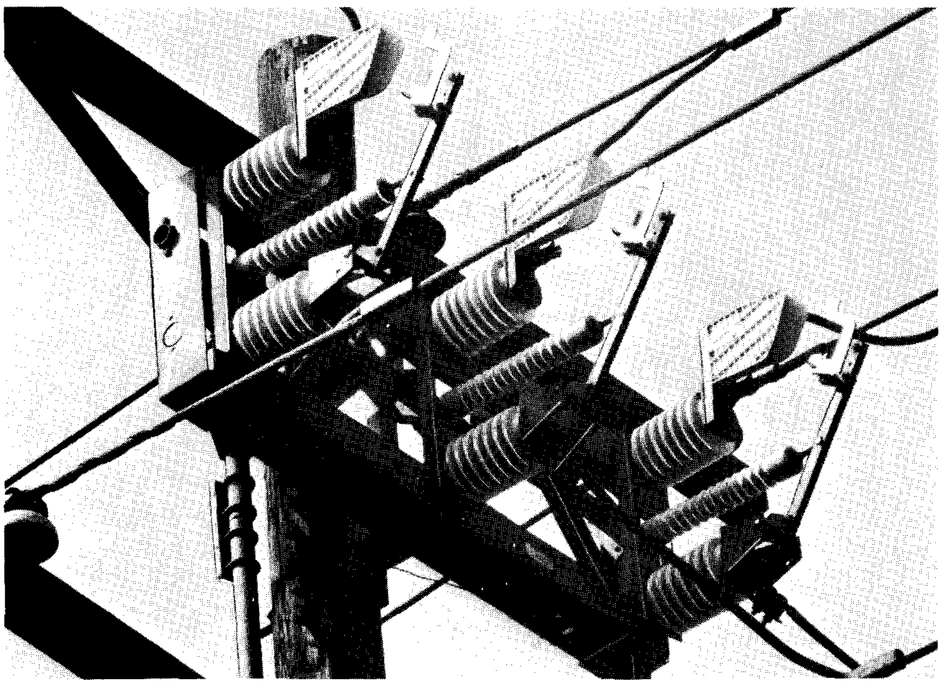
Westinghouse Electric Corporation
Distribution Apparatus Division
Bloomington, Ind. 47401

September, 1981
Supersedes Application Data 38-831, pages 1-4, dated April, 1971
Mailed to: E, D, C/1993/DB

