



APPARATUS BUSHINGS

TYPE U

23 Kv - 69 Kv

INTRODUCTION

These instructions apply to a series of Type U bushings which comply with the mechanical and electrical characteristics of the American National Standards Institute standards for transformer and circuit-breaker bushings in the range from 23 kv through 69 kv. A limited number of special bushings, which are constructed similar to the ANSI line, are also covered by this publication.

The Type U bushing, Figs. 1 and 2, has an oil-impregnated paper-insulated core with a multiplicity of electrodes (Rescon* equalizers) embedded in the paper for proper distribution of electrical stresses. The core, after extensive vacuum treatment and oil impregnation, is immersed in high dielectric strength transformer oil inside a center-clamped, gasket-sealed structure consisting principally of a top porcelain, a ground sleeve, a bottom porcelain and the necessary spring-loaded, center-clamping hardware. Sufficient clamping pressure is applied in the factory to make these assembled outer parts a sealed housing for the core and the immersion oil, and for a nitrogen gas cushion above the oil level.

*-Registered trade-mark of G. E. Co. for semi-conducting material

UNPACKING

Bushings are shipped ready for installation. As soon as a bushing is received, open the shipping crate or box carefully to avoid damage, and examine the bushing for any damage incurred during shipment. If damage or rough handling is evident, file a claim with the transportation company, and notify your General Electric Sales representative immediately.

Note the oil level as explained under the heading "Liquid Level Indication"; and examine the surface of the porcelain for small breaks or cracks which might cause leakage later, but which will not immediately affect the oil-level indication.

HANDLING

Bushings rated up to 69 kv can be lifted from a horizontal position or from a vertical crate by the use of a rope sling placed under the top petticoat of the top porcelain.



