Westinghouse

Outdoor Oil Circuit Breakers

Single Tank Construction

600 to 3000 Amperes

5000 to 73000 Volts

Rupturing Capacities Up to 1,000,000 KVA at 73 KV

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Canadian Westinghouse Company, Limited

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Bulletin H-7403-A

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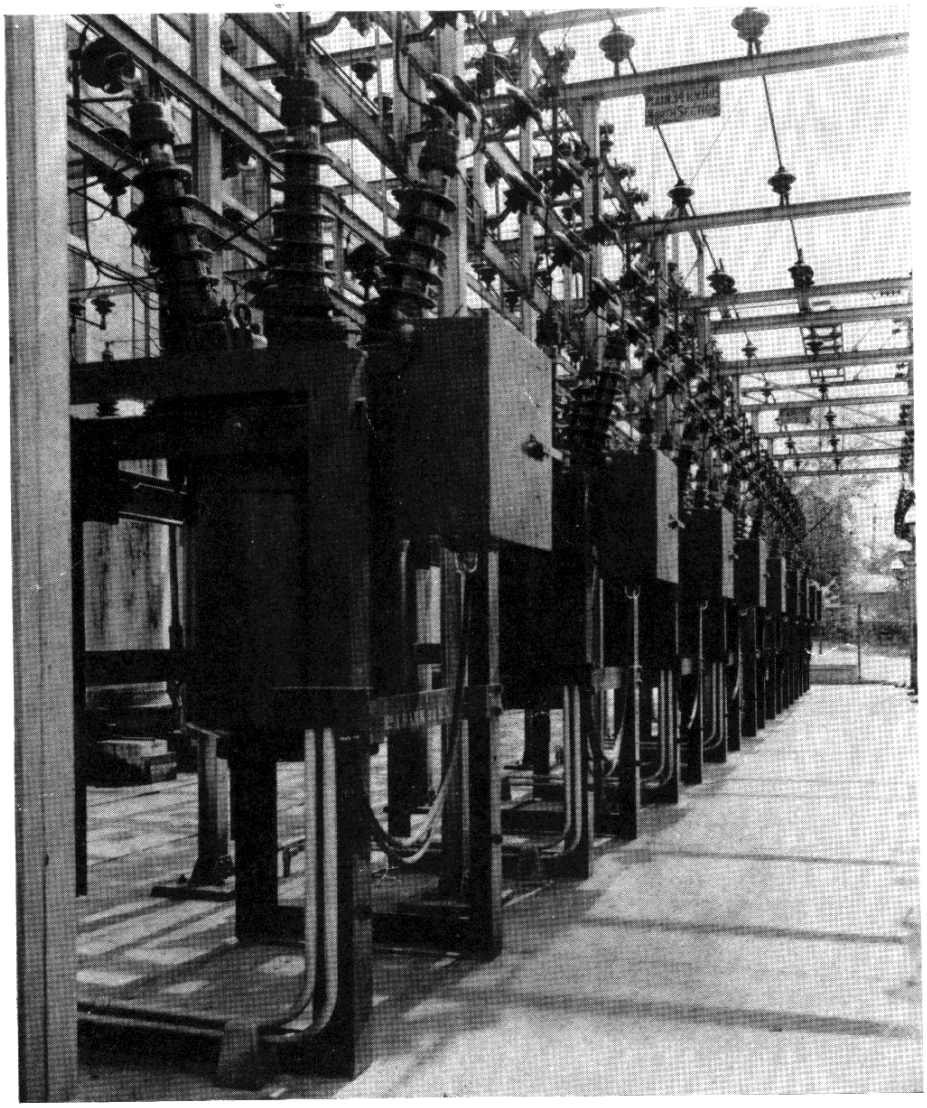

Fig. 1. 600 Amp. 46000 Volt Type BNOB Oil Circuit Breakers in British Columbia Electric Railway Company's Burnaby Substation at Vancouver, B.C.

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GENERAL

The outdoor oil circuit breakers described herein comprise a complete line of modern oil tight shaft operated breakers to meet present day operating requirements. They are available in voltages up to 73 KV, ampere ratings up to 3,000 and interrupting capacities up to 1,000,000 KVA.

