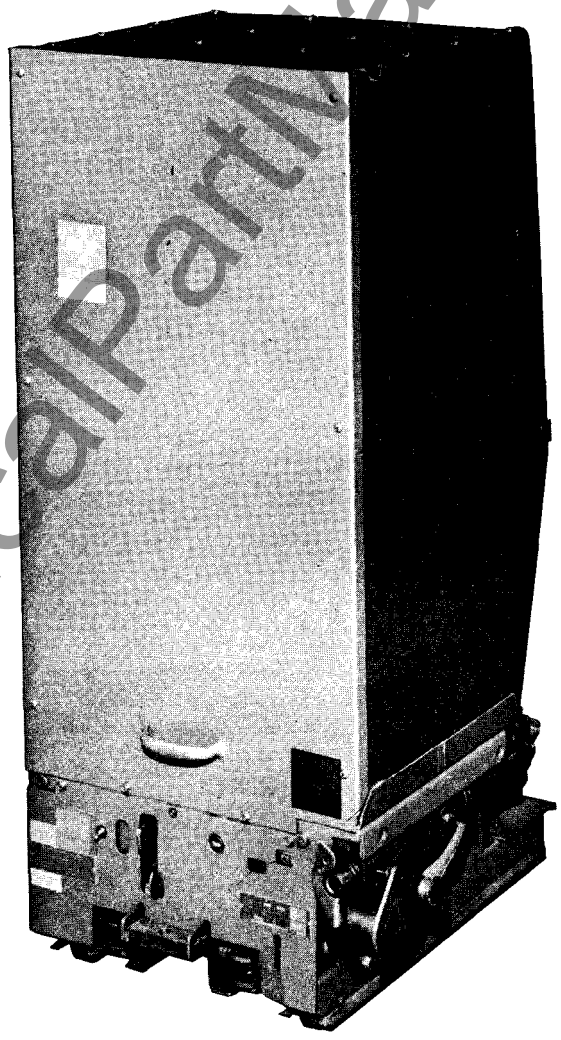
IB-8.2.7-2

ISSUE G

GOULD I-T-E METAL CLAD SWITCHGEAR
INSTRUCTIONS

5 KV POWER CIRCUIT BREAKERS
TYPE 5HK75, 5HK150, 5HK250 AND 5HK350



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INSTRUCTIONS FOR 5 KV POWER CIRCUIT BREAKERS TYPE 5HK75, 5HK150, 5HK250 AND 5HK350

Section 1. INTRODUCTION

These instructions for installation, operation and maintenance of HK circuit breakers should be read carefully and used as a guide during installation and initial operation.

The specific ratings of each model circuit breaker are listed on the individual nameplates.

File these instructions in a readily accessible place together with drawings and descriptive data of the switchgear. These instructions are guides to proper maintenance of the equipment to prolong its life and usefulness.

Section 2. RECEIVING AND STORAGE

Immediately upon receipt of the circuit breakers, examine the cartons to determine if any damage or loss was sustained during transit. If injury or rough handling is evident, file a damage claim at once with the carrier and promptly notify the nearest Gould Inc. representative. Gould Inc. is not responsible for damage of goods after delivery to the carrier. However, Gould Inc. will lend assistance if notified of claims.

Unpack the circuit breakers as soon as possible after receipt. If unpacking is delayed, difficulty may be experienced in making a claim for damages not evident upon receipt. Use care in unpacking in order to avoid damaging any of the circuit breaker parts. Check the contents of each carton against the packing list before discarding any packing material. If any discrepancy is discovered, promptly notify the nearest sales representative of Gould Inc. Information specifying the purchase order number, Gould sales order number, carton number and part numbers of the damaged or missing parts should accompany the claim.

Circuit breakers should be installed in their permanent location as soon as possible. If the breakers are not to be placed in service for some time, it is required that adequate means of protection be provided. This may be done by keeping the breaker in its original shipping carton and storing in a warm (approximately 15°C) dry (50% max humidity) and uncontaminated atmosphere. If the circuit breaker cannot be stored properly due to abnormal circumstances, it must be thoroughly checked before going into service to ensure that it is without damage and it has not become generally contaminated.

Section 3. CIRCUIT BREAKER INSTALLATION

3.1 GENERAL

Prior to installation of the circuit breaker into a switchboard, certain preliminary inspections are made to ensure proper operation.

CAUTION

PRIOR TO ANY DISASSEMBLY OR INSPECTION OF THE CIRCUIT BREAKER THE CLOSING SPRINGS SHOULD BE DISCHARGED, AND THE BREAKER SHOULD BE OPEN.

IF IT IS NECESSARY TO RAISE OR MOVE THE BREAKER, ATTACH THE LIFTING YOKE AT POINTS 4 (FIGURE 1), OR A FIFTH WHEEL AT POINT 5 (FIGURE 2) TO TRANSPORT THE BREAKER AS REQUIRED.

3.2 INSTALLATION INSPECTION

Inspect condition of circuit breaker arc chutes, contact and electrical connections prior to installing the circuit breaker into the switchboard. Even though each circuit breaker is completely adjusted and tested at the factory, shipping and handling conditions could cause defects.

3.3 REMOVING INTERPHASE BARRIER

For 5HK75, 150 and 250, remove two lower front sheet screws, lift straight up above arc chutes by grasping front handle and top sheet at rear, then draw barrier forward and away from circuit breaker.

For 5HK350, remove two lower front sheet screws, and lift front sheet up and away from the breaker. Remove arc chute tie bar at upper front of arc chutes. Pivot rear brace at rear of each barrier upward and slide the separate barriers forward and away from the circuit breaker.

CAUTION

THE 5HK350 BARRIERS WILL NOT STAND UNSUPPORTED AND MUST BE BRACED.

3.4 REMOVING ARC CHUTES (See Figure 1)

For 5HK75, 150 and 250, remove nut (6) and gently disconnect return connection (5). Grasp the arc chute (1) at the front and top and gently tilt on its pivot towards the rear until it rests on the lead support molding (2). If other than visual inspection is to be done, the arc chute, in the tilted position, should be lifted straight out of the pivot guide slots and fingers and removed from the circuit breaker.