A. 23 kv 400/1200 amp B. 34.5 kv 400/1200 amp C. 46 kv 400/1200 amp D. 69 kv 400/1200 amp

Fig. 1 Type U bushings

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

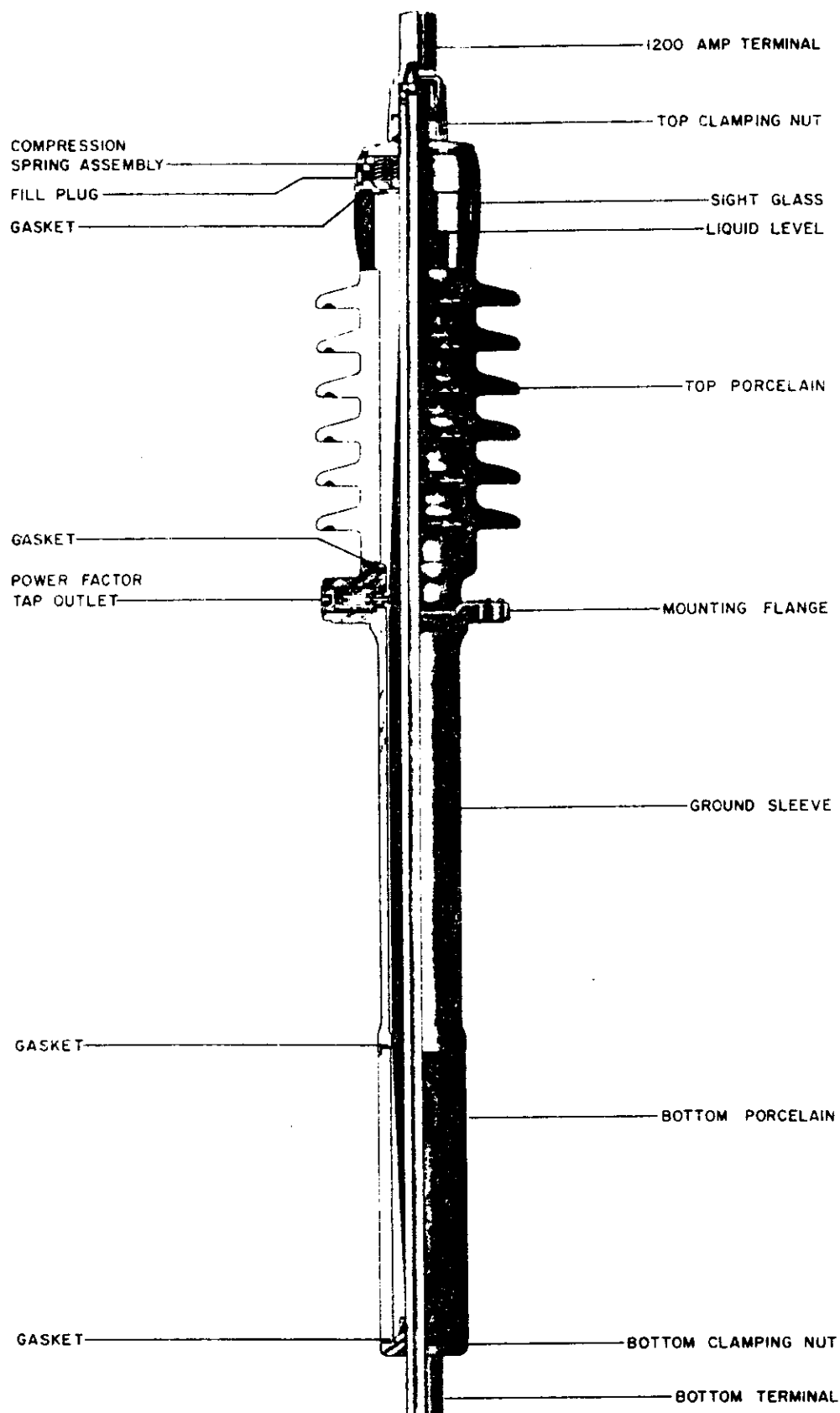


Fig. 2 Sectional view of 34.5 kv Type U bushing

STORING

A bushing in a horizontal position may have part of the core insulation above the level of the filling oil, because of the nitrogen gas cushion above the oil level. For this reason, it is generally recommended that for extended storage, the top end of the bushing be elevated. In ratings up to and including 69 kv, horizontal storage is permissible for short periods of time since the normal time associated with installation is sufficient to allow the return of nitrogen to its proper location at the top of the bushing. However, if a proof-testing overvoltage is to be applied to the bushing, rock it to release any entrapped nitrogen; then keep the bushing vertical for forty-eight hours prior to testing.

INSTALLATION

CLEANING

Before installing the bushing, wipe the porcelains with a cloth to remove dust and dirt accumulated during transit and storage.

MOUNTING

Inclined Bushings

Bushings rated 23 kv through 69 kv may be positioned in any convenient angular alignment. In the case of a few special 69 kv bushings with liquid level gages, mounting should be done so that the liquid level gage faces the lowest point of the dome.

Bolting

Tighten the mounting bolts a fraction of a turn at a time, working progressively in one direction around the bolt circle until all bolts are uniformly tight. Tighten sufficiently to seal the bushing to the apparatus. Normally, the torque values as listed below will provide adequate gasket compression for sealing.

| SIZE OF BOLT Inch-Thread | TORQUE Foot-Pounds |
|-----------------------------|-----------------------|
| $\frac{1}{2}$ -13 | 25 |
| $\frac{3}{8}$ -11 | 30 |

LIQUID LEVEL INDICATION

The oil level in the bushing is adjusted in the factory to the normal level at approximately 25C. Unless there is subsequent mechanical damage to the bushing, which results in loss of oil, the filler level should be satisfactory for the life of the bushing.