The single tank construction results in a compact and rugged design, embodying the latest developments in the art, based on the extensive research work, high power laboratory tests, and field experience of Westinghouse, the recognized leaders in this field.

In the following tabulation, the type designations ending in "O" indicates plain contacts of the conventional wedge and finger design, while those ending in "B" indicate breakers equipped with the well-known DE-ION grid contacts.

While these breakers are listed as outdoor breakers, they can, of course, be furnished with bushings and details designed for indoor service if desired.

DISTINCTIVE FEATURES

This line of outdoor oil circuit breakers has the following distinctive features:

Single Tank Construction:

This arrangement, in which all poles are enclosed in a single tank, results in a very rugged and compact structure.

These breakers may be shipped as completely assembled 3 pole units ready to be mounted on foundation, connected up, and placed in service. All pull rods, conduit for current transformer secondaries and control wiring, running between poles are eliminated, greatly reducing the amount of assembly and fitting required in the field, and eliminating a number of possible entrances for moisture.

Inspection and maintenance is facilitated since it is only necessary to lower the single tank to allow access to the complete contact assembly.

Oil-Tight Assembly:

In this design the lifting rod and linkage are operated by means of a rotating shaft, passing through oil tight bushings in the dome which completely enclosed the lifting rod and linkage. This results in an oil tight enclosure which definitely prevents the ejection of oil.

DE-ION Grid Contacts:

When indicated, these breakers are equipped with the well-known DE-ION grid contact, insuring rapid arc extinction, decreased contact maintenance and oil deterioration, resulting in higher interrupting capacities.

CONSTRUCTION

Main Frame:

The circuit breaker domes are of cast steel, except in the type BPOB, the dome of which is of fabricated steel plate. Non-magnetic inserts are used in the case of the medium heavy current ratings, and for extra heavy current ratings, the complete dome is cast of non-magnetic alloy, of ample mechanical strength.

This dome is supported by means of a rugged frame-work of structural steel.

The dome supports the tank which is drawn up by heavy holding bolts against resilient packing placed in a groove on the underside of the dome or top frame.

The dome is furnished with carefully machined surfaces to which the terminal bushing flanges are bolted.

Tanks:

The BKO, BKOB, BJO and BJOB breakers are furnished with rectangular tanks with rounded corners, having reinforced welded joints at the bottom, and with reinforcing bracing on the side.

The BNO, BNOB, BPO and BPOB breakers are furnished with heavy welded circular steel tanks, with dished bottoms as shown in the accompanying illustrations.

An oil gauge of the sight glass type is provided to facilitate inspection of the oil level.

The drain connection in the bottom of the tank permits drawing off the oil without lowering the tank and, if desired, the tank may be filled while it is in position by removing the oil separator from the main frame.

The inside of the tank is protected by a heavy, removable, insulating lining, and barriers of the same material, forming part of the tank lining assembly, extend completely across between phase contact assemblies, the whole being carefully designed to permit free circulation of oil.

This tank construction provides maximum dielectric strength, maximum mechanical strength against internal pressures, and a high head of oil over the contacts.

Terminal Bushings:

In the BKO, and BKOB breakers, and in the BJO and BJOB breakers up to 15 KV rating, the terminal bushing consists of a heavy wound micarta insulating sleeve around the full length of the conductor, surrounded by a rugged one piece porcelain. The upper end of this porcelain external to the breaker comprises the weather casing and the lower portion, inside the dome, is carried down below the oil level.

For the BKOB 27 KV rating and the BJOB 34.5 KV rating the bushing construction is similar to the above except that the bushing is oil filled, with heavy glass oil cylinder at the top as shown in Fig. 5, similar to the "compression assembly" condenser bushing described below, except that heavy wound micarta is used in place of the condenser bushing.

All type BNO, BNOB, BPO, and BPOB breakers are equipped with the latest design of oil filled condenser bushing, giving very high dielectric strength and long leakage distance under oil.

The upper end of the bushing is enclosed in a one-piece porcelain weather casing, with cap having provision for expansion and contraction. This whole enclosure is absolutely waterproof as proved by shop routine air pressure and oil pressure tests. A test plug is provided on the cap for an air test in service if desired.

