IB-2325C

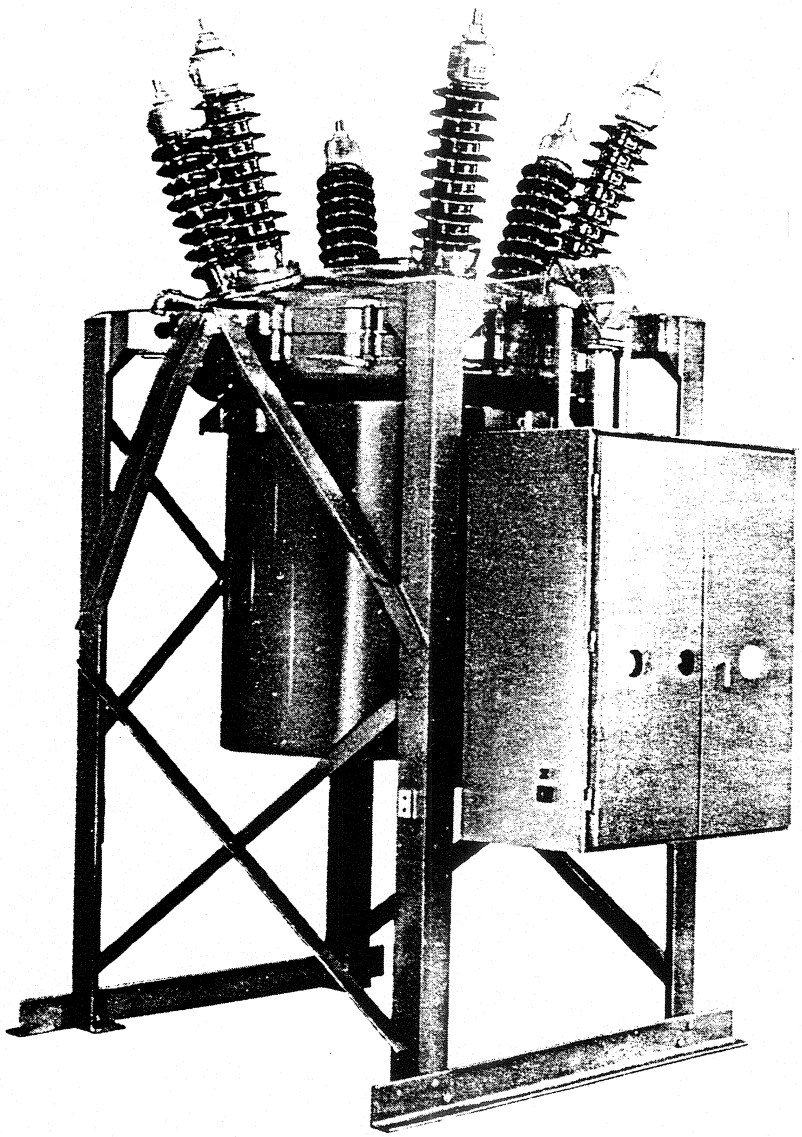
TREND-LINE POWER CIRCUIT BREAKERS

INSTRUCTIONS
RENEWAL PARTS

SUBTRANSMISSION CLASS

TYPES

69KS2500 – 12B
69KS3500 – 12B



I-T-E CIRCUIT BREAKER COMPANY

INSTRUCTIONS FOR
69 KV POWER CIRCUIT BREAKERS
TYPE KS – SUBTRANSMISSION CLASS

INTRODUCTION

The Trend-Line Power Circuit Breaker with the KOOL-ARC® interrupters represent the most modern type oil circuit breaker while incorporating time-tested design and construction techniques. The KOOL-ARC® interrupters are designed for fast short circuit interruption which means less system disturbance and inevitably lower maintenance. These breakers are constructed with all three phases mounted in a common top frame and oil tank. A pneumatic mechanism enclosed in a weatherproof housing is mounted at the front of the breaker and is mechanically linked to the breaker operating mechanism.

These instructions should be read carefully and completely before attempting to install or operate this equipment. These instructions are general and do not cover all variations in equipment or provide for every problem which may be encountered when installing, operating or maintaining this equipment. If a problem arises which is not adequately covered in this book and further information is required, contact the I-T-E Circuit Breaker Company for prompt assistance.

The circuit breaker plays an important part in the modern subtransmission system, being depended upon for protection and flexibility of control. It should not be operated at voltages or currents which exceed those given on the nameplate. The interrupters are designed to meet the required interrupting rating at the rated voltage.

When the breaker is to be operated on a circuit of lower than rated voltage, the normal interrupting rating can be retained only down to the value of the circuit voltage where the amperes to be interrupted equal the maximum ampere rating of the breaker. For operating on circuit voltages lower than this value, then the interrupting rating must be reduced proportionately.

RATINGS

The rating of each circuit breaker is stamped on the nameplate located on the inside lower portion of the door of the operating mechanism housing. These circuit breakers are designed for application on 60 cycle A-C voltages in the ratings listed:

Type	Current Rating Amperes	Interrupting Rating MVA	Maximum Voltage Rating KV
69KS2500-12B	1200	2500	72.5
69KS3500-12B	1200	3500	72.5

RECEIVING

The breakers are completely assembled and tested at the factory. Each breaker is carefully inspected and packed by personnel experienced in the proper handling and packaging of electrical equipment.

Upon receipt of a breaker, immediately examine it 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 transportation company and promptly notify the I-T-E Circuit Breaker Company, though not responsible for damage to goods after delivery to the carrier, will lend assistance to help secure adjustment if notified of such claims.

HANDLING

Remove the protective packing materials as soon as possible after receipt including the protective packing around the bushings. After the bushings have been inspected and found in satisfactory condition, replace the packing. If the packing removal is delayed, difficulty may be experienced in making a claim for damages not evident upon receipt. Use care while removing the packing. Check all loose parts against the packing list and make certain that no parts have been overlooked while unpacking. If a shortage of material is discovered, promptly notify your representative of the I-T-E Circuit Breaker Company. Inform him of your purchase order number and the identification of the missing part so that he may assist you in handling the matter as quickly as possible.

STORAGE

The breaker should be set up immediately at its permanent location and filled with oil, if at all possible. This should be done even though it may not be placed in service for some time. The tank should be clean and dry before filling with oil. (Refer to page 6 for instructions on filling the tank). The protective packing should not be removed from the bushings until after the breaker has reached its permanent location and all overhead work is completed.

The space heater in the operating mechanism housing should be energized. (Refer to the control wiring diagram for heater connections.) This should be done as soon as possible in order to prevent moisture condensation inside the housing. Exposed machined surfaces of the operating mechanism, etc., should be slushed with grease to prevent rusting and if the breaker is to be stored for any length of time it should be inspected periodically to insure that rusting has not started and to guarantee good mechanical condition.

Renewal parts, especially lift rods, interrupters, and other parts made of insulation material should be stored in a dry room. It would be advisable to hang the lift rods in a vertical position to minimize the possibility of warpage, if a level storage surface is not available.

INSTALLATION PROCEDURE

Study these instructions and review the drawings and diagrams which supplement these instructions to facilitate installation.

MOUNTING

Total weight of the breaker with and without oil is given on the nameplate and the outline drawing. This will establish the capacity of the hoisting equipment required for handling of the breaker.

The breaker may be lifted by hooking into the framework.

Use caution when lifting so as not to allow cable slings to strike the bushings. Any strain or blow may cause the porcelain to crack or break.

The breaker has been shipped with the lower portion of the framework removed. This is done to facilitate shipping. Before installing the breaker on its foundation, reassemble these lower sections to the framework and bolt securely in place.

Install the breaker where it will be readily accessible for cleaning and inspection.

Provide sufficient space for operation of the tank lifter and for removal of the tank, so as to allow for proper maintenance.

Where flood conditions exist, locate the breaker so that the mechanism housing will be above the high water level.

Locate the breaker on its foundation, leaving nuts on the foundation bolts loose so as to permit the frame to be properly plumbed and leveled.

Loosen and remove the nuts holding the tank to the top frame and lower the tank with the tank lifter. (Refer to page 8 for instructions on the tank lifter). Place a level against the machined bottom surface of the top frame. Shim under the feet, where necessary to level the frame. Reposition the level at 90° to its original location. Shim under the feet, where necessary to level the frame.

Tighten the nuts on the foundation bolts to fasten the frame securely to its foundation.

The breaker is shipped with the mechanism locked in the closed position. Refer to the mechanism instruction book for complete information and instructions.