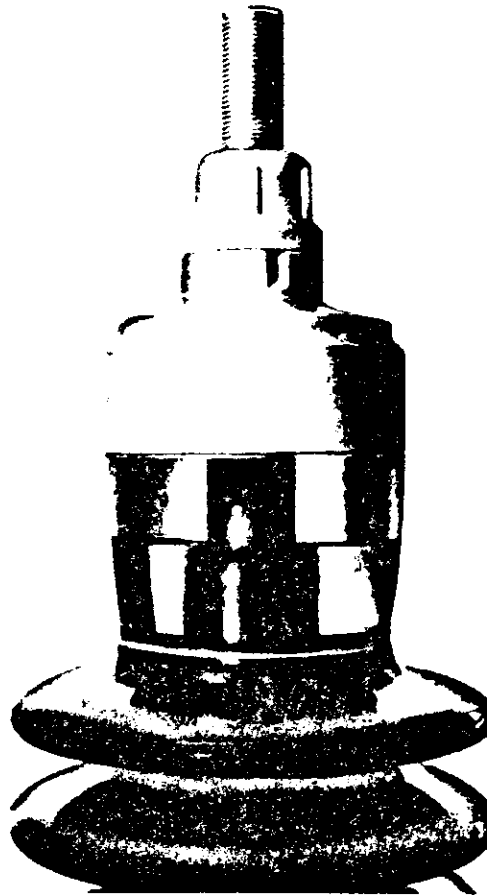


Fig. 3 Typical dome of 23 kv-69 kv Type U bushing. Liquid level indicated in sight glass by apparent change in conductor size

Since fluctuations in oil level will necessarily occur with changing temperatures, the column of oil in the bushing is topped with a compressible cushion of nitrogen gas to fill any space left by a varying amount of oil.

Except for a few special bushings, all bushings are equipped with a sight glass as shown in Fig. 3. This sight glass consists of a short section of amber-tinted, extra-heavy-walled glass shell which is hermetically bonded to the top of the porcelain. The actual oil level is visible through the glass and is readily distinguishable by the apparent magnification of the center conductor below the oil surface. On bushings rated 23 kv thru 46 kv the normal liquid level is at the mid point of the sight glass. On 69 kv bushings the normal liquid level is $\frac{1}{2}$ -inch below the mid point of the sight glass. A bushing is considered to have a satisfactory liquid level when any amount of oil is visible in the sight glass.