The porcelain weather casing is held under compression by a heavy spring in the cap. Thus no cemented rings are required at the top and bottom of the porcelain. (Such clamping rings, where used, may subject the porcelain to high unbalanced mechanical stresses due to the clamping bolts or contraction in cold weather.)

Bushing flanges are pressed on, no clamps or cement being employed. This construction gives maximum strength and ensures an oil tight assembly.

A test plug is provided at the bottom of the weather casing so that this oil may be readily tested or removed. This, of course, can be done without dropping the breaker tank.

Outdoor bushings for 34.5 KV service and up are equipped with a rod gap for surge protection.

The upper end of the terminal bushing is supplied with a clamp type, solderless connector to give the best possible connection and at the same time permits easy disconnection in emergency.

Contacts:

The BKO, BJO, BNO and BPO breakers are equipped with the well-known wedge and finger type of contacts. This form of contact provides liberal contact area and the flat steel springs bearing against the fingers provide high contact pressure.

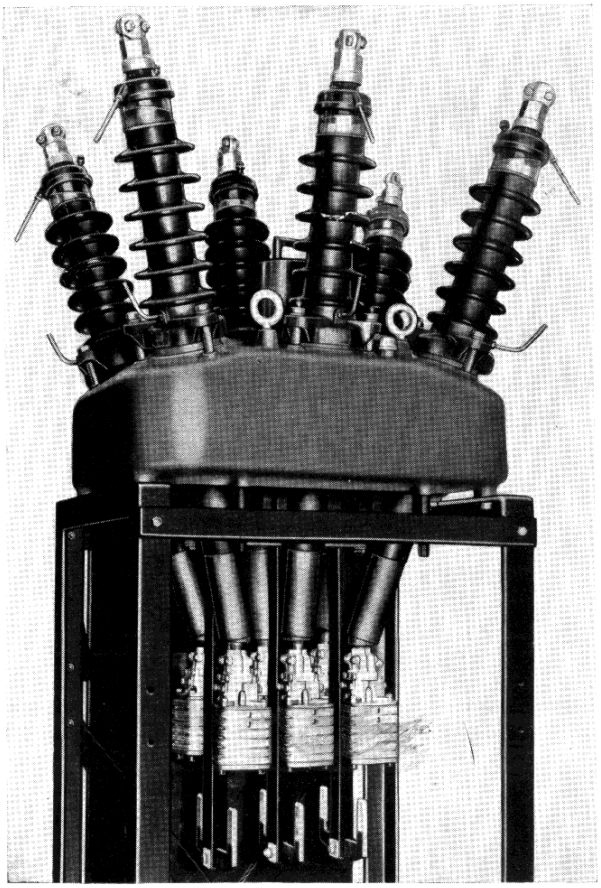

Fig. 2. 600 Ampere, 34000 Volt Type BJOB Oil Circuit Breaker with Tank Dropped, Showing DE-ION Grids and Contacts.