15 and 25 Kv 400 and 600 Amps
3 ∅ Gang Operated

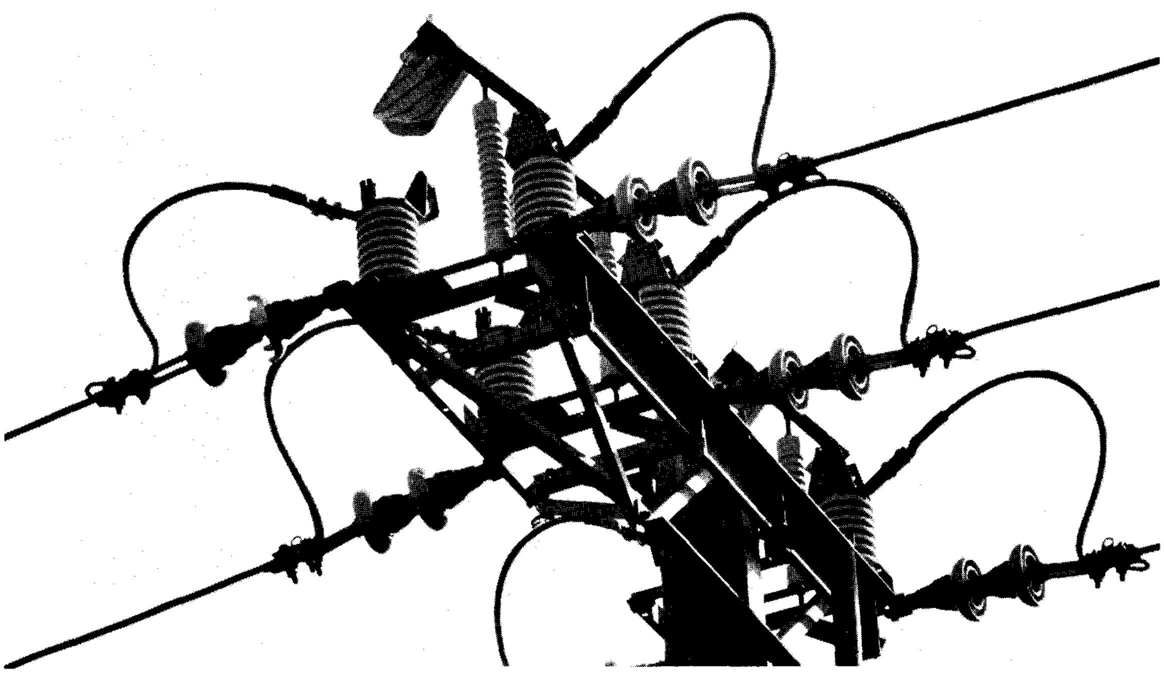
LB-3 Switches



LB-3V Vertical View

In recent years increased system complexity has created a demand for fuller understanding of three phase gang operated switches. This guideline has been prepared to provide the utility industry with a further understanding of the parameters which have dictated the design and manufacture of three phase gang operated switches.

Line sectionalizing, avoidance of unwanted ground trips on up line devices, ferro-resonance control, installation and phase timing considerations are among the subjects discussed.



LB-3 Horizontal View

Line Sectionalizing: The LB-3 is ideal for use in sectionalizing radial express feeders. Utilities vary sectionalizing point locations between the ranges of one switch per every several spans to several miles of feeder (Figure 1).

Use of these switches increases the reliability of the system and allows the utility to sectionalize only the portion of the line affected by the fault (Figure 2).

On more complicated loop feed systems one switch is normally left in the open position (Figure 3).

If the system is faulted at location X service crews can open up the section of the line affected by the fault and close the normally open tie switch to backfeed portions of the system not directly associated with the fault (Figure 4).

Some utilities utilize reclosers, reclosing vacuum breakers, or sectionalizers at the locations of switches 1, 2, 3, 5, 6, and 7 to have the sectionalizing function of the system performed automatically. Often they use a rather expensive automatic throw-over recloser at the normally open point of the system (Figure 4). When this recloser senses loss of voltage on either side, it automatically closes and backfeeds the faulted section of the line.

Computer studies show that after the extra reliability achieved by the use of this tie recloser is not worth the investment. The improvement in outages-per-year and minutes-per-outage gained by use of the exotic tie recloser is more than overshadowed by the decrease in reliability associated with the extra sophistication needed at reclosers 1, 2, 3, 5, 6, and 7 which must be set up to automatically change minimum-pick-up values, number of trips-to-lock-out, etc., when backfed under an emergency situation.