For 5HK350, remove nut (6) and gently disconnect return connection (5). Remove bolt connecting the front leg of the arc chute to the block on the base sheet of the circuit breaker. Attach the accessory lifting bracket to the tie bar bushing at the top front of the arc chute and slowly raise the arc chute as required by means of a hoist. It will pivot at its terminal connection and then should be guided straight out of the pivot guide slot and fingers and removed away from the circuit breaker. If only a visual examination is to be made, each arc chute may be tilted back gently, hand held and then slowly lowered.

CAUTION

BE SURE RETURN CONNECTION IS CLEAR AND DOES NOT CATCH ON THE ARC CHUTE. ALSO BLOCK WHEELS TO PREVENT BREAKER FROM ROLLING.

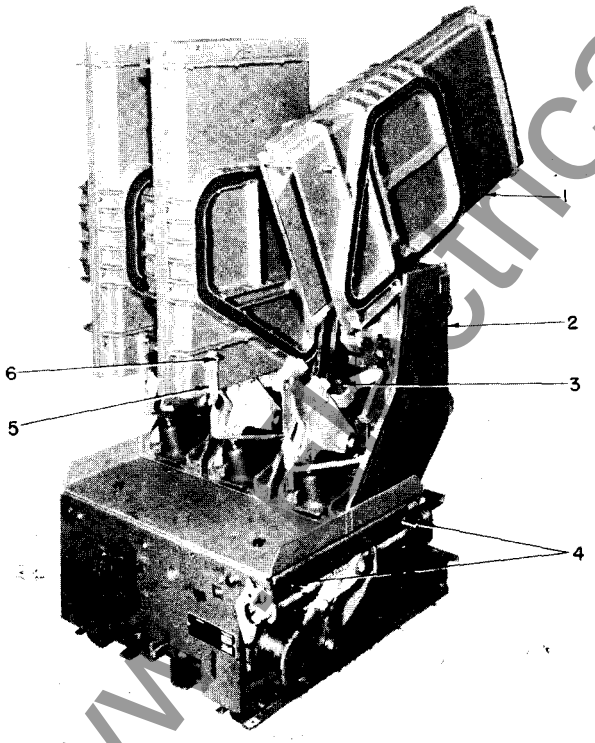

Fig. 1 — View Showing Arc Chute and Contact Structure

3.5 ARC CHUTE EXAMINATION

Examine arc chutes carefully before placing into service. Look for any breakage to liner plates and arc chute plates. Check for presence of any foreign particles such as chips of ceramic and metal. Inspect exterior for any damage or deformation. The polyester glass moldings occasionally have some small cracks develop in resin-rich areas, but these cracks do not indicate defective material and should not cause concern.

3.6 INSULATION STRUCTURE

All insulated parts should be checked for damage. Any dust or dirt should be removed by compressed air or wiped with a clean, lint-free cloth saturated with an oil-free solvent. This is important because the soot or dirt can accumulate and, with moisture, place the circuit breaker in jeopardy, dielectrically. The lead support moldings are polyester glass and occasionally have some resin-rich cracks or crazing develop, but these do not indicate defective material and should not cause concern.

3.7 MANUAL SLOW-CLOSE TO CHECK CONTACT PRESSURE (Figure 2)

NOTE: Ensure that accessories that affect electrical/mechanical operation are set in their operating positions: i.e., undervoltage devices should be energized or mechanically closed; mechanical interlocks, key or other, should be properly set, etc.

1. Turn racking screw clockwise approximately two to three turns until the racking-unlocking lever snaps into the first position corresponding to the "DISCONNECT" position.
2. Engage manual charge handle (8) with charging lever (3). Pump charging lever until breaker closing springs snap into charge position, then remove handle.
3. Insert BOTH tangs of spring retainer bracket (7) into holes of closing spring guides (2).
4. Pull manual close lever (4) to discharge closing springs onto tangs of spring retainer bracket (7). At this time the contacts will partially close.
5. Re-engage manual charge handle (8) with charging lever (3), then slowly pump to slow-close breaker contacts. Check contact pressure as listed in paragraph 5.2. Use the manual trip button (6) to open the breaker.
6. To remove spring retainer bracket (7) from circuit breaker, continue pumping until closing springs are again heard to snap into fully-charged position. Spring retainer bracket can now be removed.
7. Discharge closing springs by pulling manual close lever (4) and pushing manual trip button (6) at the same time to effect trip-free operation. (The breaker can also be closed first and then tripped.)

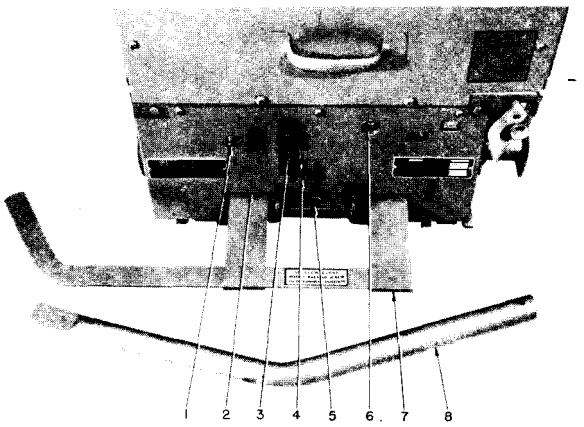

Fig. 2 — Front View of Control Panel

3.8 INSTALLING ARC CHUTES (See Figure 1)

Position arc chute (1) in tilted position, squarely down into its rear pivot guide slots and fingers (avoid bumping and chipping of all moldings), then lower slowly into position.

CAUTION

BE SURE RETURN CONNECTION IS CLEAR AND DOES NOT CATCH ON THE ARC CHUTE.

Securely fasten return connection (5) by its nut (6). Also, on 5HK350 breakers the front arc chute support leg must be secured to its hold down block.

3.9 INSTALLING INTERPHASE BARRIER

1. For 5HK75, 150 and 250, lift barrier and slide it approximately halfway on the breaker.
2. After aligning the vertical sheets of the barrier properly between the lead support moldings and inside the clips on the outside moldings, slide the barrier as far to the rear as possible.
3. Lift the barrier slightly by its handle at the lower front (Figure 2) to permit the rear brace of the barrier to drop down behind the arc chutes.
4. Push firmly down and back on the barrier handle to properly position the interphase barrier in place.
5. Secure the barrier in place with the two lower front sheet screws.
6. For the 5HK350, slide the right and left interphase barriers, as marked, in place between the lead support moldings and inside of the clips on the outside moldings, and pivot the rear brace downward behind the arc chutes.
7. Install the arc chute tie bar at the upper front on the arc chutes.
8. Lift front sheet in place so that it hooks over the arc chute tie bar.
9. Secure the barrier front sheet in place with the two lower front sheet screws.