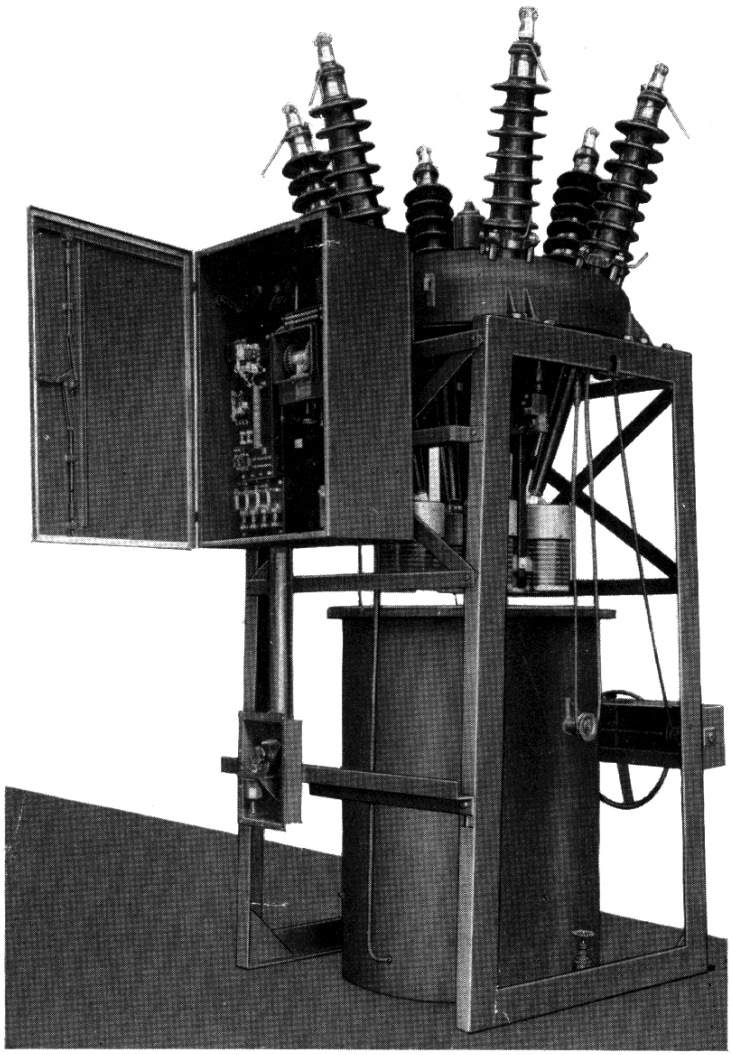

Fig. 3. 800 Ampere, 69,000 Volt Type, BPOB Oil Circuit Breaker, Tank Lowered.

The main contacts are protected by arcing contacts which are placed outside of the main contacts to take the full effect of the arc when the breaker opens.

The renewable arcing tips are of extruded copper, having high thermal capacity to reduce to a minimum the burning during circuit interruption.

The BKOB, BJOB, BNOB and BPOB breakers are equipped with the well-known DE-ION grid contacts which have proved unequalled for high interrupting capacity, and general circuit breaker performance.

The special features of this contact are:

(a) Decreased arc energy dissipated in the structure.

(b) Decreased gas volume.

(c) Decreased tank pressures.

(d) Decreased oil deterioration.

(e) Decreased contact burning and maintenance.

(f) Decreased system disturbance owing to speed of clearance.

Detailed description of the DE-ION contacts will be found in leaflet 20523-A.

All breakers are equipped with oil dashpots to absorb the mechanical shocks incidental to opening and closing.

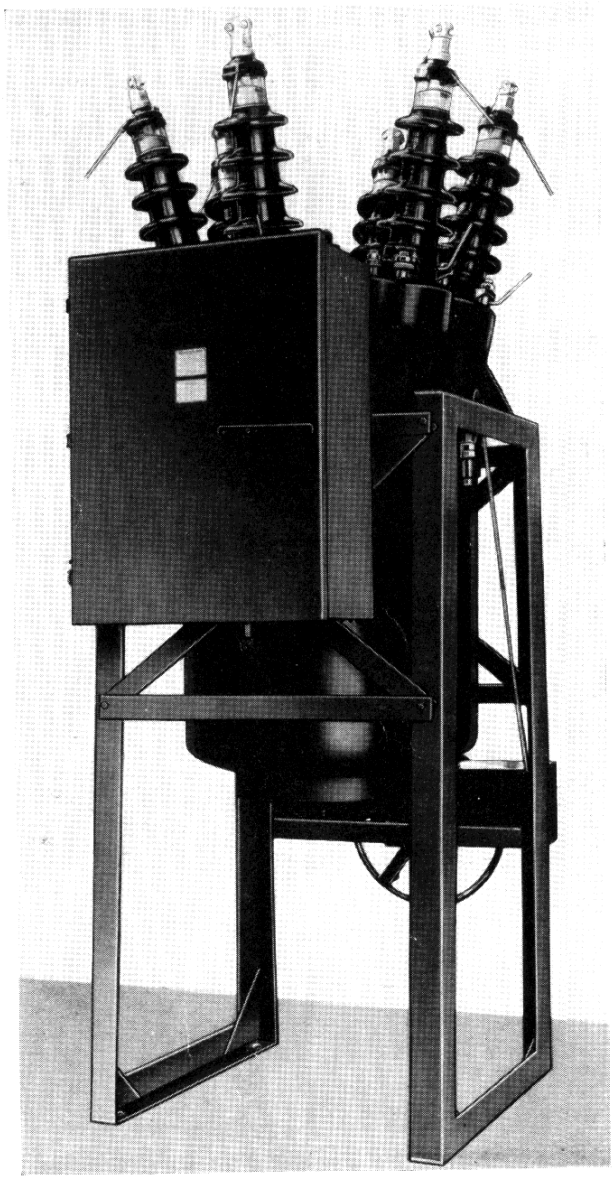

Fig. 4. 800 Ampere, 34,000 Volt Type, BNOB Oil Circuit Breaker.

