all other positions.

Operation of the "close" button energizes relays X-Y to close the primary breaker. Instantly, the current element picks up to break contact 9-21, as the result of current inrush to the motor. When the inrush current drops to about 50% of the initial inrush value (90% speed) current element contacts 9-21 close to complete a circuit to the pilot motor through 1CR contact 21-16 and drum fingers 16-18. After a short initial movement finger 14 "makes" to connect the pilot motor across line so that the movement continues. The second circuit to "make" is finger 12, causing relay 1CR to pick up. At approximately the same time the current element calibrating cam releases the spring tension, so that contact 9-21 again opens. After 9-21 has opened finger 6 "makes". As the spring tension is gradually restored 9-21 will close to complete a circuit to field contactor MF through 1CR contact 21-6. Once MF has closed a holding circuit is established, either through jumper A to the line, or through jumper B, MF contact 6-12, fingers 12-14 to the line. These holding circuits by-pass current element contacts 9-21 until the drum returns to the off position, so that transient operations of the current element attendant to application of excitation does not trip MF.

With jumpers A and E in place, the motor will shut down if current element contacts 9-21 open due to pull out. Opening of 9-21 trips relay 1CR and the contact 7-24 close to energize the circuit breaker trip coil. With jumper B in place, the motor will resynchronize in the event of pull out. Opening of 9-21 trips both 1CR and MF but the breaker does not trip since the jumper "E" is not in place. The 1CR contact 21-16 closes to start the STA unit through a sequence when 9-21 recloses same as occurs when the motor reaches 90% speed during a normal start.

The saturating transformer is not always included. It will be used when there is a possibility of obtaining heavy short circuit currents in the case of a fault, and where the switching equipment must withstand same without injury. The saturating transformer prevents possible destruction of the Rectox.

The operating coils on the current element each has 200 turns, with a tap at 125 turns. There are normally connected in parallel and use the total 200 turns.

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Current Element

This is a simple current relay of the type where movement of the magnet armature which carries the moving contact, is opposed by spring tension. The magnet is of the direct current type, and is operated by the rectified current from the secondary of a current transformer, connected in the primary circuit of the motor. The calibration is such that the pull of the magnet due to high accelerating current overcomes the spring tension while the motor accelerates from 0 to about 90% full speed. Near 90% speed, the motor accelerating current drops off rapidly, with the result that magnetic pull falls to the point where it is overcome by the spring tension, and the armature drops. The current relay makes two complete operations (armature "up and down") during one motor starting period, the first as mentioned above, the second as explained below.

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The unit can be supplied for front or rear connection. The front connected version (Fig. 2) is adapted for mounting within steel cubicles. There is no cover, and all connections are made at the front. The unit may be mounted directly against steel, no insulation is required. The rear connected version is for front panel mounting. It includes a steel cover, and with terminal studs at the rear for all connections.

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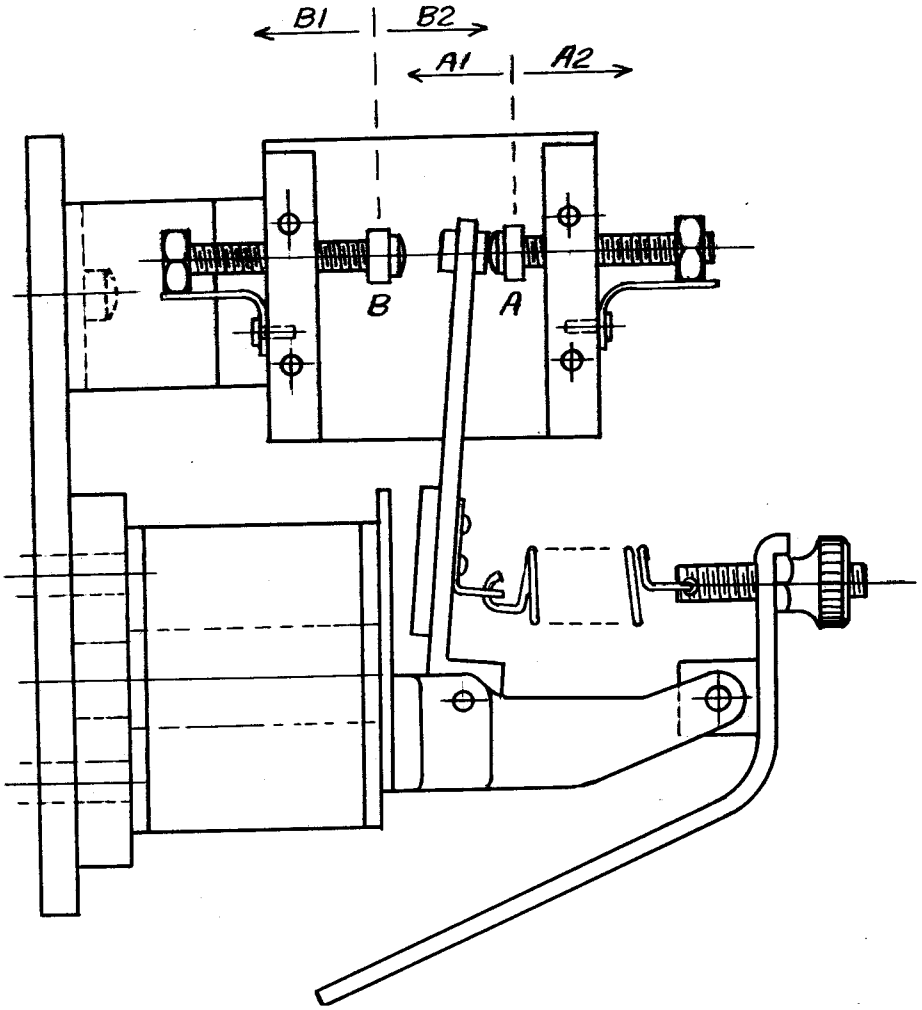
I.L. 4021