CONNECTIONS

INTERNAL ELECTRICAL CONNECTIONS

The method used in making connections between

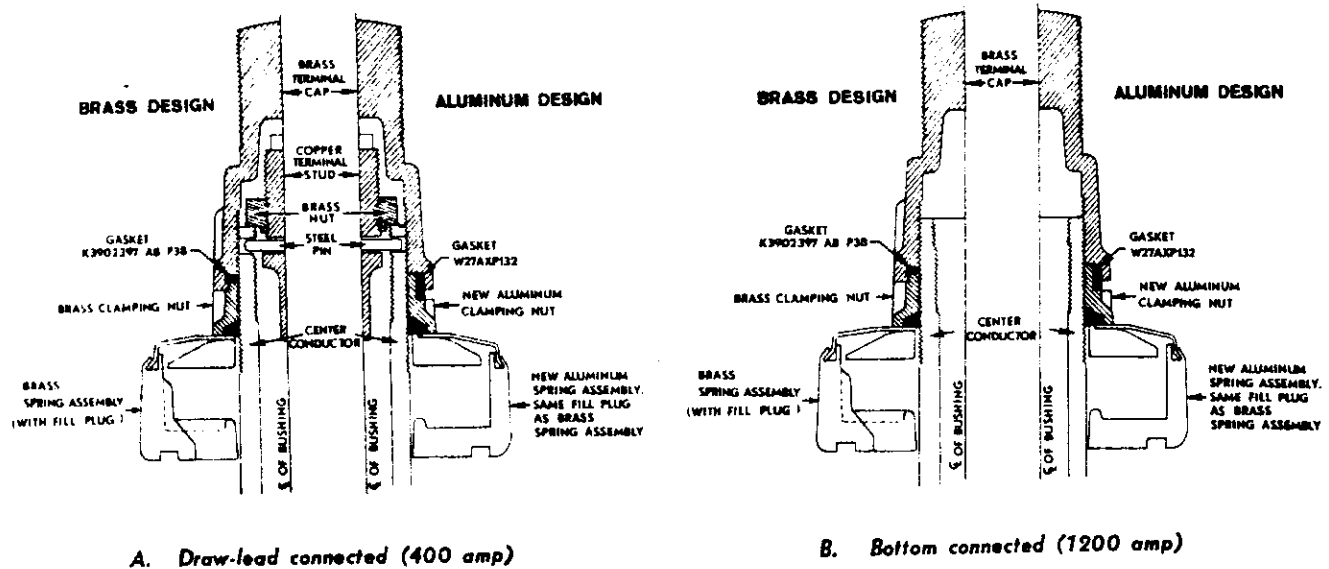


Fig. 4 Top end construction for 400/1200 ampere, Type U bushing

a bushing and the apparatus on which it is mounted will depend upon the type of connection used in the apparatus.

Several parts of the top end hardware on 23 thru 69 kv Type U bushings have been changed from brass to aluminum. These changes are another step in the long range conversion of bushing parts to aluminum. The next two paragraphs describe the gasketing differences for the new aluminum parts and includes handling considerations for bushings with these new parts.

The external appearance of the top end of both draw lead and bottom connected bushings is similar when either brass or aluminum parts are used. The difference can be easily observed to distinguish which type of parts is used. As shown in Fig. 4, the terminal cap sealing gasket (W27AXP132) is visible on bushings with the new aluminum parts, while the terminal cap sealing gasket is internal on the bushing with the brass parts. The "O"-ring gasket 3902397-ABP38 used for sealing with brass parts has been replaced with a neoprene gasket W27AXP132 for sealing with aluminum parts. This gasket is rectangular in cross section and measures 0.500" x 1.688" ID x 1.938" OD. All other parts remain unchanged. At assembly, lubricate the edges of gasket W27AXP132 with petroleum jelly or transformer oil to prevent gasket distortion.

The method of making connections between a bushing with aluminum top end parts and the apparatus on which it is mounted is basically the same as that for bushings with brass parts. However, when changes in connections are made it is imperative that gasket W27AXP132 be used when alumi-

num top end parts are assembled. The terminal cap is tightened until contact is made with the internal stop of the mating clamping nut. Compression of gasket W27AXP132 is preset by the internal stop.

DRAW-LEAD CONNECTED BUSHINGS

Bushings with a current rating of 400 amperes are designed with a hollow core through which a flexible cable can be pulled. The cable is considered a component of the transformer on which the bushings are mounted and is not supplied as a part of the bushing.

Refer to Fig. 4A. Remove the terminal cap, the steel pin, brass nut, and the stud. Pass a wire or cord through the bushing core and attach it to the hole in the top end of the terminal stud on the flexible transformer cable. Lower the bushing into the opening in the cover, simultaneously pulling the cable up through the core. Secure the cable terminal stud to the center conductor by replacing the steel pin and threading on, and tightening, the brass nut. Coat the gasket with a thin film of light oil, and assemble it in position. Screw the terminal cap onto the center conductor until the cap makes a metal-to-metal seat on the clamping nut. Avoid excessive tightening since it will only bend the steel pin.

BOTTOM-CONNECTED BUSHINGS

Bushings rated 1200 amperes and higher are designed so that the core is the conductor. A circuit-breaker interrupter or transformer terminal may be connected to the threaded extension of the core. Refer to Fig. 4B.

EXTERNAL ELECTRICAL CONNECTIONS

External connections to the bushing must be

sufficiently slack or flexible to avoid putting a mechanical strain on the bushing parts.

POWER FACTOR MEASUREMENT

The outlet shown in Fig. 5 is located just above the mounting flange and provides a convenient means for making power factor measurements by the ungrounded specimen test (UST) method. In order to connect to the tap outlet, remove the threaded cap and connect the UST lead of the power factor measuring equipment to the terminal spring.

Reassembly of the sealing cap after the testing has been completed will ground the power factor test tap for proper operation of the bushing.

Many bushing users make it a practice to measure the UST power factor at the time of installation. This practice is endorsed by the General Electric Company and discussed in more detail under "Maintenance."