OPERATING MECHANISM

Trip Free Operation:

All breakers supplied for normal manual operation will be trip free on overload and short circuit.

All electrically operated breakers, except types BKO and BKOB solenoid operated will be trip free or overload and short circuit both on normal electrical operation and when operated manually, for maintenance purposes, by means of the emergency manual operating device.

The BKO and BKOB solenoid operated breakers are normally supplied trip free on electrical operation only. These breakers can, however, also be furnished trip free on manual maintenance operation if specified.

Manual Operation:

In general manual operation is not recommended for high voltage breakers. However, the BKO, BKOB, BJO, BJOB can be furnished for direct manual operation if desired.

Inasmuch as manual operation of outdoor breakers is rather special, it is desirable that such applications be referred to the Engineering Department for their recommendations.

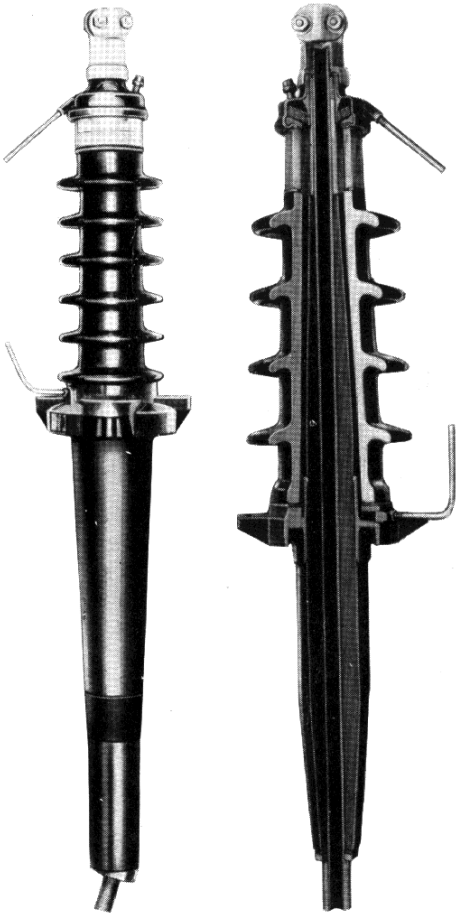

Fig. 5 (left), 34,000 Volt Oil Filled Porcelain Bushing.

Fig. 6 (right), 34 000 Volt Oil Filled Condenser Bushing (Section).