CAUTION

ON 5HK350, FOR OLDER UNMARKED BARRIERS, ENSURE THAT THE FLUX SHUNT PAD IS INSTALLED BETWEEN POLES.

3.10 INSTALLING CIRCUIT BREAKER INTO COMPARTMENT (See Figures 2 and 3)

NOTE: CLOCKWISE ROTATION of racking crank for inserting breaker. COUNTERCLOCKWISE rotation of racking crank for removal of breaker.

1. Turn motor disconnect switch (if supplied) (1, Figure 2) to "OFF" position.
2. Engage racking crank (4, Figure 3) and push racking unlocking lever (3) to left, then rotate racking crank counterclockwise only until resistance to motion is felt. (DO NOT FORCE.) (If closing springs were left in charged condition, they will automatically discharge.)
3. Engage fifth wheel with hole guide (5, Figure 2) and push circuit breaker into compartment until stopped.
4. Engage racking crank and rotate clockwise until racking mechanism automatically stops at "DISCONNECT" position. (Breaker is now held captive in compartment.)
5. To rack circuit breaker to "TEST" position, push racking unlocking lever (3, Figure 3) to left,

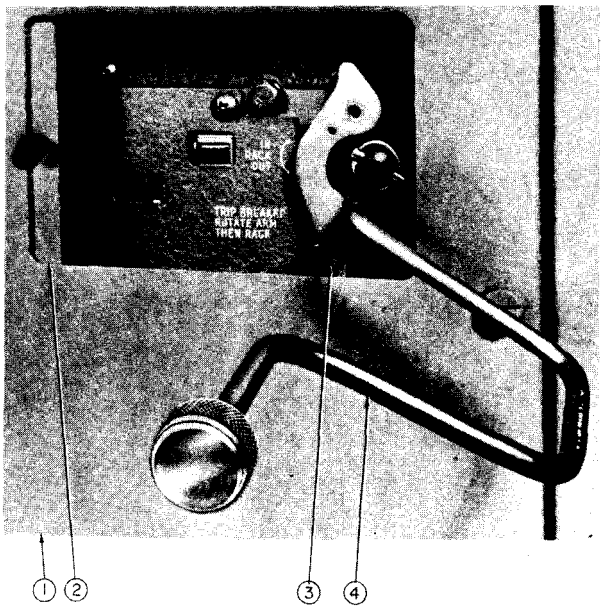

Fig. 3 — Method of Racking Circuit Breaker

rotate racking crank approximately 1/4 turn clockwise, then release unlocking lever. Continue cranking until racking mechanism automatically stops at "TEST" position.

6. With the circuit breaker racked to "TEST" position, check for proper operation by operating all possible means of opening and closing. This includes control switches, relays, etc. Turn motor disconnect switch (1, Figure 2) to "ON" position to charge the closing springs, and operate the breaker as required. If motor disconnect switch (1, Figure 2) is not provided, springs will automatically charge when approaching "TEST" position.

FOR SAFETY: When racking circuit breaker to "CONNECTED" position, close compartment door (1, Figure 3) and insert racking crank (4, Figure 3) through sliding panel (2, Figure 3).

7. Push unlocking lever (3) to left and turn racking crank (4) approximately 1/4 turn clockwise, then release unlocking lever. Continue cranking until racking mechanism automatically stops at "CONNECTED" position.

CAUTION

DO NOT ATTEMPT TO RACK ANY FURTHER.

The circuit breaker may now be put in service and be operated as required.

Section 4. CIRCUIT BREAKER REMOVAL (See Figure 3)

4.1 REMOVAL FROM "CONNECTED" POSITION

To remove circuit breaker from "CONNECTED" position, open the breaker as required.

1. Open sliding door (2) in front compartment door (1).
2. Engage racking crank (4) and push racking unlocking lever (3) to left.
3. Rotate racking crank (4) counterclockwise approximately 1/4 turn, then release unlocking lever.
4. Continue cranking counterclockwise until racking mechanism automatically stops at "TEST" position.

4.2 "DISCONNECT" POSITION

Repeat same operation for "DISCONNECT" position.

4.3 REMOVAL FROM SWITCHBOARD

To position the racking mechanism for withdrawal of the circuit breaker from the switchboard, again push racking unlocking lever to the left and turn racking crank counterclockwise only until resistance to motion is felt. (Approximately 2-3 turns — DO NOT FORCE.)

NOTE: The closing springs, if charged, will automatically discharge when the racking mechanism is positioned for withdrawal from the switchboard.

The circuit breaker can now be removed from the compartment by pulling on the handle located at the bottom of the front barrier, or by pulling at the lower edge of the front barrier on the 1200 and 2000 ampere, 5HK350 breaker.

4.4 SAFE OPERATION RECOMMENDATIONS

1. It is recommended that any circuit breaker be withdrawn and stored in the test position whenever it is to be maintained in the open position with no planned switching.
2. It is recommended that a ground test device be connected to the proper compartment when any work is to be done on any bus or feeder circuit.

Section 5. MAINTENANCE AND ADJUSTMENTS

5.1 GENERAL INFORMATION

HK circuit breakers are designed for minimum maintenance and tested to ensure that minimum maintenance will be required. Only one basic adjustment is normally required and that is contact adjustment. This should be checked to the dimensional values required as described in paragraph 5.2. Other adjustments are required only when operational check indicates a need. During maintenance checks, all accessible bolts, nuts and screws should be routinely checked to ensure that they are tight.

It is recommended that the 5HK75, 5HK150 and 5HK250 circuit breakers be normally inspected after 2000 operations and that the 5HK350 circuit breakers be normally inspected after 1000 operations. These operations can be either no-load mechanical or load current switching where the power factor is relatively high. When the circuit breakers are used for direct bulk capacitor or reactor switching operations or for motor starting applications, it is recommended that the 5HK75, 5HK150 and 5HK250 circuit breakers be inspected after 1000 operations and that the 5HK350 circuit breakers be inspected after 500 operations because of the switching severity.