DO NOT APPLY VOLTAGE TO THE BUSHING WITH THE POWER FACTOR TAP CAP REMOVED, EXCEPT WHEN MEASURING POWER FACTOR.

TRANSFORMER-BREAKER INTERCHANGEABLE (TBI*) BUSHINGS

An outstanding feature of this line of bushings is the fact that a 1200 ampere, 16½-inch EL, bottom-connected bushing (ASA for oil circuit breakers) is also a 400 ampere, 21-inch EL, draw-lead connected bushing for transformer use, and (with approval of the apparatus manufacturer) may usually be used as an ASA transformer bushing. See Table 1.

CONVERSION

A series of photographs, (Fig. 6) shows the step-by-step procedure for conversion of a bushing used on a circuit breaker to one used on a transformer.

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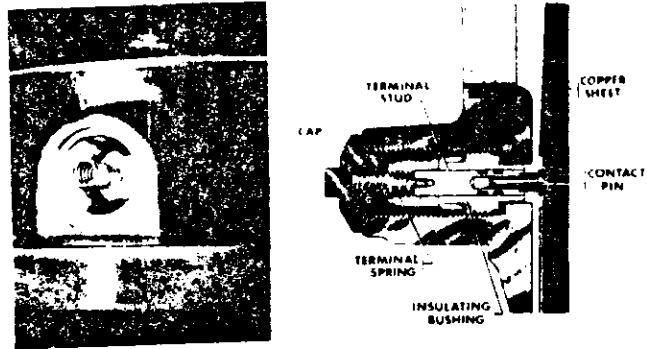


Fig. 5 Power factor tap outlet

Proceed as follows:

1. Remove the top terminal cap.
2. Pull up the transformer draw lead with attached stud.
3. Insert the cross pin.
4. Thread on contact nut, and tighten.
5. Assemble the terminal cap with its gasket.

AMPERE RATINGS

Interchangeable bushings are available in current ratings of 400/1200 amperes. **ALL DRAW LEAD TYPE BUSHINGS ARE LIMITED TO OPERATION AT 400 AMPERES.**

Examination of the illustration (Fig. 3) will show the current path from the conductor to the terminal cap (1).

In the case of draw-lead accessories, the current flow is from the transformer draw lead to the stud (8), through the threads to the contact nut (7) and through the center conductor threads (2) to the terminal cap (1). This current path is limited to 400 amperes.

In the 1200 ampere, bottom-connected bushing, the current flow is up the center conductor of the bushing (2), through the threads and into the terminal cap (1).

The nameplate lists two current ratings. The 400 ampere rating is maximum for draw lead

TABLE 1 TYPE U BUSHINGS

| T B I | | | |
|---------|---------------|----------|---|
| KV | AMPERES | CAT. NO. | REMARKS |
| 23 | 400/1200 | 7B522 | 16½-inch EL for Breakers. 21-inch EL permitted for Transformers. |
| 34.5 | 400/1200 | 7B532 | |
| 46 | 400/1200 | 7B542 | |
| 69 | 400/1200 | 7B590 | |
| NON-ASA | | | |
| KV | AMPERES | | REMARKS |
| 23-34.5 | 2000 and 3000 | | 17.75-inch EL OCB application |
| 23-34.5 | 2000 and 3000 | | 21-inch EL Transformer application |
| 69 | 2000 | | 19-inch EL OCB and Transformer application |

application and the 1200 ampere rating is maximum for bottom end connected application.

DRAW-LEAD TERMINAL STUD

The draw-lead terminal stud, Fig. 7, used in TBI bushings is of the same general type used throughout the industry for many years. Unfortunately, all such studs are not identical in length. Due to the limited clearances of this line of bushings, the length of the threaded, draw-lead stud is critical. The critical dimensions of the stud furnished with the bushing are shown in Fig. 6. Any stud that complies with the dimensions shown can be used.

NAMEPLATE DATA

Nameplate data can be of special importance in answering questions about bushings.