CONNECTIONS

Before making any electrical connections, make certain that all leads to be connected to the breaker are de-energized.

PRIMARY

Where possible, leads should be brought down from above.

Provide ample electrical clearance between leads and station structures such as walls, channels and framework.

Properly support leads to prevent unnecessary strains on breaker bushings. Bushings should not carry cable or bus bar strains.

Connecting leads must have current carrying capacity at least equal to the maximum operating current which should not exceed the breaker rating.

Connections to the breaker are made by bolted connectors fastened to the top terminal of the bushing.

For good contact, all joints must be clean and free from dents or burrs and the bolts of the connectors must be securely tightened.

CONTROL AND SECONDARY

Run control wiring in conduit as far as practicable.

Run control wiring separate and remote from high tension leads. Do not use same duct or place parallel to the high tension leads unless the distance separating the two sets of wiring is sufficient to prevent possible contact between them as a result of short circuits.

Use control wiring of adequate size so that with full operating current flowing to the operating mechanism, the voltage across the terminals of the mechanism will be within the standard limits for the range of control voltage.

All conduits entering the mechanism housing should be properly sealed at their entrance to the housing to prevent condensation.

GROUND

The framework should be permanently grounded.

Two grounding pads are provided for convenience, one on the rear leg and one on the front leg of the framework. A bolted connector is also provided for attaching the grounding cable. The cable should be able to carry twenty-five per cent of the current rating of the breaker, but should not be smaller than #4/0.

CAUTION: A good, permanent, low resistance ground is essential for adequate protection. A poor ground is worse than no ground at all. It gives false security to personnel working around the equipment and may result in loss of life or equipment damage.

INSTALLATION ADJUSTMENTS

The breaker has been completely assembled, adjusted and tested at the factory. It is recommended, however, that all adjustments be reviewed to check that no changes have occurred during shipment or installation. For instructions concerning adjustments of the operating mechanism, refer to the operating mechanism, instruction book. IB-2254.

Instructions concerning adjustment to the breaker follow in subsequent paragraphs.

The purpose of this section is to outline the various adjustments of the breaker mechanism which affect the operation of the breaker. Check each one carefully. If any of the adjustments do not fall within the values shown in this section, then refer to the section on MAINTENANCE ADJUSTMENTS, page 12 for complete information on properly adjusting the mechanism. Factory settings are to be preferred in all cases. Re-adjustment should not be made unless dimensions exceed the tolerances.

PRECAUTIONS

Check that the primary circuit disconnect switches on both sides of the breaker are open and effectively grounded.

Check that all control circuits are de-energized.

Check that the breaker framework is well grounded.

Properly connect grounding leads before coming in contact with any of the breaker parts.

Use the maintenance closing device to assist while performing maintenance inspection and making adjustments.

DO NOT use the maintenance closing device for opening or closing the breaker under power load conditions.

BREAKER MECHANISM

(Refer to Figures 1 & 2, pages 4 & 5)

Manually close the breaker until the latch mechanism falls into place to hold the breaker in the closed position.

Check dimension A. The distance between the edge of the pin (35) of the bell crank assembly, and the surface of the top frame for mounting the bell crank housing.

Check dimension B. The distance between the top of pin, (144) at the top of the pull rod (117), and the top surface of the breaker mechanism frame, (71).

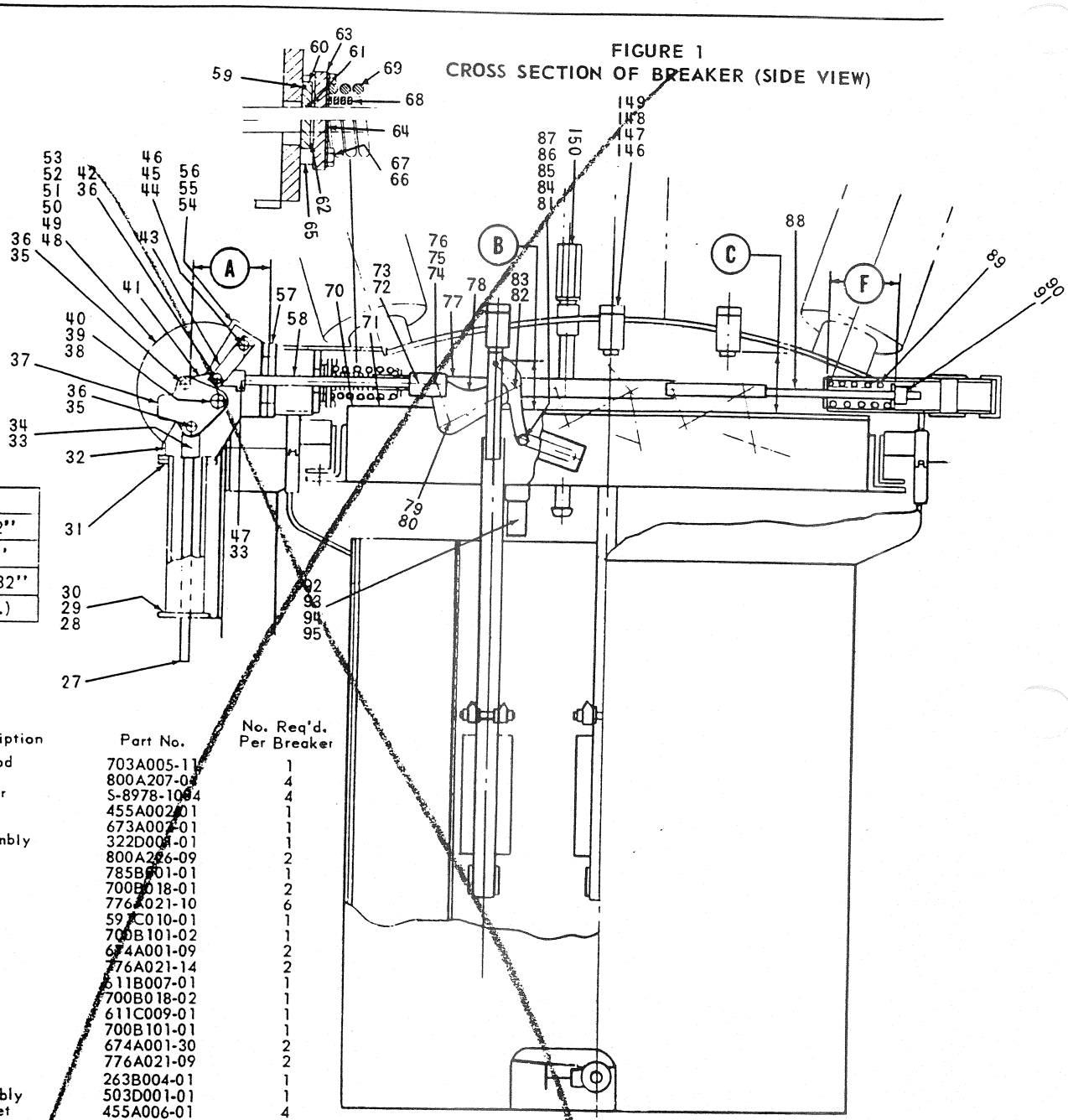
Check dimension C. The distance from the bottom of the buffer housing to the top of the breaker mechanism frame, (71).

Check dimension D. Refer to Figure 2, page 5). The distance between the bottom of the interrupter tube to the top of the cross bar (127, 128).

STROKE (Refer to Figure 2, page 5).