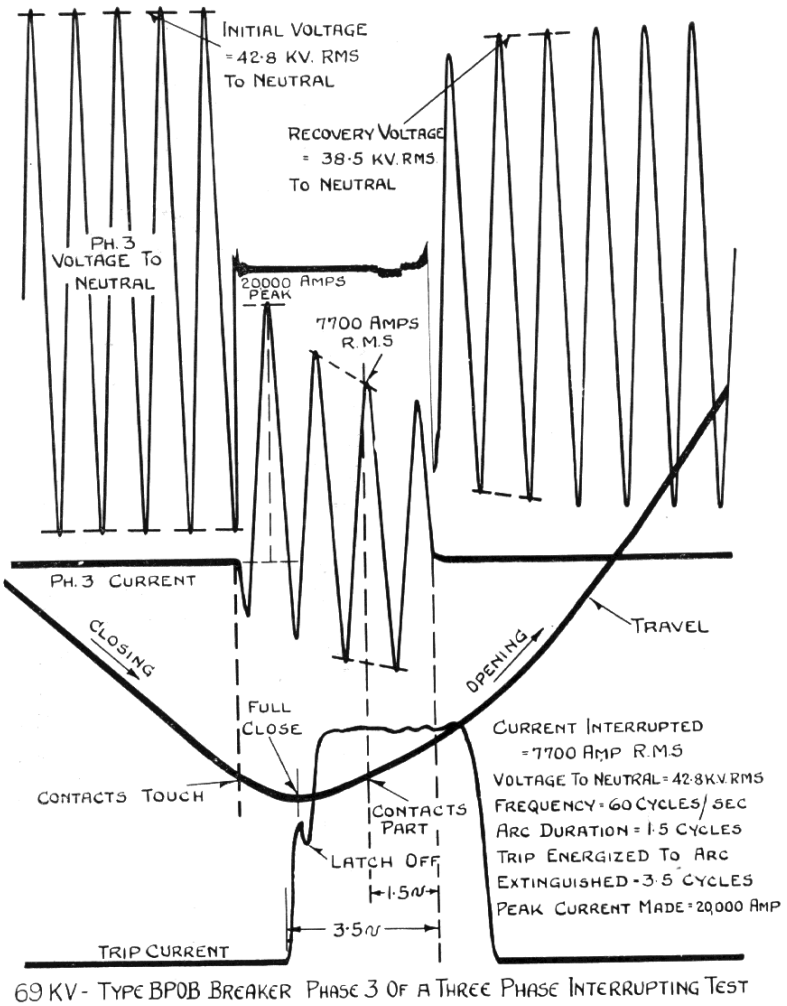

Fig. 7. Oscillogram showing typical performance of Westinghouse single tank High Voltage Circuit Breaker.

Electrical Operation:

These circuit breakers can be furnished for remote electrical control by means of either a solenoid operating mechanism or a motor operating mechanism.

The solenoid mechanism consists of a magnetic circuit with closing coil and trip coil assembly, bolted directly to the circuit breaker unit and completely enclosed as shown in the accompanying illustrations.

The motor operated mechanism utilizes the type BC motor operating mechanism which is a unique Westinghouse development, its outstanding features being reliability, speed of operation, and compactness.

As will be seen from the accompanying illustrations it comprises a small high speed vertical motor, the shaft of which is geared to a horizontal clutch unit, comprising a magnetic clutch coil and a steel band clutch.

Complete detailed descriptive information on this type BC mechanism can be obtained by reference to leaflet H-6105.

MECHANISM

The levers operating the moving contacts are entirely enclosed under the dome of the main frame and are operated by a shaft which passes through an oil tight bearing from the dome of the main frame to the solenoid or hand operating mechanism mounted on the front of the breaker.

The rugged steel operating levers are arranged to raise and lower the moving contacts in a straight line, the result being a proper alignment of contacts when closing the breaker.

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VENT

Each breaker is equipped with a Westinghouse concentric type of separator vent. This consists of a metallic drum, enclosing several concentric cylinders, the outer one connecting directly to the tank and the inner chamber opening to the atmosphere.

A slot is cut in each cylinder, slots in adjacent cylinders being spaced 180° apart.

Thus as the hot vapors proceed from one compartment to the next with a continually changing direction, the gases are cooled, and the oil is condensed, and drops away from the gas, returning to the breaker tanks by gravity.

This oil separation is also assisted by the centrifugal action involved.

Tank Lifter:

A rugged windlass type tank lifter of the detachable type, as illustrated, can be furnished for use with these breakers. With this device only one tank lifter is necessary for a group of breakers.

INSULATING OIL

Oil for circuit breaker service must have certain very special characteristics, to secure which the oil must be refined under strict control, to meet the requirements of rigid specifications. The Canadian Westinghouse Company supplies Wemco "C" oil for this service and the performance of Westinghouse breakers is only guaranteed when Wemco "C" oil is used.