The handling of all requests will be expedited if the factory is furnished the serial number, the catalog number, and the year of manufacture as stamped on the bushing nameplate. **IT IS ABSOLUTELY NECESSARY FOR THE FACTORY TO HAVE AT LEAST THE SERIAL NUMBER.**

The catalog number identifies the bushing by type and rating. In most cases, the catalog number stamped on the nameplate will include a group designation; i.e. Gr. 1, Gr. 2, etc. The group number is of importance only to the factory and indicates minor design changes. All bushings of the same catalog number are completely interchangeable, regardless of the group number.

The class symbols identify certain characteristics of the bushing to the factory. There should be no concern about them.

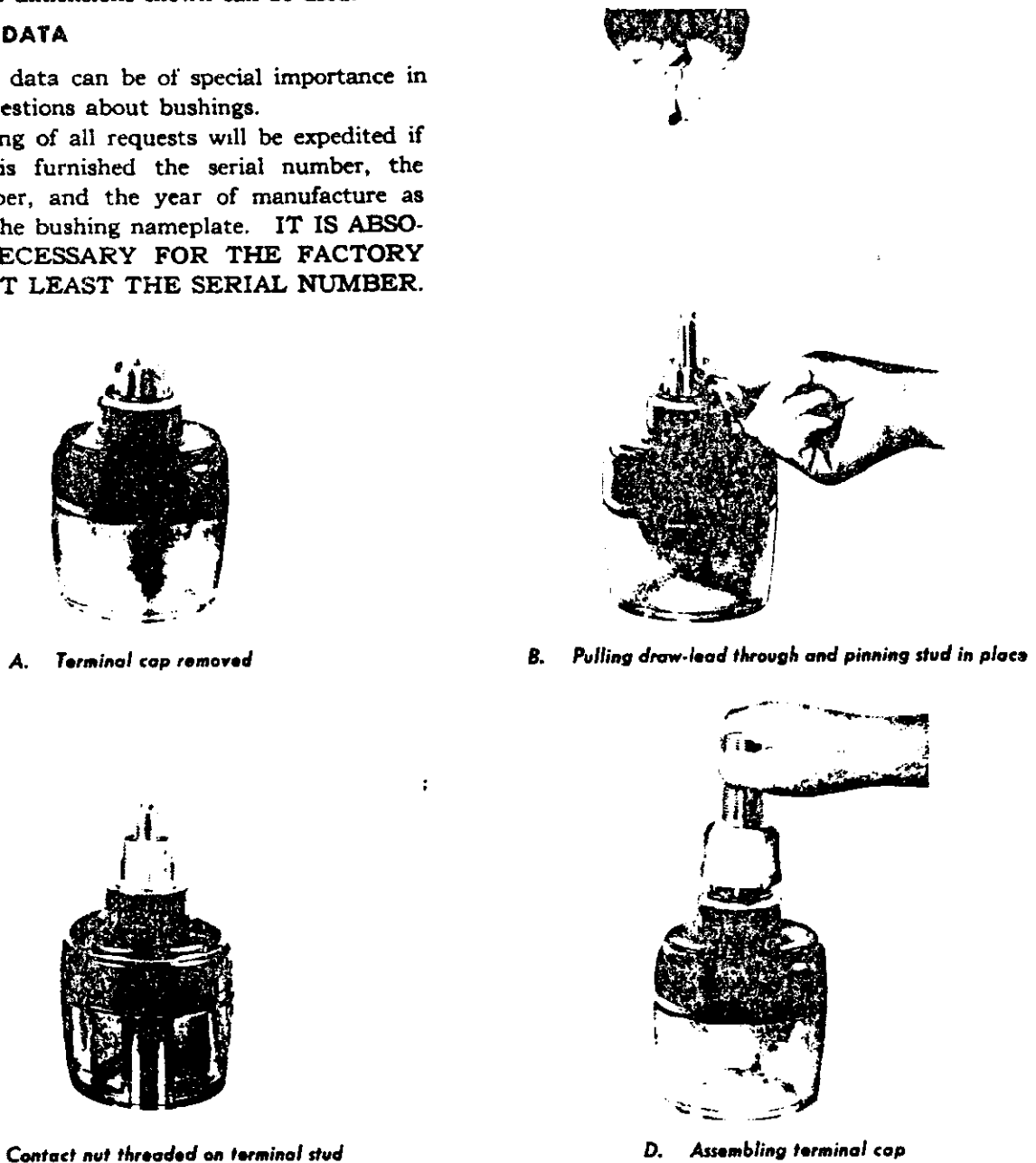


Fig. 6 Converting bushing from circuit breaker to transformer use

A careful record should be kept for the interchangeable bushings. Complete information about the application of the bushing must be given in any correspondence with the factory concerning the bushings.

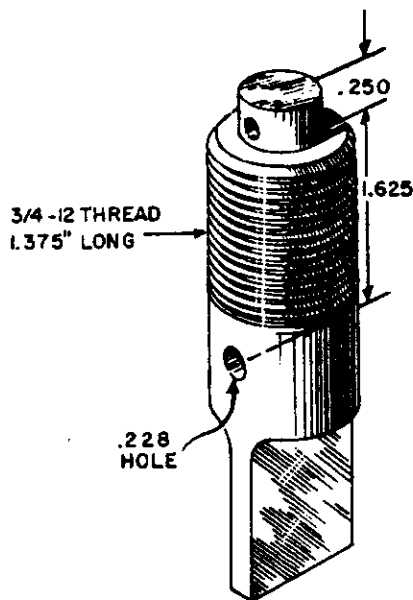


Fig. 7 Terminal stud

ORDERING ACCESSORIES

Accessories for conversion purposes may be taken from bushings being replaced in the field, or may be ordered from the factory. In ordering, give the following information:

1. Catalog number of the bushing being converted.
2. Type of apparatus on which the bushing will be used.
3. Current rating of the bushing as it will be used.

MAINTENANCE

Type U bushings require little or no maintenance other than periodic checking of the oil level as indicated in the sight glass or by the gage, and the measuring of the power factor. Bushings exposed to salt spray, cement dust and other abnormal deposits are subject to a special hazard and must be cleaned regularly to prevent flashover.

Should it become necessary to add oil to a bushing, the fill plug in the dome may be removed. Insertion of a clean standpipe, with an outside diameter of slightly less than the diameter of the hole, will provide a means of adding small quantities of oil to the bushing.