Open the breaker manually. Refer to the operating

FIGURE 1
CROSS SECTION OF BREAKER (SIDE VIEW)

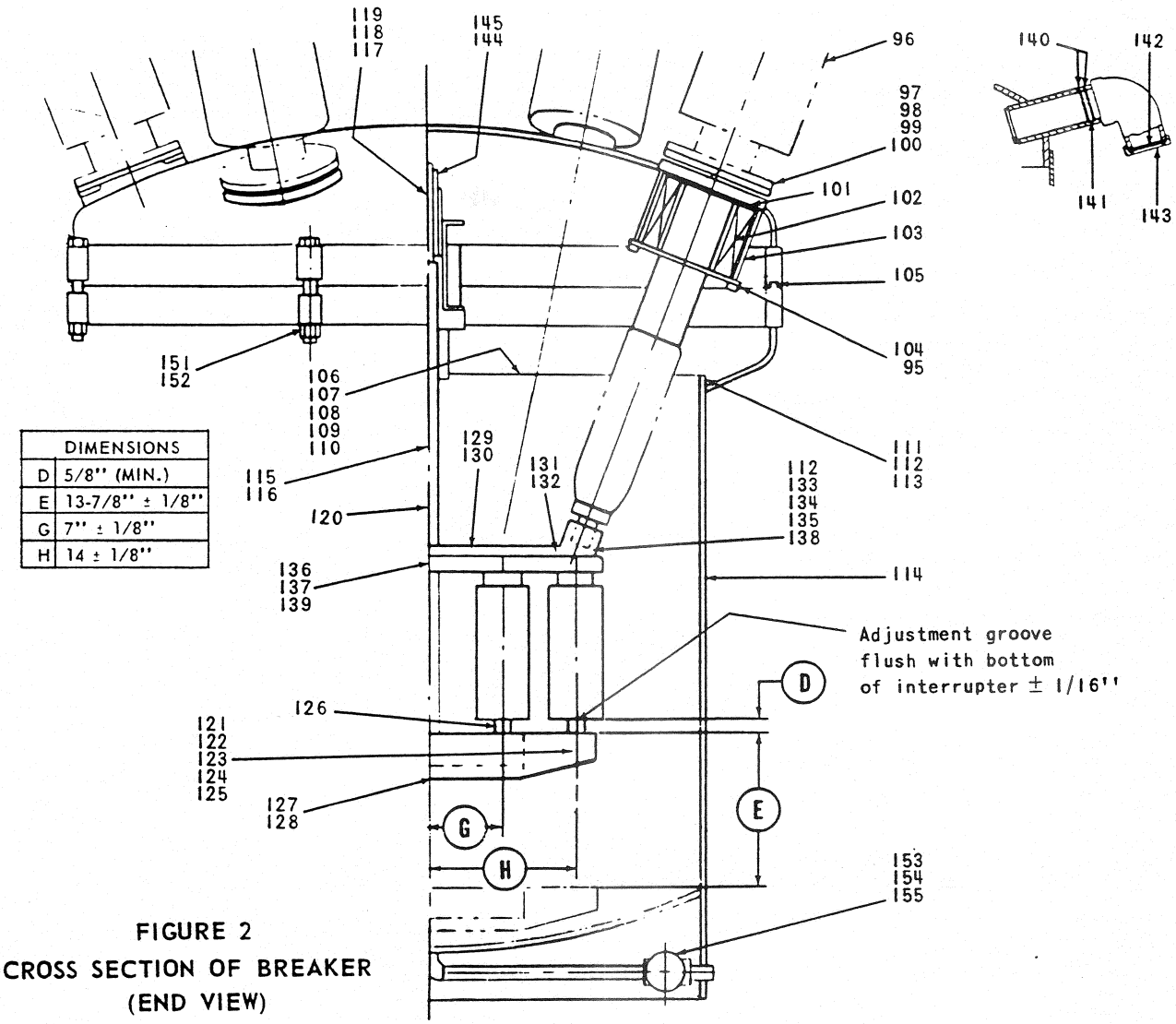


DIMENSIONS	
A	7-9/16" ± 1/32"
B	4-3/4" ± 1/32"
C	5-15/16" ± 1/32"
F	6-15/16" (MIN.)

Item No.	Description	Part No.	No. Req'd. Per Breaker
27.	Threaded Rod	703A005-11	1
28.	Cap Screw	800A207-03	4
29.	Plain Washer	S-8978-1004	4
30.	Gasket	455A002-01	1
31.	Lock Nut	673A007-01	1
*32.	Crank Assembly	322D001-01	1
33.	Cap Screw	800A226-09	2
34.	Rod End	785B001-01	1
35.	Pin	700B018-01	2
36.	Snap Ring	776A021-10	6
37.	Lever	591C010-01	1
38.	Pin	700B101-02	1
39.	"O" Ring	674A001-09	2
40.	Snap Ring	776A021-14	2
41.	Link	611B007-01	1
42.	Pin	700B018-02	1
43.	Link	611C009-01	1
44.	Pin	700B101-01	1
45.	"O" Ring	674A001-30	2
46.	Snap Ring	776A021-09	2
47.	Clevis	263B004-01	1
**48.	Hood Assembly	503D001-01	1
49.	Round Gasket	455A006-01	4
50.	Window	983A002-01	4
51.	Lock Washer	973A295-06	16
52.	Machine Screw	800A251-07	16
53.	Rubber Strip (39" Long)	3186-0324	1
54.	Cap Screw	800A202-09	4
55.	Plain Washer	973A030-05	4
56.	Hex Nut	673A050-06	4
57.	Gasket	455A007-01	1
58.	Threaded Rod	783A005-12	1
59.	"O" Ring	674A001-23	1
60.	Seal Plate	706A116-01	1
61.	"O" Ring	674A001-11	1
62.	Phenolic Washer	973A142-01	1
63.	Plate	706A046-01	1
64.	Plain Washer	973A004-12	1
65.	Sleeve	836A001-06	4
66.	Cap Screw	800A202-10	4
67.	Lock Washer	973A033-10	4
68.	Spring	361A001-19	1
69.	Spring Assembly	856A071-01	1
†70.	Breaker Mechanism	205B004-01	1
71.	Lift Frame	445D052-01	1
72.	Cap Screw	800A226-07	1
73.	Rod End	785B001-01	1
74.	Clevis Pin	700B062-02	2
75.	Flat Washer	973A007-04	6
76.	Cotter Pin	699A072-36	6

Item No.	Description	Part No.	No. Req'd. Per Breaker
77.	Link	611B008-03	2
78.	Lever	591C017-01	3
79.	Clevis Pin	700B021-03	3
80.	Snap Ring	776A021-11	6
81.	Lever	591C018-01	3
82.	Clevis Pin	700B015-02	3
83.	Snap Ring	776A021-07	6
84.	Clevis Pin	700B060-01	3
85.	Roller	787A002-01	6
86.	Flat Washer	973A007-03	6
87.	Cotter Pin	699A072-34	6
88.	Clevis	263B015-01	1
89.	Spring Assembly	856A070-01	1
90.	Lock Nut	673A034-02	1
91.	Cap Screw	800A224-05	1
92.	Dashpot Assembly	345B008-01	3
93.	Cap Screw	800A205-10	12
94.	Plain Washer (Shims)	973A004-10	As Req'd.
95.	Hex Nut	673A025-05	30

* May be purchased as an assembly, (Includes Items 33 thru 47).
** May be purchased as an assembly, (Includes Items 49 thru 53).
† May be purchased as an assembly, (Includes Items 71 thru 87).



DIMENSIONS	
D	5/8" (MIN.)
E	13-7/8" ± 1/8"
G	7" ± 1/8"
H	14 ± 1/8"

FIGURE 2
CROSS SECTION OF BREAKER
(END VIEW)

Item No.	Description	Part No.	No. Req'd. Per Breaker
96.	Bushing (Include all data from bushing nameplate.		6
97.	Gasket	455A003-04	6
98.	Bushing Ring	776B010-01	6
99.	Plain Washer	S-8978-1101	36
100.	Cap Screw	800A207-08	36
101.	Insulating Washer	973A127-14	6
102.	Bushing Current Transformer (Refer to B.C.T. Nameplate for Reference No.)		As Specified
103.	Stud	886A001-09	18
104.	C.T. Support	889A065-01	6
105.	Tank Gasket (17'-3" Long)	3101	1
*106.	Lining Assembly	608C003-05	1
107.	Tank Lining	608B005-04	2
108.	Tank Lining	608B004-04	2
109.	Stud	886A102-02	28
110.	Square Nut	673A019-02	56
111.	Cap Screw	800A203-06	20
112.	Hex Nut, Nylon Insert	673A025-03	26
113.	Plain Washer	973A030-06	20
114.	Tank	910C012-01	1
**115.	Lift Rod & Cross Bar Assy. (Phases 1 & 3)	326A031-06	2
***116.	Lift Rod & Cross Bar Assy. (Phase 2)	326A031-07	1
117.	Pull Rod	736B004-02	3
118.	Stud	886B002-01	6
119.	Hex Nut	673A025-04	12
120.	Lift Rod	599B001-08	3
121.	Cap Screw	800A205-15	18
122.	Hex Nut	673A025-05	18
123.	Square Key	558A001-01	36
124.	Eccentric	390A001-01	6
125.	Contact Adapter	127B009-01	6
126.	Contact Stud Assembly	296B025-01	6