If however, after the first inspection period, there is no indication of any problem, actual operating experience can dictate the inspection cycle.

Regarding maintenance recommendations following fault duty, reference is made to ANSI Standard C37.04 to which the circuit breakers have been tested. In accordance with this standard, a

total of 400% asymmetrical fault duty can be accumulated. This is to be ten or less close-open operations at less than 85% of full fault duty; but it can be an accumulation over a long time period of lower currents. The condition of the breaker should be such that after this duty it is capable of one more close-open operation at full fault current. Inspection is to be made at this time to ensure compliance with this requirement. Final operation can be made if everything is satisfactory. At this time, maintenance should be performed, reconditioning done and replacement made as indicated.

In accordance with the same standard, it is recommended that after a major fault duty cycle (CO-15 SEC.-CO), which is known to be between 85 and 100% of the circuit breaker rated asymmetrical short circuit current, the circuit breaker be inspected regardless of any time period or number of operations. Also, when the circuit breaker is applied on reclosing duty, it should be inspected immediately after the series of fault operations in the same range of currents.

The condition of the circuit breaker after interruption depends on circuit conditions regarding such things as power factor, X/R ratio and relay delay times. Experience with specific circuits will indicate the future amount of maintenance that will be required for the various breakers and then procedural modification can follow.

Where unusual service conditions exist, as covered by ANSI Standard C37.04, it must be assumed that these conditions were considered at the time of order; that the equipment supplied was designed for the special application; and that an appropriate supplemental maintenance program has been developed. These maintenance instructions cover only circuit breakers used under standard usual service conditions.

After normal service without major fault interruption, the following tests and adjustments should be made.

NOTE: The following tabulated tests and adjustments are all that are normally necessary for proper maintenance and operation of the HK circuit breaker. The remaining portions of the breaker—close coil assembly, shunt trip device, control relay, auxiliary switch and motor—require no maintenance during the standard life of the circuit breaker regardless of the operating duty.

5.2 CONTACT PRESSURE (See Figure 4)

A. With the circuit breaker withdrawn from the switchboard, the following step-by-step procedure should be followed for properly checking and/or adjusting the contact pressure on an "HK" type circuit breaker.

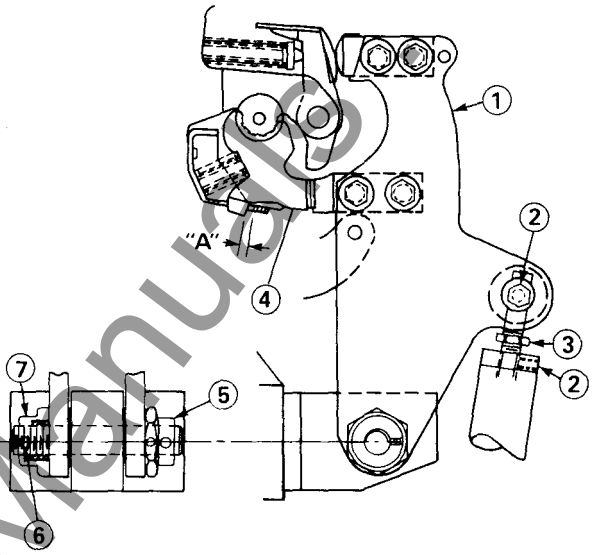

Fig. 4 — Contact Pressure and Bridge Pivot Pressure

1. Remove interphase barrier assembly and remove arc chutes as described previously.

2. Turn racking screw clockwise approximately two to three turns until the racking-unlocking lever snaps into the first position corresponding to the "DISCONNECT" position.

3. Manually slow-close the circuit breaker as described in paragraph 3.7, but only to the point that the arc contacts just touch. All arcing contacts should touch within 1/32", after all free play has been removed by pulling the bridge arm toward the open position.

4. Continue the slow-close operation to fully close the breaker. Each pole should have between 7/64" minimum and 3/16" maximum main contact compression measured at "A" between the EDGE of the metal stop plate and the main contact stop. (This dimension measured on either side is sufficient.) A rod or drill of these sizes can be used for measuring.

At this point, if the adjustments are correct, complete steps B6, B7, B8 and B9 following.

B. If any adjustment is incorrect, use the following procedure to readjust contact pressure or to initially adjust when changes are made.

1. Completely slow-close the circuit breaker and set each pole for 7/64" main contact compression at "A". (A 7/64" rod or drill should fit tightly between the EDGE of the metal stop plate and the main contact stop.)

2. Open the circuit breaker, manually recharge the closing springs, and partially slow-close the

circuit breaker until the arcing contacts of any pole or poles just touch.

3. Advance the adjustment of the lagging pole or poles so that the three arcing contacts touch simultaneously within 1/32''. This adjustment is made by loosening locking bolt or set screw (depending on model) (2) and rotating adjusting stud (3).

4. Complete slow-close operation to fully closed position and check that the main contact compression of the pole or poles that were advanced does not exceed 3/16''. Also, the arcing contact springs on these poles should not be fully compressed. If the 3/16'' dimension is exceeded, the entire procedure should be repeated to obtain the correct gap at ''A''.

NOTE: Occasionally, the center pole contact pressure may slightly exceed 3/16''. However, if the outer poles are within 3/16'' dimension and the arcing contact springs of the center pole are not fully compressed no readjustment need be made. When this condition exists, the center pole parts before the outer poles on opening.

5. Open the circuit breaker, recharge the closing springs, remove the slow-close bracket, fast-close the breaker, recheck adjustments and trip open.

NOTE: Fast-closing the circuit breaker may result in a slight increase in contact pressure over slow-closing.

6. Tighten the locking bolt (2) on each adjusting stud (3) to lock the contact pressure adjustment stud in place.

7. The arc chutes can now be replaced, and the interphase barrier assembly can now be reinstalled.

8. Return the racking screw to its orginal position by turning it counterclockwise approximately two to three turns until it stops.