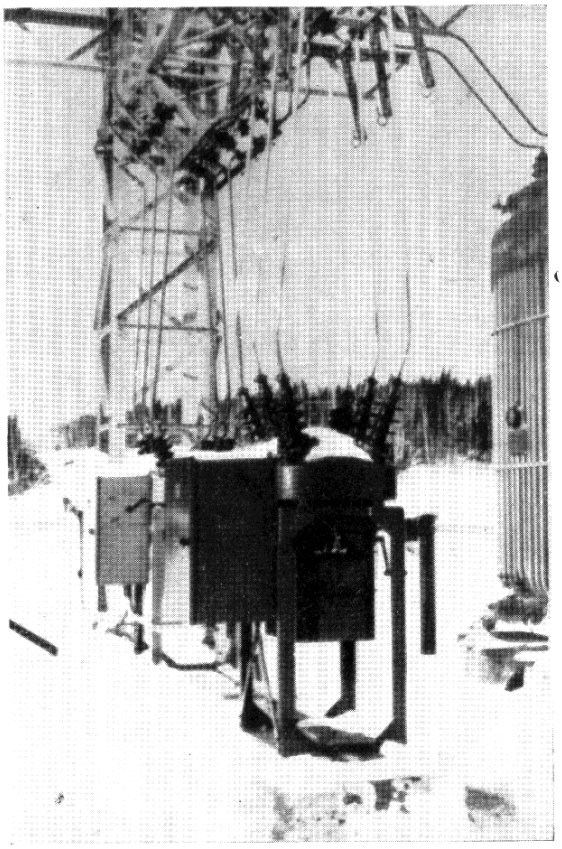


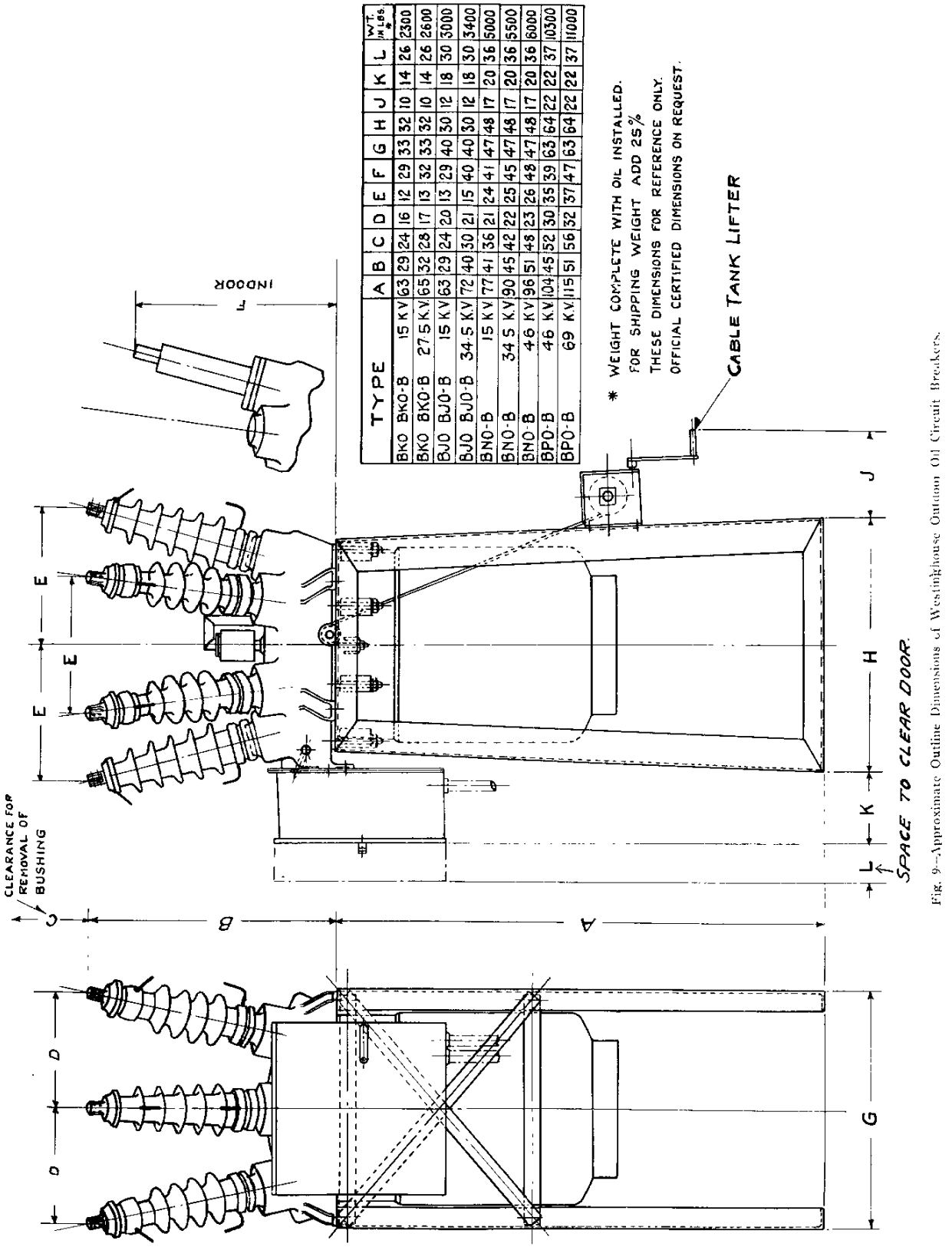
Fig. 8. 600 Ampere, 15,000 Volt Type, BKOB Oil Circuit Breakers in Northern Ontario.