Item No.	Description	Part No.	No. Req'd. Per Breaker
127.	Crossbar Plate (Phases 1 & 3)	706B038-01	4
128.	Crossbar Plate (Phase 2)	706B082-01	2
129.	Guide Board (Phases 1 & 3)	185B008-08	4
130.	Guide Board (Phase 2)	185B008-06	2
131.	Lock Washer	973A033-11	6
132.	Cap Screw	800A203-08	6
133.	Clamp	257B004-02	6
134.	Spring	856A158-01	6
135.	Plain Washer	973A030-06	12
136.	Washer	973A205-01	12
137.	Guide Pin	699A134-01	6
138.	Bolt	189A005-19	6
139.	Square Nut	673A019-03	12
140.	Retaining Ring	776A022-06	2
141.	Filter	425A001-01	1
142.	Screen	799A001-01	1
143.	Washer	973A013-02	1
144.	Clevis Pin	700B012-01	3
145.	Snap Ring	776A021-05	6
146.	Compression Washer (See Figure 1)	973A032-02	9
147.	Flat Washer (See Figure 1)	973A010-07	3
148.	Die Spring (See Figure 1)	361A001-20	3
149.	Buffer (See Figure 1)	210A001-01	3
150.	Oil Gage (See Figure 1)	458A008-02	1
151.	Hi-Strength Bolt	189A003-02	12
152.	Hex Nut	673A050-16	12
153.	Globe Valve	962A033-01	1
154.	Sampling Valve	962A091-01	1
155.	Pipe Plug	702A252-04	1

* May be purchased as an assembly, (Includes Items 107 thru 110).
** May be purchased as an assembly, (Includes Items 117 thru 127).
*** May be purchased as an assembly, (Includes Items 117 thru 126, & 128)

mechanism instruction book for details. Total movement of the left rod should be dimension E. This is the distance from the fully closed to the fully open position. It may be necessary to check that the dashpots are fully depressed in order to get the full stroke movement.

CONTACTS (Refer to Figure 2, page 5).

Close the breaker manually. Refer to the operating mechanism instruction book for details. With the breaker in the closed position, the adjustment mark on the moving contact should line up with the lower edge of the interrupter tube within the tolerance noted on the illustration.

FINAL INSTALLATION INSPECTION

After the breaker has been completely installed, with all mechanical and electrical connections completed, and all adjustments checked, make the following inspection before operating the breaker electrically.

Check that breaker is properly leveled and securely fastened to its foundation. Check all nuts, washers, bolts, cotter pins, snap rings and terminal connections for location and tightness.

Inspect all insulated wiring for damage during installation and test it for possible grounds or short circuits.

Check oil level in dashpots (should be approximately 1" below top of reservoir tube.)

Touch up surface of paint which has been scratched or chipped during shipment or installation.

Check that inside of tank is clean and dry. Check all fittings and accessories for tightness. Use sealing compound on joints if necessary. Check the compressor oil level.

Fill the air receiver to proper pressure.

Raise the tank, using the tank lifter. Refer to page 8 for instructions on the tank lifter. Replace all nuts on tank bolts and tighten securely. (The tank must be drawn solidly against the bottom machined surface of the reinforcing ring of the top frame to insure proper compression of the tank gasket, sealing the joint between tank and top frame.)

Check the breaker oil for dielectric strength. It should test a minimum of 26,000 volts. Refer to page 10 for additional information for testing the oil. Use care when filling the tank so that the oil will not absorb moisture. The oil containers should be completely dry and the filling operation performed on a dry day.

Use metal or oil proof hose. Ordinary rubber hose is not satisfactory as the oil dissolves the sulphur in the rubber and the sulphur in turn attacks the copper elements of the breaker.

Fill the tank to the proper level.

Temperature 25°C – normal (to black marker on glass).

Temperature -40°C – to lowest visible point on glass indicator.

Temperature 70°C – to highest visible point on glass indicator.

Oil level should never be allowed to fall below the lowest visible point on the glass indicator. This level is the minimum at which the ground sleeve on on the bushing will be sufficiently immersed to effect proper insulating operation. While the tank is filling with oil, check the operating mechanism. Refer to the operating mechanism instruction book, IB-2254.

ELECTRICAL OPERATION

The breaker is now ready to operate electrically.

An electric cycle counter may be used to determine opening, closing and reclosing time.

The opening time should be less than 2.5 cycles, the closing time should not exceed 15 cycles and the reclosing time should not exceed 20 cycles. Another method for checking is with the time-travel recorder (i.e., Cincinnati Analyzer). Typical travel analyzer curves for this breaker are shown on page 16.

Install the travel analyzer. Weldments for a mounting platform are provided on the top frame. Install the analyzer connecting rod (A #10-32 tapped hole is located in the top of the lift rod assembly directly below the plugged hole in the top of the closing buffer housing. Simply remove the plug, insert the rod and screw into place). The travel curve can be used to measure actual contact speed. The opening speed is determined by drawing a straight line through two points on the travel curve. One point "O" is to be located on the opening curve at the point where it intersects the contact indication line. (Contact indication is an electrical characteristic).

The second point "P" is to be located on the opening curve 2" (measured vertically) below the contact indication line. The slope of this line is an indication of the opening speed. The speed should fall within 9.0 to 10.0 feet per second. If the speed is not correct see page 13.

DESCRIPTION AND OPERATION

The type KS breaker consists of a three pole breaker unit and an operating mechanism as pictured on the front cover of this book. The three pole breaker unit is made up of the three single pole units which are permanently connected together and mounted within a common top frame and oil tank. The tank contains the high dielectric oil and combination tank liner-interphase barrier which surround the interrupters and lower ends of the bushings.

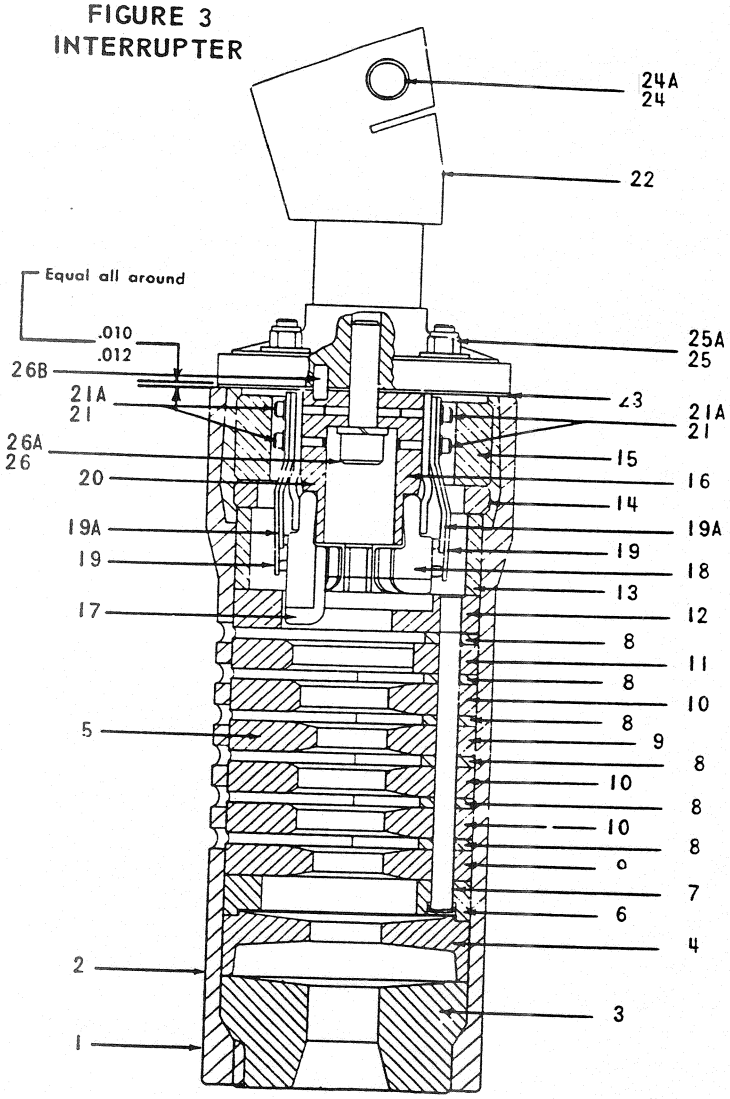
The top frame houses the breaker mechanism linkage and supports the bushings, bushing current transformers and the interupters. The breaker mechanism linkage (refer to Figures 1 & 2, pages 4 & 5) which is located in the top frame, is designed to give straight line motion to the moving contact rods, (126). A bell crank assembly, (32), located above the operating mechanism changes the motion from vertical to horizontal. The bell crank assembly is mechanically linked to the breaker mechanism by an adjustable pull rod, (58). The horizontal motion of the pull rod is transmitted to the internal linkage through the lever, (78), which converts the motion to a vertical movement. A gas and oil seal is provided for the pull rod to form a separation between the operating mechanism housing and the top frame. An accelerating spring, (68, 69), is located adjacent to the gas and oil seal and the opening spring, (89), located at the rear of the top frame give positive opening action to the moving contact at a required contact speed. Three opening dashpots, (92), and three closing buffers, (149), are located on the breaker mechanism frame and in the top frame. The dashpots absorb the energy of the moving parts to limit the rebound of the opening stroke and the buffers limit the overtravel of the moving contacts on closing.