9. The circuit breaker can now be replaced in its compartment and returned to service.

5.3 CONTACT AND INSULATION CLEANING

All dirt, soot or grease should be removed from circuit breaker contacts and surface of entire current-carrying structure, as well as all insulation surfaces, with a cloth saturated with an oil-free OSHA-approved solvent. Cleaning of insulation is important because soot and dirt can accumulate and, with moisture, place the circuit breaker in jeopardy, dielectrically.

A degree of burning and pitting of circuit breaker arcing contacts is to be expected from normal operation; also, on highly inductive or capacitative circuits and after major interruptions, some pitting may occur on main contacts. A moderate amount of pitting will not interfere with operation of the contacts. When necessary to dress the contacts, cover the puffer nozzle (5, Figure 1) with a cloth, then follow the contour of the contacts with a fine file. Do not attempt to eliminate pitting entirely. After this maintenance, contact pressure (paragraph 5.2; and millivolt drop (paragraph 5.4) should be checked.

NOTE: Replacement of contacts is required when: after repeated dressing of any contacts, less than 50% of the original contact material thickness is left;* the tips of the stationary arcing contacts have been eroded away; any contact has been broken or cracked.

On 5HK350, 3000 the arcing contact can be inverted when working surface is reduced to less than 50%.

5.4 MILLIVOLT DROP TEST

During normal maintenance periods, the condition of the circuit breaker can easily be determined by performing a millivolt drop test. This test should be performed regardless of whether the circuit breaker had interrupted low or high currents or has minimum operations.

The following table lists the millivolt drop and resistance values for the circuit breakers, when manufactured, covered by this instruction book, from terminal to terminal, exclusive of the primary disconnects.

TABLE 1. MV DROP AND RESISTANCE VALUES

Circuit Breaker	Maximum MV Drop*	Maximum Micro-Ohms
5HK75, 5HK150, 5HK250, 5HK350, 1200 Ampere	9	45
5HK150, 5HK250, 5HK350, 2000 Ampere	7	35
5HK350, 3000 Ampere	4	20

Millivolt drop with 200 amperes flowing.

Breakers operating with normal loading will require no maintenance if the millivolt drop does not exceed 150% of the listed values. If the millivolt drop does exceed 150% of the above values, the main and arcing contacts should be dressed with a fine file, cleaned and adjusted for proper contact pressure and then rechecked. If the values are still in excess of the 150% value, the bridge pivot pressure should be readjusted as outlined in Paragraph 5.6.

NOTE: For optimum performance of the circuit breakers during periods of increased loading, it is recommended that the listed values be met.

After all above steps have been taken and the millivolt drop is still excessive, contact Gould Inc. for recommendations.

5.5 PUFFERS (3, Figure 1)

FOR SAFETY

KEEP CLEAR OF ALL MOVING PARTS.

The performance of puffers can be readily checked during a maintenance interval. Each puffer should provide a moderate blast of air at breaker contacts, on opening of the circuit breaker. This can be detected by holding a piece of paper approximately 8-1/2'' x 11'' over the top of the contacts and opening the circuit breaker. All three poles must have puffing action or the circuit breaker must not be placed in service.

5.6 BRIDGE PIVOT PRESSURE (See Figure 4)

Bridge pivot pressure should be adjusted only when the millivolt drop test indicates a problem.

When adjustment is necessary, adjust as follows:

1. Locking bolt (2) should be loosened on solid pushrod models. Springloaded pushrod models do not require disconnecting.
2. Bridge (1) should be disconnected from adjusting stud (3) on solid pushrod models.
3. Loosen one set screw (6) in one pivot nut — either side.
4. Tighten bridge pivot nut (5 or 7) securely (approximately 75 ft. lbs.). Then gradually back up pivot nut (approximately 1/2 to 1-1/2 flats) until bridge motion is just free when bridge is moved by hand. On spring-loaded pushrod models, lift bridge against spring and then slowly release, ensuring that it resets freely.
5. Tighten set screw (6) in nut that was loosened, reconnect adjusting stud, if disconnected, and readjust contact pressure as described in Paragraph 5.2.

5.7 CLOSING AND OPENING TIMES

After operation intervals noted previously or a change in bridge pivot adjustment, it is recommended that opening and closing times be checked by use of a cycle counter, time-travel analyzer,* oscillograph, etc., to monitor the time from energizing to arcing contact touch or part.

****Analyzer mounting support and instructions available on special order.***

Circuit breaker closing and opening times should be within the following time ranges for normal operation.

TABLE 2. CLOSING AND OPENING TIMES

Circuit Breaker	Closing Time Range — MS**	Opening Time Range — MS**
5HK75, 5HK150, 5HK250, 1200 Ampere	50-90	23-35
5HK150 and 5HK250, 2000 Ampere	60-95	23-35
5HK350, 1200 and 2000 Ampere	50-90	23-35
3000 Ampere	65-95	23-35

***At 125 Vdc — Times at other voltages may vary slightly.*

NOTE: 5HK250, 80 kA high momentary, same as 5HK350, 1200 and 2000 Ampere, in table above.

NOTE: Below 0°C, the closing times will increase (but with no reduction in closing force); and opening times will be within the limits. Adjustments to correct speeds, if found to be outside limits, are critical and Gould Inc. should be contacted for recommendations.

5.8 ARC CHUTES

The arc chutes should be inspected internally to ensure that no breakage occurred to liner plates or arc plates. Further, there may be a crust formed on the liner plates if load current interruptions were close to the continuous current rating of the breaker, or moderate faults were interrupted. This crust should be removed by carefully using a carborundum stone or scraper. The arc chute should then be blown out with compressed air to remove the resultant dust and particles.

After 400% accumulated current or major interruptions occur, the circuit breaker should be inspected immediately. All maintenance checks or tests noted above should be carried out, plus close examination of the arc chute. Arc plate and liner plate breakage should be carefully looked for, along with excessive erosion of the arc plates. Arc plates are made of ceramic material and perform the function of extracting heat from the arc as it is being forced into and elongated by them. The leading edges become coated with glass that comes to the surface from the extreme heat. Direct measure of use is the amount of glass beads evident.

When the entire leading edge and portions of the flat arc plate are heavily encrusted with glass beads, the arc chute should be replaced. It should be noted that this condition will vary between arc chutes on the same breaker because of single-phase fault and asymmetrical current incidences. If there are any questions, Gould Inc. should be consulted for recommendations.