Table of Ratings - Type "B" Outdoor Circuit Breakers

* Circuit Breaker	Max. Rated Volts	Current Ratings in Amperes at 60 Cycles	Inter. Cap. Ratings in KVA at Rated Voltage† MB-15-MB Duty Cycle
BKO	15000	600, 800, 1200.	100,000
BKOB	15000	600.	250,000
BKOB	27500	600.	100,000
BJO	15000	600, 800, 1200, 1600, 2000.	350,000
BJOB	15000	600, 800, 1200, 1600, 2000.	500,000
BJOB	34500	600.	500,000
BNOB	15000	1200, 1600, 2000, 3000.	1,000,000
BNOB	34500	800.	750,000
BNOB	46000	800.	500,000
BPOB	69000	800.	500,000
BPOB	69000	800.	1,000,000

***Note:** The BNO and BPO (plain contact breakers) are not included in the above tabulation because, at these higher voltages, the performance of the DE-ION grid contacts is so outstandingly superior as to render the plain contact practically obsolete.

†Note: On account of possible thermal and mechanical limitations, applications involving rupturing capacities at lower voltages should be referred to the Company's Engineering Department at Hamilton for recommendations.



TYPE		A	B	C	D	E	F	G	H	J	K	L	WT. IN LBS. *
BKO	BKO-B	15 KV	63	29	24	16	12	29	33	32	10	14	26	2300
BKO	BKO-B	27.5 KV	65	32	28	17	13	32	33	32	10	14	26	2600
BJO	BJO-B	15 KV	63	29	24	20	13	29	40	30	12	18	30	3000
BJO	BJO-B	34.5 KV	72	40	30	21	15	40	40	30	12	18	30	3400
BNO-B		15 KV	77	41	36	21	24	41	47	48	17	20	36	5000
BNO-B		34.5 KV	90	45	42	22	25	45	47	48	17	20	36	5500
BNO-B		46 KV	96	51	48	23	26	48	47	48	17	20	36	6000
BPO-B		46 KV	104	45	52	30	35	39	63	64	22	22	37	10300
BPO-B		69 KV	115	51	56	32	37	47	63	64	22	22	37	11000

Fig. 9—Approximate Outline Dimensions of Westinghouse Outdoor Oil Circuit Breakers.

BIBLIOGRAPHY

In a publication of this sort it is hardly feasible to discuss the theory of circuit interruption in detail. For those who would like to obtain some further information on this subject, the following references will be of considerable interest:

Research Improves Circuit Breakers. (Editorial), Elec. World, Feb. 1, 1930.

Circuit Interruption—a Rapidly Changing Art. (Editorial), Elec. World, April 26, 1930.

Extinction of Long A.C. Arc. by Dr. Joseph Slepian, (A.I.E.E. Trans., 1930).

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Field Tests on De-ion Grid Breakers. by L. W. Dwyer, (Elec World, April 19, 1930).

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System Tested with 600 Short Circuits. by E. G. Ralston and E. H. Klemmer, (Elec World, February 11, 1933).

Indianapolis System Field Tests on De-ion Grid Breakers. by F. S. Douglas and A. C. Monteith, (Elec. Journal, February, 1933). (Elec. Journal, March, 1937).

In connection with the foregoing, it is of great interest to note how the tremendous improvements in the art of circuit interruptions in the last decade have followed the theory of De-ionization as propounded by Dr. Slepian in the articles listed above.