The dashpots are filled with the same type of oil as used in the breaker tank. They are self-contained, and when properly filled with oil, will operate properly whether or not the oil tank is filled.

(Refer to Figures 1 & 2, pages 4 & 5).

An oil separator vent in the top frame permits the gases generated during interruption to be separated from the oil and vented to the outside. A float type oil gauge, (150), is located in the top frame. The oil tank, (114), is held in place against the top frame by bolts and nuts which clamp the tank against the tank gasket, (105), which is located in a groove on the underside of the reinforcing band of the top frame. A combination tank liner-interphase barrier, (106), of insulating material is attached to the inside of the tank. Raising and lowering of the tank for inspection and maintenance of the contacts is accomplished by

FIGURE 3
INTERRUPTER



Item No.	Description	Part No.	No. Req'd. Per Breaker
*1	Interrupter Tube Assembly	539C078-01	6
2	Interrupter Tube	952B039-01	6
3	Throat Bushing	218B020-01	6
4	Interrupter Plate	706B202-02	6
**5	Interrupter Baffle Assembly	706A282-01	6
6	Ring	776B060-01	6
7	Rod	783A063-01	6
8	Exhaust Plate	706A254-01	36
9	Oriface Plate	706A257-01	12
10	Oriface Plate	706A255-01	18
11	Oriface Plate	706A256-01	6
12	Top Plate	706A258-01	6
13	Spacer	846B001-03	6
14	Lock Ring	776B003-01	6
15	Clamping Ring	776B005-01	6
***16	Contact Finger Assembly	296B083-01	6
17	Arcing Contact	296A069-03	6
18	Contact	296A061-01	42
19	Leaf Spring (Long)	856A120-01	96
19A	Leaf Spring (Short)	856B150-01	144
20	Contact Support	296B118-01	6
21	Cap Screw	800A222-04	96
21A	Lock Washer	973A033-07	96
22	Interrupter Adapter	127B041-01	6
23	Spacer	846A035-01	6
24	Cap Screw	800A227-13	6
24A	Hex Nut	673A025-05	6
25	Hex Nut	673A026-04	24
25A	Washer	973A032-01	24
26	Cap Screw	800A005-06	6
26A	Lock Washer	973A033-13	6
26B	Spring Pin	699A123-17	12

* May be purchased as an assembly (Includes Items 2 thru 15).
** May be purchased as an assembly (Includes Items 6 thru 12).
*** May be purchased as an assembly (Includes Items 17 thru 21A).

using the tank lifter, which is designed for either manual or power operation. A sampling valve, (154), is fastened to the drain pipe located at the bottom of the tank, so that the oil may be drained and samples taken. The valve is capped to prevent any leakage.

INTERRUPTERS

The KOOL-ARC® interrupters (refer to Figure 3, page 7) are attached to the lower ends of the bushings. The interrupter houses the stationary contact fingers, (18). An arcing finger, (17), which is in line with the interrupter exhaust vents, positions the arc and effects improved interrupting performance. The lift rod and cross bar assembly, refer to figure 2, items 115, 116, of each phase carry the moving contact, (126), and are mechanically linked to the breaker mechanism.

BUSHINGS

The bushings, (refer to Figure 2, item 96, page 5), which are supplied, meet both ASA C76.1 and NEMA Standards. They are installed in the top frame from above. A bushing ring (98), is used between the bushing mounting flange and the flange seat on the top frame. This ring permits proper angular alignment of the bushing as well as simplifying the contact adjustments. A gasket, (97), insures a weatherproof seal. Two bushing current transformers may be mounted around each bushing.

The bushings can be installed or removed from the breaker without disturbing the bushing current transformers.

BUSHING CURRENT TRANSFORMERS

Bushing current transformers, type BR, relaying, (refer to Figure 2, item 102, page 5) are used to provide a source of current supply for operating the breaker trip coils and protective relays. They are located inside the top frame and may be mounted before the bushing is inserted. Supporting plates (104) bolted to the underside of the top frame hold the transformers in place. The transformer leads are brought into the mechanism housing through an oil seal where they are terminated at suitably marked terminal boards.

Relaying transformers are of the multi-ratio type having five leads which provide a wide range of ratios. Ratio and accuracy classifications for standard transformers are in accordance with both ASA C57-13-24 and NEMA SG4 Standards.

Bushing current transformers, type BM, metering, can also be furnished. Single or multi-ratio types are available. These have windings designed for specified loadings and cannot be used on other loadings without affecting their accuracy.

The multi-ratio type has standard tap connections. Ratios and accuracy classifications for standard transformers of this type are also in accordance with both ASA C57.13-24 and NEMA SG4 Standards.

Performance data in the form of excitation and ratio correction factor curves are available for each type of transformer. For complete information on the bushing current transformer instruction book, IB-2400C.

TANK LIFTER

The tank lifter is optional equipment but is required for proper maintenance of the breaker. It consists of a removable drive assembly and pulleys. The drive unit is bolted to the rear frame of the breaker. A flexible cable is wound on two drums located on the ends of this drive shaft. The cables then pass over a series of pulleys on the top frame and tank, with the ends secured to the frame. Refer to the tank lifter assembly drawing for threading and securing details. The tank lifter is self-locking in any position and should be stored indoors when not being used to keep it from rusting. The tank lifter is furnished with a hand crank for manual operation. This crank can be removed, however, and a heavy duty electric drill motor attached to the drive shaft for power operation.

TOOLS

A hydraulic jack and handle is provided as a maintenance closing device. A spanner wrench is provided for disassembling the locking ring of the KOOL-ARC® interrupter. In addition, there is included a special wrench for adjusting the moving contact eccentric bushing and a special wrench for adjusting the auxiliary switches.

OIL

The performance of the modern breaker is highly dependent upon the use in the breaker of oil having the proper characteristics and refined under a controlled method to fully meet the most rigid specifications. A high dielectric strength is necessary to meet insulation requirements. Efficient cooling demands low viscosity, yet not too low as to affect the flash and burning points, which must be high enough to minimize the fire risk. A low pour point is required for successful operation when installed in a location subject to low temperatures.

High resistance to carbonization minimizes the

sludge and carbon deposits which reduce the dielectric strength and cooling effect of the oil. The proper oil should not readily retain moisture in suspension as the presence of one tenth of one per cent may reduce its puncturing resistance by fifty per cent.

It is recommended that Avon Transformer Oil, Shell Diala AX, or other oils with equivalent characteristics to be used in this breaker. Each lot of oil is subjected to a strict inspection which requires, in part, that the oil shall withstand a potential of at least 26,000 volts as measured by the standard test between 1 inch discs spaced 0.1 inch apart.

CLOSING OPERATION

As the breaker closes the pull rod moves towards the operating mechanism and the accelerating spring and the opening spring are compressed. The moving contacts enter the interrupter and penetrate the stationary multiple contacts at the end of the stroke.

The force required to compress the accelerating spring and the opening spring and the force required to insert the moving contacts in the stationary multiple contacts decelerate the moving parts.

After some overtravel necessary for the operating mechanism to latch in, the motion is reversed and the contacts fall back about 1/4'' into the normal closed position.

TRIPPING OPERATION

When the breaker opens under load, the forces of the released compression of the accelerating and opening spring cause the contacts to part and an arc between the arcing finger of the stationary contacts and the moving contact is established. The pressure generated by the arc forces oil through the lateral vents of the interrupter. The configuration of the interrupter plates is such that the oil flow through the ports aids interruption. The contact speed is considerably increased when high currents are interrupted due to the forces of the current loop. The opening dashpots in the breaker absorb the energy and provide a rebound free stop at the end of the stroke.