5.9 OPERATING MECHANISM (See Figure 5)

The operating mechanism is adjusted at the factory for proper operation and should not be disturbed unless the circuit breaker does not close electrically on reclosing duty. This condition is caused when the latch check switch (2) at right side of breaker (when used) is not actuated. Circuit breaker should not close before trip latch (4) has reset.

Latch-check switch adjustments — made with latch (4) against stop pin (3):

1. Turn in adjusting screw (1) until contacts of switch (2) "break" as indicated by an audible click or check with bell ringer.
2. Retract adjusting screw until switch contacts "make".
3. Rotate adjusting screw one turn more. (Adjustment screw is self-locking.)

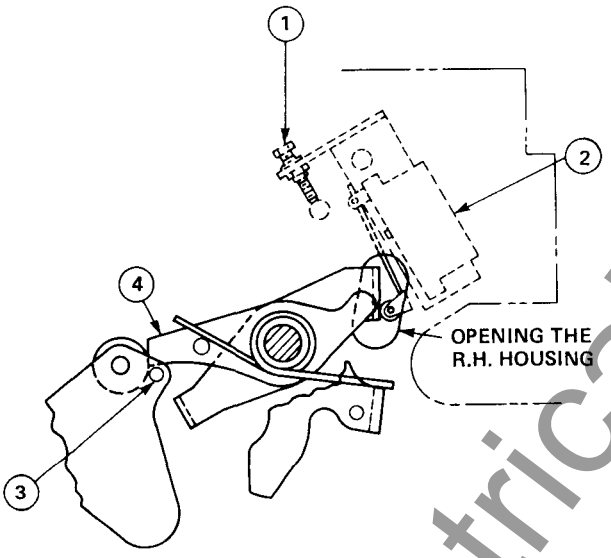

Fig. 5 — Latch Check Switch Adjustment

5.10 CONTROL RELAY ADJUSTMENT (See Figure 6)

The control relay does not normally require any adjustment in the field. The gap between the control device lever and the limit switch crank should be between 0.06" and 0.09" with the closing springs charged. If the gap measurement is incorrect adjust all 5HK circuit breakers except 5HK350, 3000 by shimming either at the lever bracket or the control device mounting screws as illustrated in Figure 6. Before changing shims at the two control device screws, loosen all three screws, replace shims and then tighten all three screws. The 5HK350, 3000 is adjusted by means of an adjusting head screw fastened to the lever.

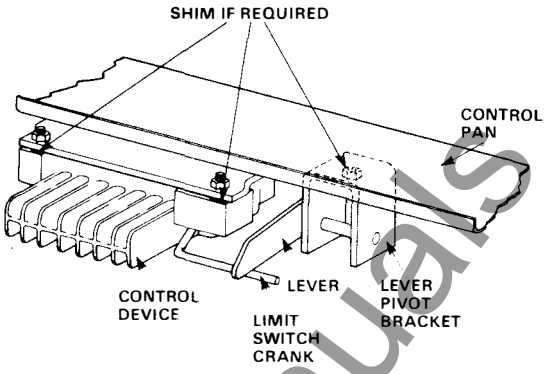

Fig. 6 — Control Relay

5.11 RACKING MECHANISM (See Figure 7)

The circuit breaker racking mechanism is adjusted for proper operation and should not be disturbed unless it becomes possible to close the breaker during a racking operation.

If it is possible to close breaker during a racking operation, it may be that interlocked blocking members are not positioned properly, which should be corrected as follows:

1. Remove the front mechanism coverplate.
2. With circuit breaker closed, make adjustments by regulating length of connecting rod (1) for 1/8" minimum to 3/16" maximum clearance at "A" between trip link (3) and blocking lever (2).

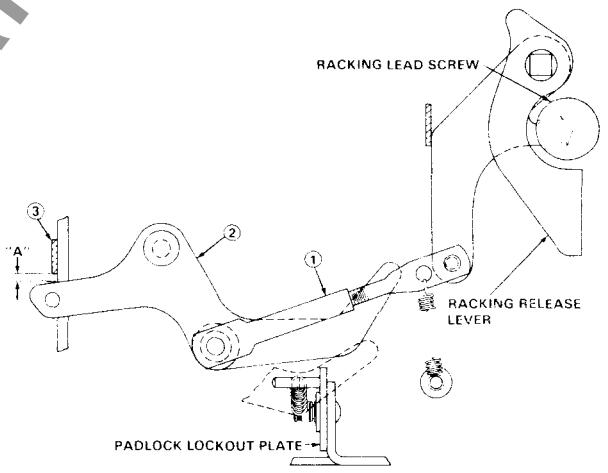

Fig. 7 — Racking Mechanism

5.12 LUBRICATION

The HK circuit breakers are lubricated during factory assembly as follows:

1. All mating surfaces of moving current-carrying joints have been lubricated with NO-OX-ID special 'grade "A" grease manufactured by Sanchem Inc.
2. All other mechanism parts, bearings, pins, etc. have been lubricated with ANDEROL 757

manufactured by Tenneco Chemical, Inc., Intermediate Division.

In order to maintain reliable operation, it is important that all circuit breakers be lubricated at all times. All bearings and rolling surfaces that require lubrication have been properly lubricated at the factory during assembly and should not require any further lubrication during the life of the equipment. However, even the finest greases have a tendency to oxidize with age, as evidenced by hardening and darkening in color. In addition to lubricant oxidation, frequent operation of the breaker causes lubricant to be forced out from between the bearing surfaces. When these changes occur, regreasing is required to maintain reliable operation of the breaker. Elimination of the hardened lubricant is essential before regreasing is performed. A simple lubrication will often clear up minor misoperations which might be mistaken for more serious trouble.

If the grease should become contaminated or parts are replaced, lubrication should be done with NO-OX-ID or ANDEROL grease as applicable. Use of other greases have not been proved by test and are not recommended.

NOTES:

1. Do not use NO-OX-ID grease on any main and arcing contact surfaces.
2. It is recommended that the primary disconnects be maintained by renewing the NO-OX-ID grease during maintenance periods.
3. Do not use light oil to lubricate any mechanism parts.
4. The charging motor is sealed and no lubrication is required.