Since inconvenient service interruptions result from bushing outages, many users have programs of Planned Preventative Maintenance. The General Electric Company endorses such programs and recommends:

1. Measurement of UST power factor and capacitance at time of installation. Such measurement is a good first point for comparison with future readings since it correlates test data made under the variable conditions encountered in field measurements with those made under controlled conditions in the factory.
2. Continued measurement of UST power factor and capacitance at various intervals depends upon the importance of the particular installation and the data accumulated on the bushing. A steadily increasing pf or capacitance is cause for concern; an increase in pf of 1.5 percent or, and increase in capacitance to 110 percent of the original value, is cause for corrective action. General Electric publication GET-908 should be consulted for more detailed information on bushing maintenance.

FIELD REPAIR

The General Electric Company recommends that any repair of Type U bushings be done in the factory because of the danger of contamination to the insulation should the seal be broken. In addition, the very high vacuum and clamping pressures required necessitate the use of equipment not usually available in a service shop.

Any damage to a bushing which might make repair either desirable or necessary should be reported in detail. **DO NOT ATTEMPT TO REPAIR A TYPE U BUSHING WITHOUT SPECIFIC RECOMMENDATIONS FROM THE GENERAL ELECTRIC COMPANY.**

WHEN YOU NEED SERVICE

IF YOU NEED TO REPAIR, recondition, or rebuild any electric apparatus, a G-E service shop near you is available day and night, seven days a week, for work in the shops or on your premises. Latest factory methods and genuine G-E renewal parts are used to maintain the original performance of your G-E equipment. For full information about these services, contact the nearest service shop or sales office.



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