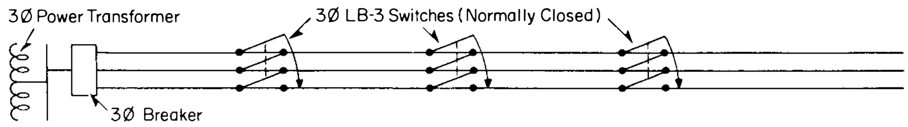


Figure 1

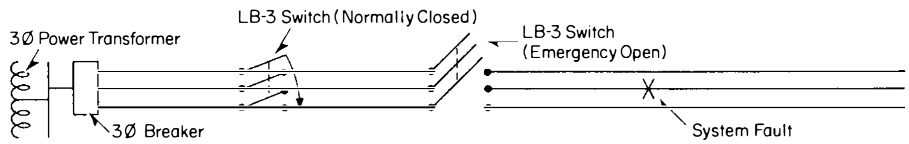


Figure 2

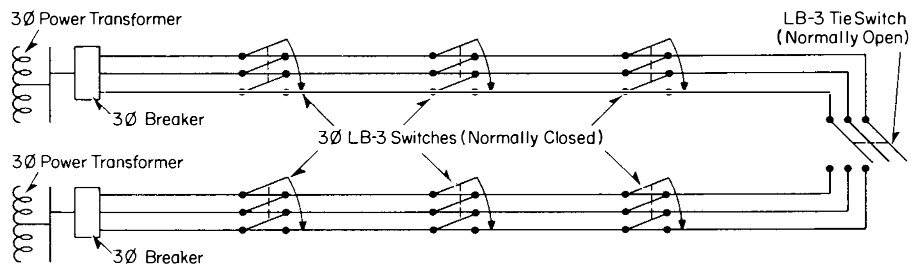


Figure 3

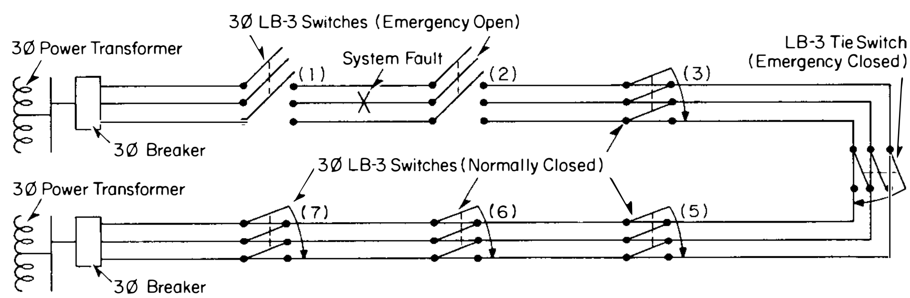


Figure 4

Avoiding Unwanted Recloser or Breaker Ground Trip Operations:

Ground trip is supplied on breakers or reclosers to sense faults of extremely low current value. In actuality, ground trip might better be termed current unbalance trip since it operates on the assumption that in a balanced three phase system very little or no neutral current is present under normal circumstances.

$$\vec{I}_{\phi A} + \vec{I}_{\phi B} + \vec{I}_{\phi C} = 0$$

$$\vec{I}_{\phi A} + \vec{I}_{\phi B} + \vec{I}_{\phi C} + \vec{I}_G = 0$$

$$\therefore I_G = 0$$

Figure 5 shows a typical system using ground trip. A fault on dry ground, pavement etc. at point X might only create fault current of 20 amperes which is below the minimum pickup of the recloser or breaker phase relays. However, the current unbalance present in the system under fault conditions would be seen by the ground relay of the recloser or breaker, thus causing the device to trip out.

The problem with ground relaying is this: if a lineman wishes to de-energize load at point "A" by opening one pole of switch 3, he unbalances the system and may well trip it entirely due to the recloser or breaker ground relay sensing system unbalance. There are two ways around this: one is to by-pass the ground trip at the recloser or breaker. This may be unsafe. A system without ground trip might stay energized on a low current fault and seriously harm or kill any person who comes in contact with the downed line. It is also expensive to drive 20 miles to the recloser site to disable its ground current sensing relay. The second way to overcome this problem is to operate switch 3 as a three pole gang operated loadbreak device. This drops load only in the immediate area of the lineman's operation and assures that the energized system remains safe and coordinated with ground trip intact.

This avoidance of unwanted ground trips requires a gang operated switch carefully timed to assure that all three phases open simultaneously. Often three phase gang operated switches that are shipped as 3 - 1 pole assembled for field installation of interphase operating mechanisms by the utility never gain the degree of timing that is necessary to function properly. This is primarily due to the fact that many utilities do not have the necessary tools and measurement instrumentation nor advice from the manufacturer as to acceptable phase timing tolerances. The end result is a three phase switch that performs like three, one phase switches. The LB-3 is shipped pre-assembled, pre-adjusted and timed leaving no room for doubt as to its function in accordance with customer requirements.