ANTI-PUMP

The breaker is provided with anti-pump protection by the use of a relay designed to perform this function. This relay remains energized as long as the operator holds the control switch. Under this condition the air valve coil cannot be re-energized to cause pumping.

MAINTENANCE PROCEDURE

The safety and successful functioning of connected and related apparatus depend upon continued and reliable operation of the oil circuit breaker. To obtain this, the oil circuit breaker must have regular systematic inspections during which every part is examined carefully.

The frequency of these inspections should be determined by each user and should be on the basis of the number of operations (including switching), the magnitude of current interrupted and any unusual operations which occasionally occur. On installations where a combination of fault duty and repetitive operation is encountered, an inspection is recommended after any severe fault operation. Operating experience will soon establish a maintenance schedule which will give an assurance of proper breaker condition.

PERIODIC INSPECTION

To maintain dependable service and safety of power equipment, it is recommended that a periodic inspection schedule be established and followed. This type of preventive maintenance will serve to eliminate serious shutdown by locating potential sources of trouble in the early stages.

CONTACTS AND INTERRUPTER PARTS

(refer to Figure 3, page 7).

Lower and remove the interrupter tube (2), by removing the four clamping nuts, (25).

Remove the clamping ring, (15).

Use special spanner wrench to loosen thread lock ring, (14).

Check the interrupter plates, (8), for erosion. The plates may be used until eroded approximately 25% along the leading edge.

Inspect all other plates of the interrupter tube assembly for excessive erosion.

Check the condition of the stationary and moving contacts. If the contact surfaces are only roughened they may be smoothed with a fine file. Care must be used in filing so as not to remove the silver surface on the fingers.

Replace the interrupter tube assembly.

OIL

Oil in service should be tested at frequent intervals. Three month periods are recommended for standard operational service. If the dielectric strength of the oil tests less than 22,000 volts it should be filtered.

When sampling oil use a large-mouthed glass container which has been cleaned and dried with benzine and free from moisture.

The oil sample should be at least one pint. The test sample should be taken only after the oil has settled for some time and should be contained in a clean glass bottle with a cork stopper. Samples should be taken from the valve at the bottom of the tank and sufficient oil drawn off to make sure the sample represents oil from the tank proper and not that stored in the drain pipe.

If water is found in the sample, an investigation of the cause should be made and a remedy applied. Excessive water is indicative of leakage somewhere in the breaker structure.

INSULATING PARTS

Thoroughly clean all insulating parts to remove all traces of carbon which may remain after the oil has been drained from the tank. It is recommended that the oil be removed and the tank cleaned at regular intervals since filtering alone does not remove the carbon which adheres to the inside of the tank and to internal parts.

DASHPOTS

Check the oil level in the dashpot by removing the pipe cap from the top of the reservoir tube. With the breaker open and the dashpot depressed, the oil level in the reservoir tube should be approximately 1" below the top of the tube. Unless otherwise specified, the dashpots are filled with the same oil as used in the breaker. Check the operation of the dashpot and note that the piston works freely and that it will fully retrieve.

Visually check that there is no sludge present.

FITTINGS

Check all bolts, nuts, washers, cotter pins, lock rings and terminal connections to see that they are in place and properly tightened.

Check the gland nuts on all valves and oil gauges to see that they are sufficiently tight to prevent leakage. Use caution in tightening the gland nuts to prevent damaging the packing.

BUSHINGS

Clean the bushing porcelains at regular intervals. This is especially important where abnormal conditions prevail such as salt deposits, cement dust or acid fumes. This periodic cleaning will avoid flashover as a result of accumulation of foreign substances on the porcelain surfaces.

LIFT ROD GUIDES

Inspect the guides carefully as the vibrations due to the operation of the breaker may have caused the bushings to move slightly and result in misalignment of the contacts.

OPERATING MECHANISM

Consult the operating mechanism instruction book, IB-2254 for maintenance procedure.

MAINTENANCE ADJUSTMENTS

Check all adjustments of the breaker linkage mechanism as explained in the MAINTENANCE ADJUSTMENTS Section, page 12.

This shall include electrical operation and speed adjustments to completely insure, after the maintenance function is completed, that the breaker is properly adjusted and ready for operation.

REPAIR AND REPLACEMENT

It may be necessary, from time to time, to remove and replace those parts of the breaker which are subject to wear and damage through operation of the equipment.

INTERRUPTER PARTS (refer to Figure 3, page 7).

Remove the interrupter tube, (2).

To remove the interrupter plates:

Remove the clamping ring, (15).

Use special spanner wrench to loosen thread lock ring, (14).

Lift the plates out and replace those which are excessively worn or damaged. These plates are keyed for proper positioning during re-assembly. Tighten lock ring, (14), firmly with the special spanner wrench after all internal plates have been replaced.

Check the position at the exhaust vents with Figure 4, page 11. The interrupter tubes of the four outside bushings (phase 1 and 3) are different from the ones in the center (phase 2). The exhaust vents of the

two center phase interrupters are in line with one of the mounting studs, but they fall between the studs on the four outside interrupters.

After inspecting the contact fingers, (18) replace the complete interrupter tube assembly on its contact support, (22), on the lower end of the bushing. Before tightening the four clamping nuts check that the arcing finger, (17), has entered the cut-out in the top plate, (12).

Slight rotation of the tube back and forth will help position and center the arcing finger in the cut-out. Tighten the four clamping nuts firmly. This will draw the tube against the flange of the contact support and lock it in place. Tighten these nuts evenly all around so that the gap as indicated on Fig. 3, page 7 is obtained.

CONTACTS (refer to Figure 3, page 7).

To remove the contact fingers, (18):

Remove the screws, (21), holding the fingers to the support, (20). Note carefully the position of the arcing fingers, (17), and the number of leaf springs used with each finger. Replace all fingers that are badly burned or pitted. Re-install the contact fingers paying special attention that three short leaf springs (19A) and two long leaf springs (19) are used with all fingers. These springs must be carefully stacked and lined up with the contact fingers. Check each finger after the fastening screws have been tightened by lifting it against the force of the springs to make certain that it is free of binding and that it repositions itself upon releasing and that the leaf springs rest on the insulating buttons. Check that the arcing finger is in its proper location. The arcing finger must be in line with the lateral vents as there is a cut-out in the top interrupter plate into which the lower end of the finger must fit.

To remove the moving contact rod: (refer to Figure 2, item (126).

Loosen the nuts on the cross bar, (127, 128), and screw the rod out of its eccentric bushing, (124). Screw the new moving contact rod into the eccentric bushing (124). Operate the maintenance closing device and slowly close the breaker. While doing this make certain that the moving contact rod lines up properly with the hole in the lower end of the interrupter tube. To align this properly use the special wrench provided to move the eccentric bushing for the moving member until it is positioned properly in relation to the opening in the tube.

The adapter, (125) into which the eccentric bushing fits also has some adjustment and can be moved towards or away from the lift rod to assist in alignment. Continue to operate the maintenance closing device and fully close the breaker and check to make certain that the indicator groove on the rod lines up properly with the lower end of the interrupter tube to insure proper contact penetration. When this has been completed tighten the nuts on the cross bar to hold the eccentric bushing firmly in position.

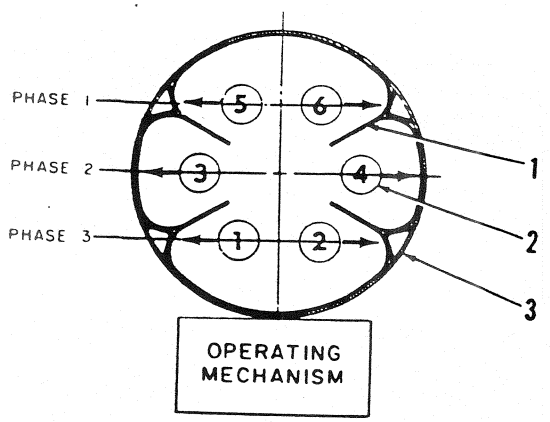


FIGURE 4
POSITION OF INTERRUPTER EXHAUST VENTS

1. Tank Liner and Interphase Barrier
2. KOOL-ARC® Interrupter
3. Tank

BUSHINGS

To replace a bushing: (refer to Figure 2, item 96).

Remove the lift rod guide, (129, 130).

Remove the interrupter, (1), and contact support, (22).

Loosen and remove the bushing bolts in the mounting flange on top the breaker.