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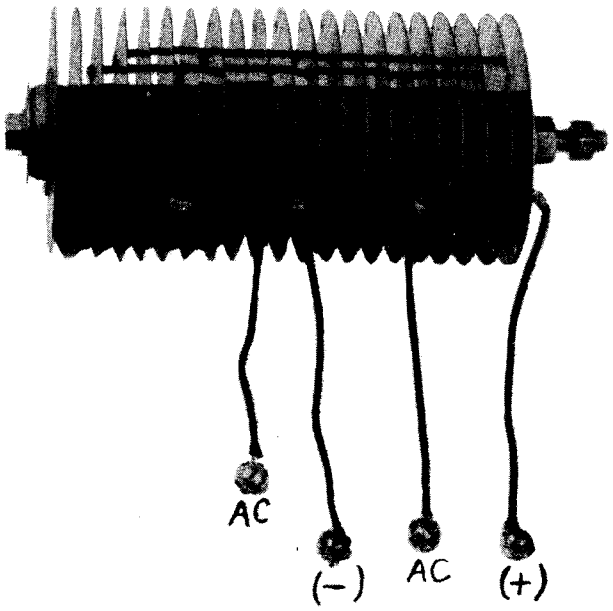

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fins, with the positive terminal of the test voltage applied to the positive fin. The room temperature for testing should be (20° - 25°C), (68°- 77°F). Back current at this voltage and temperature should not exceed 5 milliamperes.

Maintenance

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Examine contacts to see that they are not burned away beyond their useful values. Contacts of the current element may require adjustment with wear in order to retain the original settings. Oil or lubrication should not be used on the current relay, or the four pole shunt relay contacts. The drum switch segments may be lubricated with a thin film of vaseline. The contacts should not require any filing or dressing, as they are made of silver and even though they become blackened, they still give good contact. The only attention that should be necessary is replacement of the contacts after they have worn down to somewhat less than one-third of their original thickness.

Examine shunt and hinge pins of current element. The latter should be free to rotate, but oil should not be used.

The operating coils of the current element may be removed, by removing the counter-sunk screws in the rectangular pole faces to the cores.

The magnet and coil assembly of the shunt relay may be removed by taking out the holding screws at the top of the magnet and removal of the two screws which attach the moving armature to the cross bar. The entire magnet assembly may then be lifted out. The moving contact may be removed from the contact support saddle by tilting to approximately a 60° angle, depressing it fully against the spring, and tilting sidewise until the projecting ear clears the saddle on the inside. This may be done without removal of the cross bar. In case it is desired to remove the cross bar, it may be done by removal of the two screws which attach the moving armature to the cross bar, removal of the two arc box mounting screws, and removal of such long stationary contacts as are on the front side only. The moving armature should run free and loose in the magnet guides. In case there is any binding or friction from dirt collection or otherwise, the armature should be cleaned and freed.