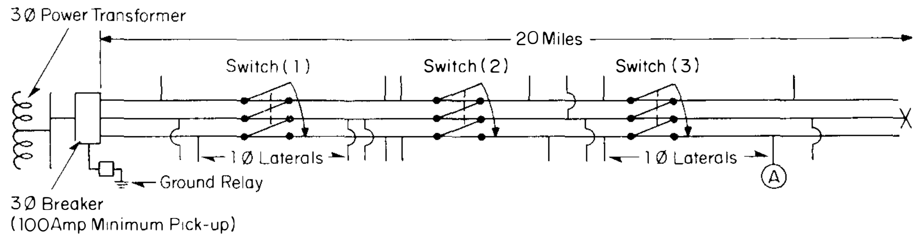


Figure 5

Avoiding Ferro-resonance in Transformers:

In recent years higher distribution system voltages have created problems for utilities in three phase transformer banks. Pad-mounted transformers fed from runs of underground cable (often less than 20 to 30 feet) are susceptible to ferro-resonance especially when connected grounded-wye/ungrounded wye, grounded wye/ungrounded delta, or T-T (Scott). Ferro-resonance is established in these and also some overhead applications when switcched one phase at a time. Once ferro-resonance is established it may ultimately damage the transformer. There are two general rules to combat ferro-resonance in these circumstances:

1. Always switch the cable and transformers high side, in a three phase manner. (Ferro-resonance is established when one or two phases of the circuits are left energized momentarily.)

2. Always switch the transformer and cable as fully loaded as possible. This reduces the probability of ferro-resonance occurring.

The LB-3 is ideal for solving the ferro-resonance problem. The LB-3V is extremely versatile for use at the transition point from overhead to underground. Almost every industrial power user which utilities serve utilizes padmounted transformers to serve their plant. The LB-3V is a device that suits the utilities need to supply reliable power to these industrial users.

Installation:

Both models of the LB-3 are designed to be easily and quickly mounted on the utility's system. The switch frame is simply lag-bolted to the pole face in two places. The back side of the switch is framed-in by attaching an adjustable turnbuckle bolt. The operating rod is connected to the switch handle at the bottom of the pole. The operating rod is standard 1½ galvanized pipe threaded at each end with standard tapered pipe threads. This type of pipe is normally available in 10′ lengths from any supplier of heavy-wall galvanized conduit. Operating rods are not available from Westinghouse due to the wide variance in customer requirements for length.

Installation time for these switches is quite short (approximately two to three hours) because no cross arms are needed and all switch adjustments are performed at the factory. Many standard 3 Ø switches are sold in one-pole pieces which require utility installation of cross arms, braces, doublearming bolts, interconnecting pipe, and adjustment of the individual pole piece timing. This is quite time consuming. Average installation times for a device of this nature may be as high as 16 hours.

Shipping and Storage:

LB-3 crates are designed with ease of customer storage and movement in mind. Approximate shipping dimensions and weights are as follows:

	Shipping Length	Shipping Height	Shipping Width	Shipping Weight
LB-3	6½′	3½′	4′	490#
LB-3V	5′	3½′	2½′	545#

General Specifications
Voltage Ratings
7.8/13.8 KV grounded wye max. voltage – 95 KV BIL
15 KV Maximum voltage – 110 KV BIL
14.4/24.9 KV grounded wye max. voltage – 125 KV BIL

Continuous Current Ratings
400 and 600 ampere

Loadbreak Rating
400 ampere

Momemtary Rating
20,000 amperes ASYM

Mounting Configurations
Vertical or horizontal

Arresters
Provision for mounting arresters provided as standard.

Dead Ending Capability
2500 lbs/phase on horizontal designs.