Remove the bushing. Reinstall new bushing, being careful to keep from damaging the bushing or the bushing current transformer.

When reinstalling a bushing make certain that the gasket, (97), between the top frame flange seat and the mounting flange of the bushing is in good condition.

Replace the lift rod guide. Tighten the guide clamping screws which will draw the lower ends of the bushing into the proper relative position to each other.

Replace the interrupter, but do not tighten the contact support clamping screw. The mounting of the bushing in the top frame is designed to allow limited angular adjustment. The angle may be altered by a variation in the tightening process of the bushing flange mounting nuts.

Adjust the bushing angle and the interrupter so that the moving contact will slip freely into the interrupter when the breaker is closed slowly. A level should be used to check the vertical position plumb of the interrupter tube. If necessary the moving contact rod may be re-positioned as explained in the previous section. Tighten all the nuts and screws and recheck the alignment and adjustment.

BUSHING CURRENT TRANSFORMERS

To replace a transformer: (refer to Figure 2, item 102).

Refer to Instruction Book No. IB-2400C for instructions concerning correct connections and proper polarity of these transformers.

Should it be necessary to replace a transformer, care must be taken when installing a new one to see that the end of the transformer carrying a white mark is placed upwards. This identifying mark is placed on the bushing to indicate proper polarity and must be in the up position to insure proper operation. The bushing current transformer, (102), is mounted in a well surrounding the bushing, (96), in the top frame. It is held in position with a supporting plate. Disconnect the transformer lead wires at the terminal board in the operating mechanism housing, and remove the interrupter, (1), and lift rod guide, (129, 130). After this has been done then remove the nuts holding the supporting plate in position and lower the bushing current transformer down and over the lower end of the bushing. Bushing current transformers may be installed either before or after the bushings are in place.

Insulation washers above the transformer protect it from injury. It must be properly centered to prevent it from becoming damaged when the bushing is installed. After it has been installed reassemble the lift rod guide and interrupter and connect the transformer leads. Again it is necessary to check the interrupter adjustments and alignment to insure proper operation.

MAINTENANCE ADJUSTMENTS

After any maintenance or the periodic inspection has been completed, it would be advisable to check all breaker linkage mechanism and operating mechanism adjustments. For information concerning the operating mechanism adjustments, refer to the operating mechanism instruction book. Proper adjustments are an important part of the maintenance and inspection function and will insure proper operation when the equipment is placed back in service.

When the maintenance or inspection functions have been completed, refer to the INSTALLATION-ADJUSTMENT section for all dimensional data on the breaker mechanism adjustments. If these adjustments do not fall within the specified limitations, then return to this section for supplemental information on adjustment procedures.

NOTE: Use same precautions, while making adjustments as are outlined for the INSTALLATION ADJUSTMENT section page 3).

BREAKER MECHANISM (refer to Figure 1, page 4).

Manually close the breaker until the latch mechanism falls into place to hold the breaker in the closed position.

Check dimension A. Loosen the clamping nut and turn operating rod, (27), either in or out until the proper dimension is obtained. Tighten clamping nut.

Check dimension B.

Loosen the clamping nut on the connecting rod clevis. The connecting rod, (58), has right and left-hand threads. Shortening the rod will increase dimension B. Tighten the clamping nut on the connecting rod clevis. It must be noted that if concurrent adjustments are made on the opening spring or closing buffer, that the connecting rod adjustment will have to be reviewed and possibly the procedure repeated until the proper adjustment has been secured in light of all contributing pressures.

Check dimension C. This dimension can be adjusted by raising or lowering the lift rod.

STROKE (refer to Figure 2, page 5).

Total movement of the lift rod should be dimension E. This is the distance from the fully closed to the fully open position. The dashpots, (Figure 1, item 92), form the stopping point of the breaker in the open position. Check when measuring the stroke that they are fully depressed thus giving full stroke movement. It may be necessary to manually depress the dashpots to get the true position. If the stroke is not correct it may be adjusted in the following manner:

Loosen the nuts mounting the dashpot. To lengthen the stroke, add shims to lower the dashpots. To shorten the stroke remove shims to raise the dashpots. When the proper stroke has been obtained, tighten the nuts. Adjust all three dashpots so that they operate approximately the same time.

CONTACTS (refer to Figure 2, page 5).

Check that, with the breaker in the closed position, the adjustment mark on the moving contact lines up

with the lower edge of the interrupter tube, within ± 1/16".

ELECTRICAL OPERATION

After all maintenance has been performed, adjustments made and the tank filled with oil and the operating mechanism with air then the breaker should be operated electrically and the speed checked. Refer to the INSTALLATION-ADJUSTMENT section, paragraph on ELECTRICAL OPERATION (page 6) for instructions. The opening speed of the breaker should check 2.5 cycles maximum with the cycle counter or 9.0 to 10.0 ft/sec. with the travel analyzer. If the opening speed does not meet these requirements, it can readily be changed by adjusting the opening spring (Figure 1, item 89) setting as follows:

Remove the housing covering the spring at the rear of the top frame. Loosen the lock nut. If the speed is too slow, tighten the spring so that it will be more compressed in the closed position. If the speed is too fast, reverse the process and relieve the compression in the closed position. When the spring has been properly set and the proper speed achieved, tighten the lock nut and replace the spring housing.

RENEWAL PARTS

Sufficient renewal parts should be carried in stock to enable prompt replacement of worn or damaged parts. Careful planning for a stock of such parts will minimize service interruptions caused by equipment breakdown and will ultimately save time and expense.

The amount of stock of renewal parts which should be maintained is dependent upon your conditions of operation and past experience. When continuous operation is of primary importance, more renewal parts should be stocked, the amount being dependent upon the severity of the service and the time required to secure replacement. We would recommend that you stock sub-assemblies for use as spares as they offer considerable convenience in time of replacement.

Renewal parts may not always be identical to the original parts, since revisions are being made constantly in an effort to improve our products. The parts which are furnished, however, will be interchangeable.

On the preceding pages are parts assembly illustrations of the breaker showing all the working or functional parts. These illustrations are for your convenience to assist you in locating and identifying the parts which you wish to stock or re-order.

DELIVERY

Unless otherwise specified, all parts are shipped F.O.B. point of shipment regardless of transportation costs being allowed, prepaid, or collect. The company, unless instructed otherwise, shall establish the method and routing of the shipment of parts, our standard carriers being either rail or truck. Freight being sent by rail or truck and weighing under 300 lbs. shall be sent collect. Shipments of 300 lbs. or over will be sent freight prepaid to the nearest rail or truck terminal within the continental limits of the United States, with delivery service from terminal to customer door, where common carrier provides such service.

The customer may specify method and route of shipment but in so doing, obligates himself for the additional expense incurred. Shipments may also be sent by parcel post or by air. Shipments of this type are sent collect regardless of the weight. Any claims for shortages, breakage or damage in shipment must be made by the purchaser (as consignee) directly to the carrier. The I-T-E Circuit Breaker Company should be notified of such claims so that it might assist in settling the claim.

RETURNED MATERIAL

All parts or apparatus being returned must be sent freight prepaid. No returns will be permitted without proper authorization and instructions from the factory. Goods returned without complete identification in accordance with our instructions or without charges prepaid will not be accepted.

DEFECTIVE MATERIAL AND WORKMANSHIP WARRANTY

All parts are guaranteed to be free of defects in material and workmanship for a period of one year from the date of shipment. The company will either repair or replace any part or parts which become defective within this period of warranty, free of charge, F.O.B. point of shipment, provided the company is given the opportunity to confirm the existence of defects. The company is not liable for damages or expense in connection with the results or consequences of the operation of the equipment.

REPAIR POLICY

Extensive repairs to circuit breakers should be done in the field. Contact your nearest I-T-E Sales Office. They will be able to assist you by providing information and recommendations to help you with your service problem. If the repair required is of a more difficult nature they will assist you in obtaining the services of one of our field servicemen.

CONDITIONS OF SALE

We are not responsible for any loss, damage, detention or delay caused by fire, strike, civil or military authority, or by insurrection, or by any other cause which is unavoidable or beyond our reasonable control; nor for consequential damages.

We are not responsible for charges for installing apparatus which has been repaired or replaced, or for resulting loss of service.

RECOMMENDED STOCK

The following chart represents our recommendation as to a stock of renewal parts. This recommendation is suggested only as a guide for your own particular requirements. Your past experience and service requirements will dictate where the amounts recommended in this tabulation will not fulfill your needs and should be adjusted.