5.13 DIELECTRIC TESTS

If it is desired to make dielectric tests during maintenance periods, the following test values should be used. These are to be applied for a one-minute period.

TABLE 3. DIELECTRIC TEST VALUES

Circuit	60 Hz	DC
Primary Circuit	11.5 kV	16 kV
*Secondary Circuit (Control)	1100 V	1500 V

It is necessary that the charging motor be disconnected for this test by turning the motor disconnect switch to the "OFF" position. If a test is desired on the motor, then the motor disconnect switch should be turned to the "ON" position and the circuit retested at 540 V, 60 Hz or 760 V DC.

5.14 TROUBLESHOOTING

The following chart lists typical problems, their causes and corrective action required to remedy the malfunction.

TROUBLESHOOTING CHART

Problem	Probable Cause	Corrective Action
Breaker Fails to Close	Low or Incorrect Control Voltage	Adjust to Proper Level
	Closing Springs Not Charged	Adjust Per Section 5.10
	Control Relay Limit Switch Out of Adjustment	
	Breaker is not Racked into Test or Connected Position	Turn Operating Crank Clockwise until lever is locked into the desired position
	Latch Check Switch not Making (When Supplied)	Adjust Per Section 5.9
	Auxiliary Switch "b" Contact not Making	Determine Cause and Repair
	Racking Release Lever Linkage not properly adjusted	Adjust per Section 5.11
	Excessive Friction	Insufficient or Contaminated Lubrication (See Sec. 5.12)
	"Y" Contact not Making*	Defective "Y" Coil Circuit
	Undervoltage not operating (When Supplied)	Low or Improper Voltage Applied
	Defective Close Coil Assembly	Replace Close Coil Assembly
Breaker Fails to Trip	Low or Incorrect Control Voltage	Adjust to Proper Level
	Auxiliary Switch "a" Contact not Making	Determine Cause and Repair
	Defective Trip Coil Assembly	Replace Trip Coil Assembly
	Excessive Friction	Insufficient or Contaminated Lubrication (See Sec. 5.12)

Caution — Improper "Y" circuit operation could permit the breaker to pump to destruction.

5.15 ELECTRICAL CHARACTERISTICS OF CONTROL DEVICES

For operating voltage ranges for various nominal control voltages refer to Table 4, Operating Voltage Ranges.

For average current values at various nominal control voltages, refer to Table 5, Average Current Values. Current values given in this table are average, steady-state values and momentary inrush currents for all charging motors and AC coils are approximately six to eight times these values.

TABLE 4. OPERATING VOLTAGE RANGE

Nominal Control Voltage	Spring Charging Motor	Close Coil	Trip Coil	Undervoltage	
				Pick Up Maximum	Drop Out
24 V dc	-	18-28	14-30	21	7-14
48 V dc	35-50	35-50	28-60	41	15-29
125 V dc	90-130	90-130	70-140	106	38-75
250 V dc	180-260	180-260	140-280	212	75-150
115 V ac	95-125	95-125	* 95-125	97	34-69
230 V ac	190-250	190-250	*190-250	195	69-138

TABLE 5. AVERAGE CURRENT VALUES

Nominal Control Voltage	Spring Charging Motor	Close Coil	Trip Coil	Lockout Coil	Under-Voltage	N.E.C. Fuse
24 V dc	-	22.0	22.0	0.30	0.9	30
48 V dc	25.0	10.7	10.7	0.15	0.5	30
125 V dc	10.0	5.0	5.0	0.06	0.2	30
250 V dc	5.0	2.2	2.2	0.03	0.1	30
115 V ac	10.0	4.5	*4.5	0.40	0.2	30
230 V ac	5.0	2.3	*2.3	0.20	0.1	30

Alternating current is never recommended because the control power is affected by the power system that it is protecting. A sufficient reduction in control power during a heavy fault condition could prevent the HK circuit breaker from opening, leading to loss of total load and/or equipment damage.

Section 6. ELECTRICAL OPERATING SEQUENCE

Please refer to the specific schematic diagrams and other operational information furnished with your order.

Figure 8 is provided as a typical schematic for general information on electrical operation with dc closing.

Figure 9 is provided as a typical schematic for general information on electrical operation for HK breakers with ac closing. The following is the sequence of electrical operation with ac closing.

With the circuit breaker open, the closing springs uncharged, and the control power source energized across disconnects 5 and 02 and 01 and 6 and motor disconnect switch closed, operation occurs as follows:

1. Immediately upon the availability of control power at secondary disconnects ''5'' and ''02'' the spring charging motor (MOT) is energized, which, in turn, charges the closing springs. When the closing springs are charged, limit switch contacts ''LSb'' are opened, and limit switch contact ''LSa'' is closed. Also, upon availability of control power at secondary disconnects ''01'' and ''6'' and after the closing springs have been charged, the lockout relay coil (Y) will be energized through the circuit breaker auxiliary switch ''b'' contact and the parallel resistors R2 and R3. The lockout relay will pick up and open contact ''Yb'' and close contact ''Ya''.

2. Connecting secondary disconnects ''03'' or ''7'' to control via operation of the close control switch energizes the latch release coil (X) through the circuit breaker auxiliary switch ''b'' contact, the normally open lockout relay contact ''Ya'', and the limit switch contact ''LSa''. The latch release coil (X) releases the closing latch. The springs then discharge to close the circuit breaker.

3. When the springs discharge, limit switch contacts ''LSb'' close, and limit switch contact ''LSa'' opens

4. When limit switch contact ''LSb'' in the motor circuit closes, the spring charging motor is energized, which, in turn, recharges the closing springs.

5. When the circuit breaker closes, all auxiliary switch ''b'' contacts open and all auxiliary switch ''a'' contacts close.

6. When limit switch contacts ''LSb'' close, the lockout relay coil (Y) is de-energized and opens lockout relay contact ''Ya'', which de-energizes the latch release coil (X). Lockout relay contact ''Yb'' closes, which locks out the lockout coil (Y) as long as the ''Close'' contact is maintained. This is true because control power maintained on secondary disconnects ''03'' or ''7'' with ''Yb'' contact closed puts resistor R1 in parallel with the ''Y'' coil. The additional current flow through R2 and R3, and the associated increased voltage drop across R2 and R3 leaves insufficient voltage to pick up the lockout relay. The purpose of the lockout relay coil (Y) is to prevent pumping of the closing mechanism when closing against a faulted circuit.