Further Information:
Prices, PL 38-830

Printed in USA

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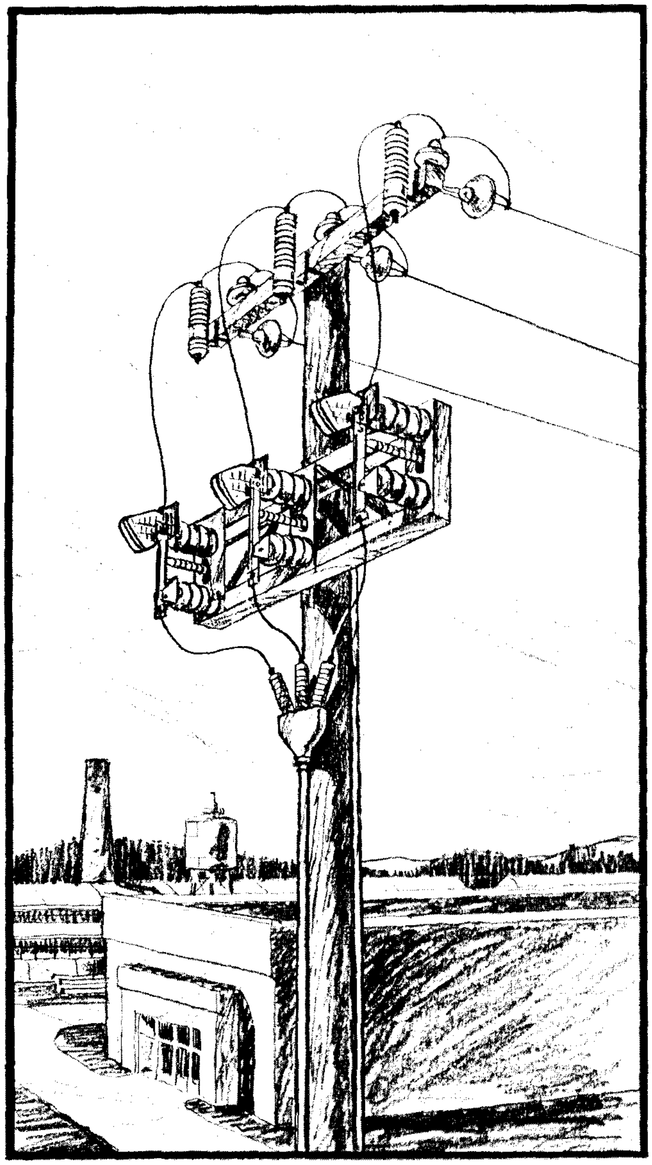
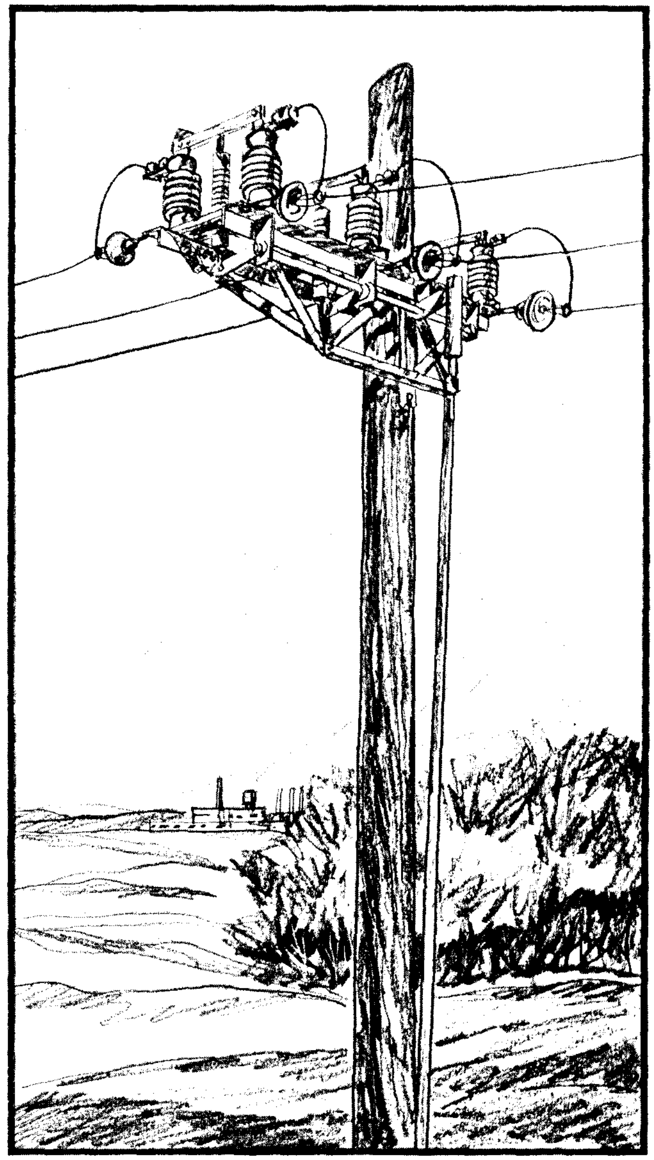