Note that the stock of the individual items is based upon the number of breakers (of the same type) which you have in service.

RENEWAL PARTS RECOMMENDATIONS

PART DESCRIPTION	ITEM NO. (FROM PARTS ILLUSTRATIONS)	NO. REQ'D. PER BREAKER	MIN.	RECOMMENDED STOCK	
				1 TO 5 BREAKERS	MORE THAN 5 BREAKERS
Bushing	96	6		1	2
Bushing Gasket	97	6	6	6	6
Tank Gasket	105	1	1	1	2
Tank Lining Assem	106	1		1	1
*Lift Rod & Crossbar Assem. (Phases 1 & 3)	115	2		1	2
**Lift Rod & Crossbar Assem.(Phase 2)	116	1		1	1
Lift Rod	120	3		1	2
Contact Stud Assembly	126	6	2	6	12
Crossbar (Phases 1 & 3)	127	4		2	4
Crossbar (Phase 2)	128	2		2	2
Guide Board (Phases 1 & 3)	129	4		2	4
Guide Board (Phase 2)	130	2		2	2
Guide Pin	137	6		2	4
Oil Gauge	150	1		1	2
†Interrupter Tube Assembly	1	6		3	6
Interrupter Tube	2	6		3	6
Throat Bushing	3	6		3	6
Interrupter Plate	4	6		3	6
Interrupter Plate Assembly	5	6		3	6
Ring	6	6		3	6
Rod	7	6		3	6
Exhaust Plate	8	36		9	18
Orifice Plate	9	12	4	12	24
Oriface Plate	10	18	6	18	36
Oriface Plate	11	6	2	6	12
Top Plate	12	6	2	6	12
Spacer	13	6		3	6
Contact Finger Assem.	18	42	14	42	84
Arcing Finger Assembly	17	6	2	6	12
Leaf Spring (Short)	19A	144		72	144
Leaf Spring (Long)	19	96		31	96

* Assembly, includes items 120, 126 & 127.
** Assembly, includes items 120, 126 & 128.
† Assembly, includes items 2, 3, 4, 5, 6, 7, 8 & 9.

These parts need not be stocked as individual items when included as part of an assembly.

ORDERING PROCEDURE

When ordering renewal parts, or for information concerning service or repair of your equipment, address the nearest sales office of the I-T-E Circuit Breaker Company. Give the following information taken from the breaker nameplate:

1. SERIAL NUMBER (imperative, to properly identify parts)
2. TYPE
3. RATING (Ampere and Voltage)

Also include (when ordering parts):

1. ITEM NO. (from parts illustrations)
2. DESCRIPTION (from parts illustrations)
3. PART NO. (from parts illustrations)
4. NO. REQ'D. (from parts illustrations)

This book lists and shows all parts which are replaceable. Most of the items must be ordered from the factory. Some items are standard hardware. We would recommend that these items be purchased locally to save you time and expense. Where the hardware is a special nature or where standard hardware is specifically requested by the customer, it will be provided by the factory. Parts orders of low monetary value will be invoiced at the minimum billing rate in effect at the time of shipment.

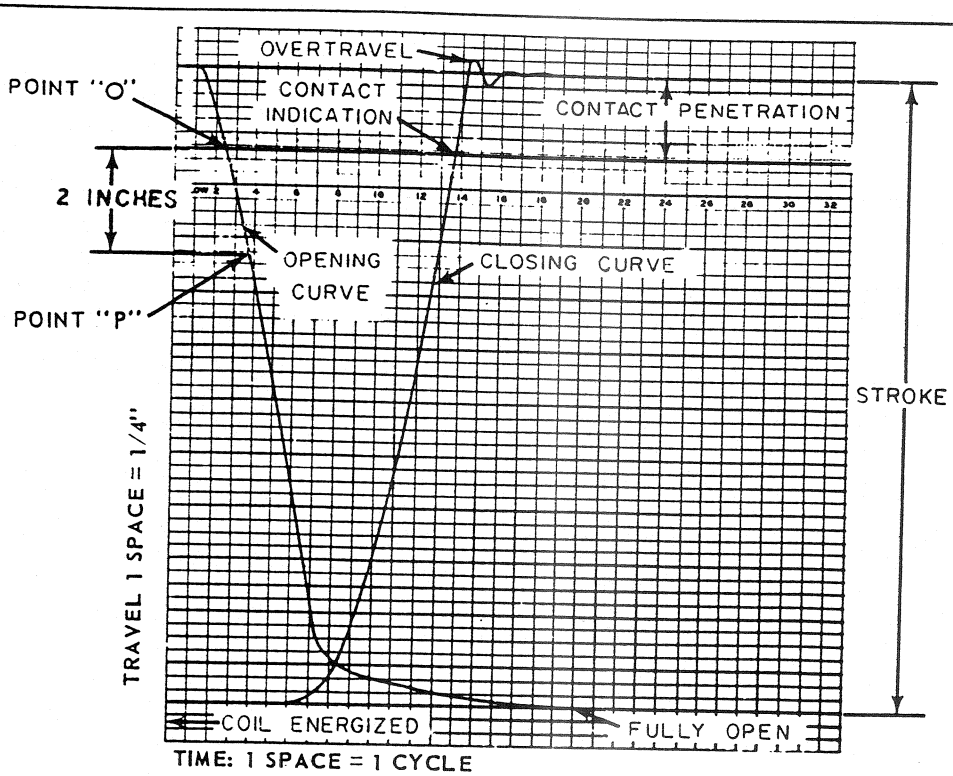


FIGURE 5

Typical No Load Travel Curves For Opening And Closing Operations

At Rated Control Voltage And Air Pressure

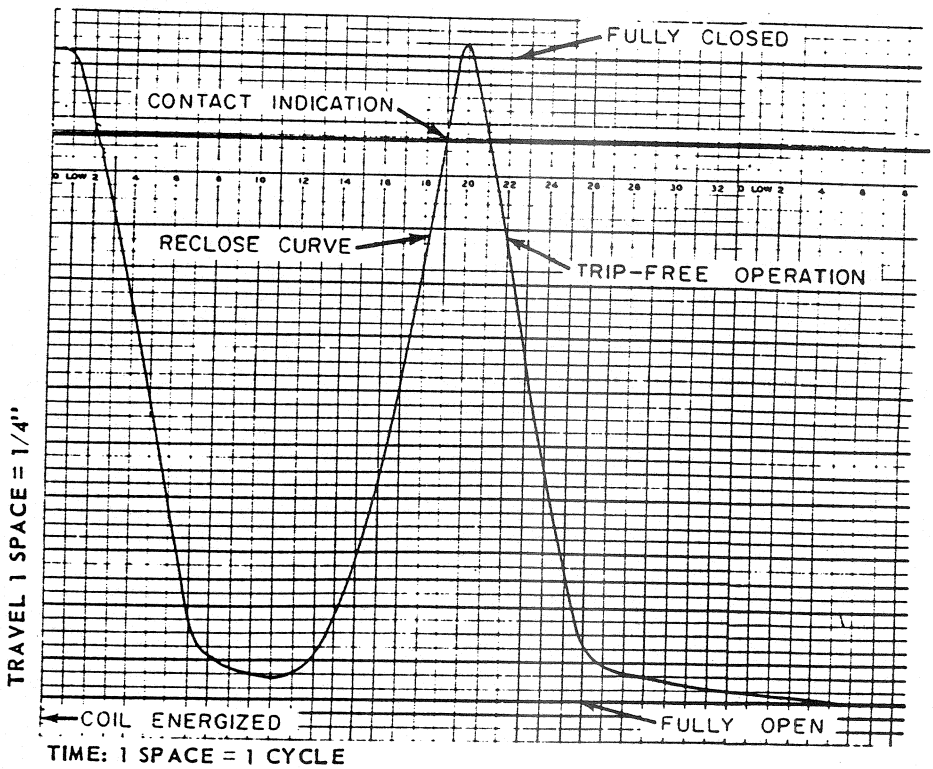


FIGURE 5A

Typical No Load Travel Curves For Reclosing And Trip-Free Operations

At Rated Control Voltage And Air Pressure

Consult Our Sales Offices

The I-T-E Circuit Breaker Company is represented in all principal cities of the United States and Canada. These representatives are experienced and are competent to make correct applications, as well as give complete information and prices. We suggest you consult the representative nearest you.

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Tampa, Florida
Toledo, Ohio
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