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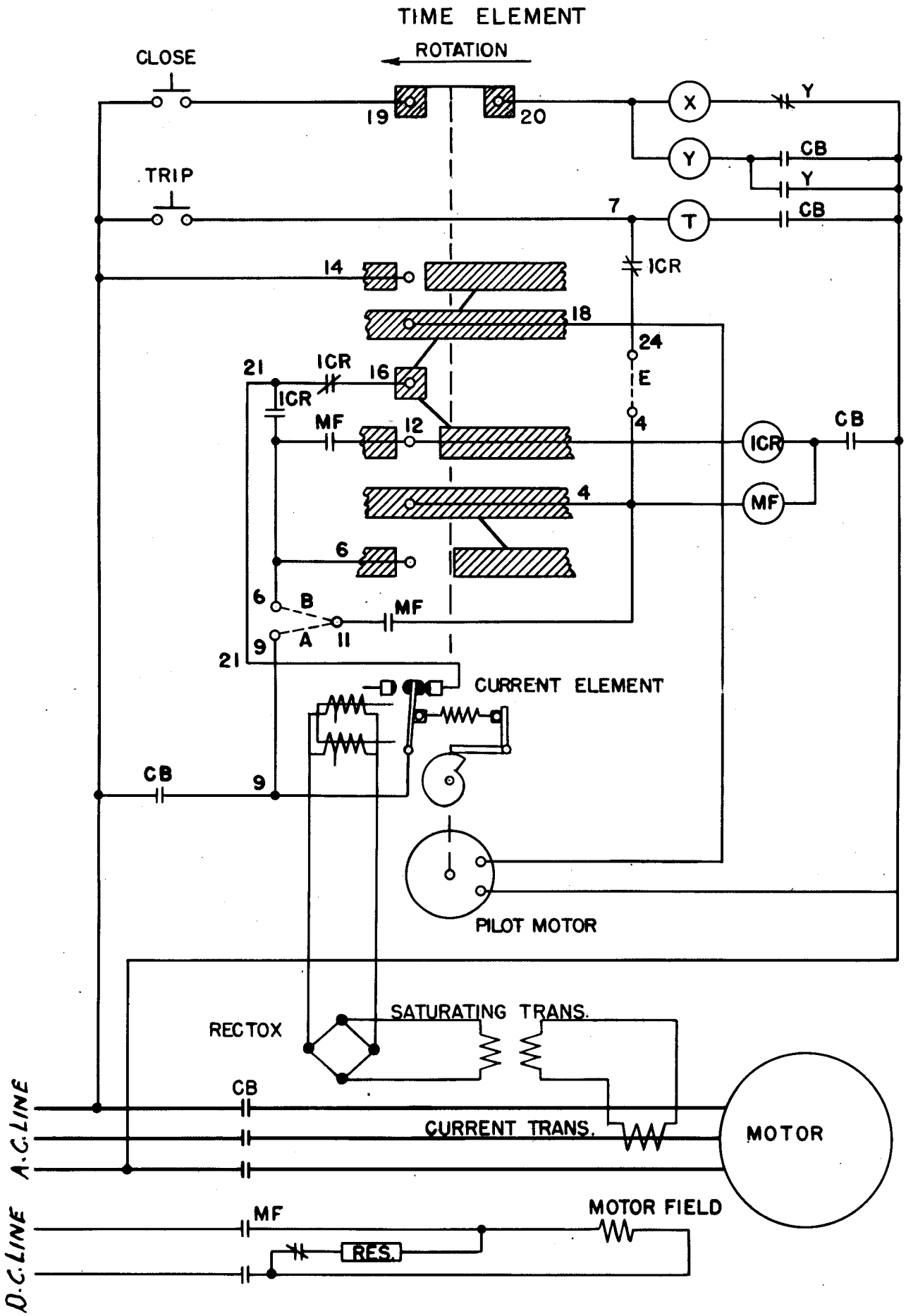
TIME ELEMENT
ROTATION
CLOSE
TRIP
19
20
X
Y
CB
7
T
14
ICR
18
24
E
21
16
MF
12
4
6
B
A
11
9
CURRENT ELEMENT
PILOT MOTOR
RECTOX
SATURATING TRANS.
CURRENT TRANS.
MOTOR
A.C.LINE
D.C.LINE
MOTOR FIELD
RES.

TYPICAL CONNECTIONS

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Operation of the "close" button energizes relays X-Y to close the primary breaker. Instantly, the current element picks up to break contact 9-21, as the result of current inrush to the motor. When the inrush current drops to about 50% of the initial inrush value (90% speed) current element contacts 9-21 close to complete a circuit to the pilot motor through 1CR contact 21-16 and drum fingers 16-18. After a short initial movement finger 14 "makes" to connect the pilot motor across line so that the movement continues. The second circuit to "make" is finger 12, causing relay 1CR to pick up. At approximately the same time the current element calibrating cam releases the spring tension, so that contact 9-21 again opens. After 9-21 has opened finger 6 "makes". As the spring tension is gradually restored 9-21 will close to complete a circuit to field contactor MF through 1CR contact 21-6. Once MF has closed a holding circuit is established, either through jumper A to the line, or through jumper B, MF contact 6-12, fingers 12-14 to the line. These holding circuits by-pass current element contacts 9-21 until the drum returns to the off position, so that transient operations of the current element attendant to application of excitation does not trip MF.

With jumpers A and E in place, the motor will shut down if current element contacts 9-21 open due to pull out. Opening of 9-21 trips relay 1CR and the contact 7-24 close to energize the circuit breaker trip coil. With jumper B in place, the motor will resynchronize in the event of pull out. Opening of 9-21 trips both 1CR and MF but the breaker does not trip since the jumper "E" is not in place. The 1CR contact 21-16 closes to start the STA unit through a sequence when 9-21 recloses same as occurs when the motor reaches 90% speed during a normal start.

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WESTINGHOUSE
W