LB-3V Vertical



LB-3 Horizontal

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April, 1971
New Information
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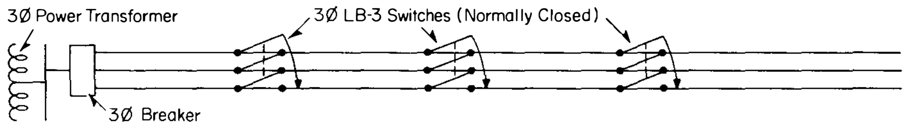

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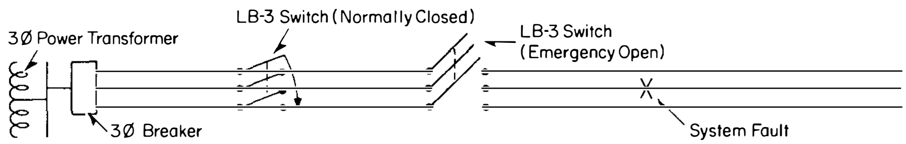

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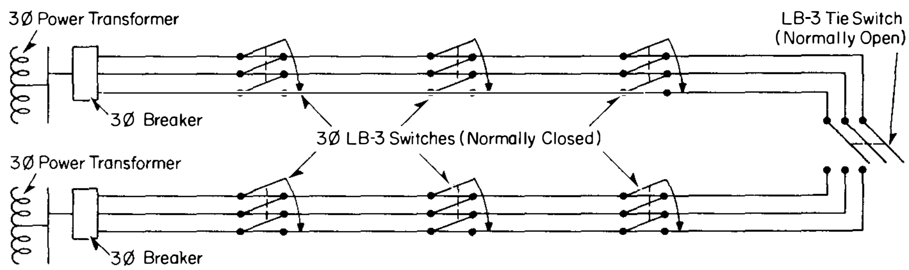

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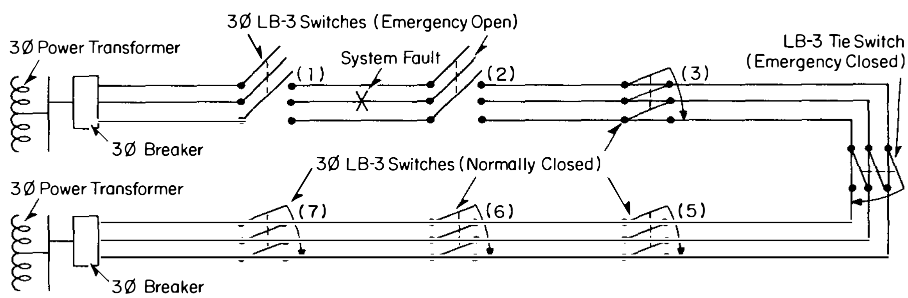

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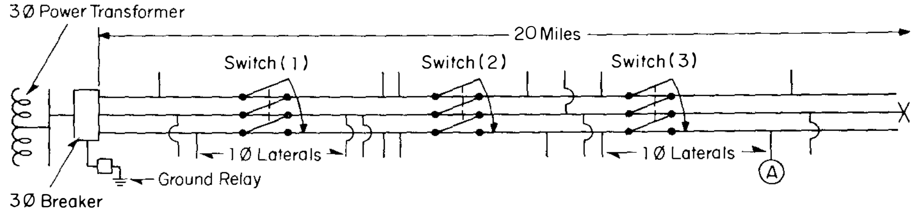

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