7. After the breaker has closed and when the closing control switch is released by the operator, the lockout relay coil (Y) remains de-energized due to the auxiliary switch ''b'' contact in the closing circuit being open.

8. The circuit breaker can be tripped by operation of a remote trip switch, which energizes the circuit breaker trip coil (TC) through the auxiliary switch ''a'' contact.

9. The undervoltage device, if furnished, provides a direct acting lock-open and undervoltage tripping feature. This device must be energized to initially close the breaker, and also to maintain the breaker in a closed position.

10. The latch check switch, if furnished, ensures that the operating mechanism must be reset prior to energizing the closing latch release coil (X).

11. The remote mounted capacitor trip feature, if furnished, provides an electrical energy storage

network, whereby should a loss of control power occur at the instant of a tripping signal, sufficient energy will be furnished to ensure an electrical tripping operation.

12. The stopping device switch, if applicable, prevents electrical reclosing of the circuit breaker after a manual trip until the stopping device switch has been manually reset.

When AC closing control power is supplied, the circuit breaker will not reclose unless the reclosing circuit has sufficient time delay to permit the "Y" coil to pick up.

Operation of accessories, when installed as ordered, can affect electrical/mechanical operations of the circuit breaker. When the circuit breaker is being tested electrically or mechanically, undervoltage devices should be energized or otherwise mechanically closed and mechanical interlocks, key or other, should be set in the "operate" position.

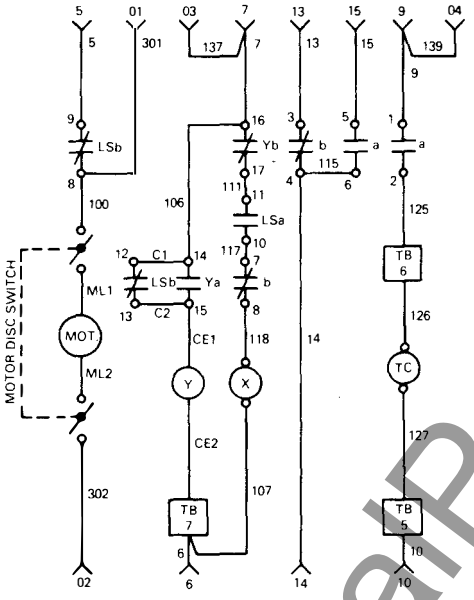

Fig. 8 — Typical Schematic Diagram of Control Circuit, DC Closing

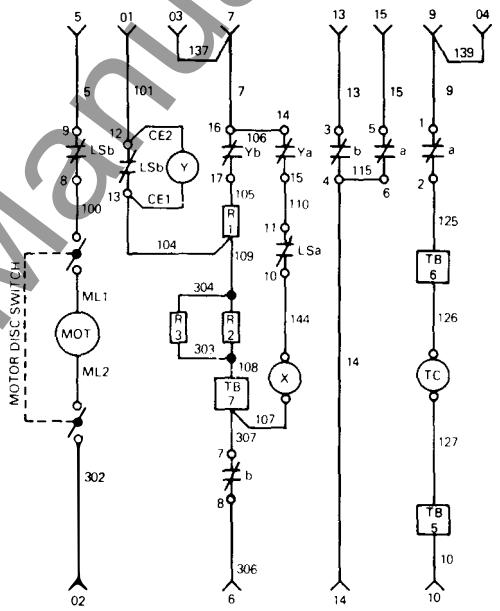

Fig. 9 — Typical Schematic Diagram of Control Circuit, AC Closing

REAR VIEW OF SECONDARY DISCONNECTS

6 >	< 5
9 >	< 7
10 >	< 13
15 >	< 14
04 >	< 03
02 >	< 01

LEGEND

- a — Auxiliary Switch Contact Closed When Breaker Is Closed.
- b — Auxiliary Switch Contact Open When Breaker Is Closed.
- LCb — Latch Check Switch Contact Closed When Breaker Operating Mechanism Is Reset.
- LSa — Limit Switch Contact Open When Springs Are Discharged, Closed When Springs Are Charged.
- LSb — Limit Switch Contact Closed When Springs Are Discharged, Open When Springs Are Charged.
- TC — Shunt Trip Coil
- X — Closing Latch Release Coil.
- Y — Control Relay Lockout Coil.
- Ya — Normally Open Control Relay Contact.
- Yb — Normally Closed Control Relay Contact.
- TB — Terminal Block Point.
- ML — Motor Lead.
- CE — Coil Lead End.
- C1, C2 — Terminal Jumper (Control Device).
- ⌒ — Female Secondary Disconnect Contact.
- UV — Undervoltage Trip Device.
- UVb — Normally Closed Undervoltage Trip Device Contact.
- 69 — Permissive Control Switch.
- BL — Blocking Lever Switch (Open When Ground Switch Is Locked In Ground Position).

Section 7. GROUND AND TEST DEVICES

These devices are supplied when ordered and are basically three design types, with certain component variations such as test ports and interlocks.

— Simple, three-terminal, non-automatic.
— Simple,. three-terminal, electrically operated.
— Complex, six-terminal, electrically operated with manual selector switch.

These devices are basically maintenance free for their normal operating life. Racking procedure is the same as for the basic circuit breaker as outlined previously, and all detailed operational instructions are attached to the individual devices.

Section 8. RENEWAL PARTS

Gould recommends only those renewal parts be stocked that will be required to ensure proper and timely maintenance for normal operation of HK circuit breakers. Copies of the applicable Renewal Parts Bulletin for specific circuit breakers will be furnished on request to the nearest sales office of Gould Inc.

The minimum quantity of assemblies and items recommended in these bulletins are predicated on infrequent replacement of parts based on accumulated test and operating experience. Total assemblies are recommended for fast replacement, when necessary, to return the breaker to service as quickly as possible. Then certain replaced assemblies, such as the stationary upper terminals, can be returned to the factory for nominal reconditioning. The bulletins contain specific part-ordering instructions. Specific instructions regarding replacement of those part assemblies recommended are available if required.

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Issue G, 4-78 Supersedes Issue F

TM-1800-478

Printed U.S.A.