INTERRUPTERS
RECIPROCATING BAR TYPE
PROCEDURES FOR REPLACING CAM SHAFT BUSHINGS

1. GENERAL

1.01 This section covers procedures for replacing cam shaft bushings in reciprocating bar-type interrupters.

1.02 This section is reissued to revise the list of tools and materials, to revise the procedure covering general preparation of tools, and to amplify the procedure covering removal of bushings. Detailed reasons for reissue will be found at the end of the section.

1.03 In all cases it will be necessary to remove an interrupter from the frame in order to replace the bushings. This replacement may be effected without disconnecting the wires from the interrupter provided the work is done by two men, one to hold the interrupter while the other replaces the bushings. Where it is necessary to use ladders to gain access to an interrupter, the replacement of the bushings may be effected without disconnecting the wires provided ladders either on opposite sides of the frame or on the same side of the frame can be brought close enough together and provided the operation can be performed without excessive reaching on the part of either man. When ladders are used, take care that they are prevented from rolling during the replacement operation. Otherwise, give consideration to disconnecting the wires and removing the interrupter to a work bench. Where the interrupter is not fully equipped, it may be more economical to disconnect the wires and remove the interrupter to a work bench. When this is done, the services of only one man will be required.

1.04 When necessary to replace a bushing in either bearing hub of a reciprocating bar-type interrupter, replace both bushings to assure that a satisfactory alignment of the reamed surfaces of the bushings is obtained.

2. TOOLS AND MATERIALS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
*491A	Reamer
*492A	Bushing Remover and Replacer
*493A	7/64-inch Pin Punch
KS-16619,L1	Punch ←
—	Hand Drill, North Bros Mfg Co No. 1446 (or equivalent) ←
—	No. 31 Gauge (0.120-inch diameter) Twist Drill
—	4-ounce Riveting Hammer
—	4-inch Regular Screwdriver
MATERIALS	
P-147152	Bushing for 149-, 152-, 160-, 161-, and 164-type interrupters (9/16-inch long — 15/32-inch diameter hole)
P-147254	Pin
P-154295	Bushing for 149-, 152-, 160-, 161-, and 164-type interrupters (9/16-inch long — 7/16-inch diameter hole)
P-173136	Bushing for 165-, 166-, and 167-type interrupters (3/4-inch long — 7/16-inch diameter hole)
P-173137	Bushing for 165-, 166-, and 167-type interrupters (3/4-inch long — 15/32-inch diameter hole)
KS-2423 or KS-14666 (or replaced D-98063)	Cloth ← Cloth ←
KS-16326	Oil

*Part of No. 1000A tool kit.

3. PROCEDURES FOR REMOVING AND INSTALLING BUSHING IN RECIPROCATING BAR-TYPE INTERRUPTER FRAMES

3.01 ***Preparation of Interrupter:*** Make busy any affected associated circuits in the approved manner. Stop the drive.

3.02 Remove the cam shaft gear from the interrupter as covered in Section 163-651-801.

3.03 *General Preparation of Tools:* Before starting to remove a bushing, remove the tools from the carrying case and remove any lubricant that may be on them with a dry KS-14666 cloth. The parts of the No. 492A bushing remover and replacer with the exception of the knurled cap screws are used on all interrupters. The cap screws are furnished in two sizes, the size to be used being dependent upon the bushing to be installed, as specified in the following table.

KNURLED CAP SCREW	BUSHING
Small — 21/32-inch Diameter	P-147152, P-154295, and P-173136
Large — 23/32-inch Diameter	P-173137

3.04 *Preparation of Reamer:* Place the sleeve and then the washer on the reamer. Hold the smooth end of the reamer with the one hand and the handle in the palm of the other hand. Insert the threaded end of the reamer into the hole in the handle and turn the reamer in a clockwise direction until it is tight.

3.05 *Preparation of Drill:* Insert the shank of the No. 31 drill in the hand drill and tighten it securely in place.

3.06 *Cleaning No. 491A Reamer and 492A Bushing Remover and Replacer:* Make sure that the cutting surfaces of the No. 491A reamer and the threads of the No. 492A bushing remover and replacer are free of scale, dirt, and graphite deposit. If they are not clean, clean them with a dry KS-14666 cloth. Remove as much scale or graphite deposit as possible. If the threads of the No. 492A bushing remover and replacer are clean the knurled cap screw may be easily run on and off the thread of the tool. Then lubricate the threads and cutting edges with a film of KS-16326 oil and remove most of the oil with a dry KS-14666 cloth.

Removal of Bushings

3.07 Drive out the pin from the upper and lower bushings with the No. 493A pin punch and the 4-oz riveting hammer, driving them toward the interrupter springs if the pins are lengthwise to the interrupter, or to the rear if they are crosswise.

3.08 If difficulty is encountered driving out the bushing pin, as covered in 3.07, it may be due to an incomplete drilling of the bushing pin hole in the casting. In this case, proceed as follows. Drive out the pin from the upper and lower bushings with the KS-16619, List 1 punch and the 4-ounce riveting hammer, driving them away from the interrupter springs, if the pins are lengthwise to the interrupter or to the front if they are crosswise.

3.09 To remove the bushing from the lower bearing hub, place the deep bushing locating guide on the threaded end of the No. 492A bushing remover and replacer with the open end of the guide toward the threaded end of the tool, as shown in Fig. 1. Insert the tool up through the lower bushing and place the proper size knurled cap screw over the threaded end of the tool with the shank of the screw inserted through the hole in the bushing. The bushing replacer guide is not used in this operation. Make sure that the deep bushing locating guide spans the lower surface of the bushing to be removed. Hold the cap screw with the fingers and turn the handle of the tool in a clockwise direction. When it is felt that the bushing has been started, remove the pressure of the fingers and turn the handle of the tool until the bushing is removed from the frame. If the cap screw slips in the bushing, it is an indication that the threads of the tool are not clean. In this case, clean them as covered in 3.06. With the lower bushing removed, unscrew the cap screw from the bushing and remove the graphalloy bushing and guide and proceed to remove the bushing in the upper bearing hub in the same manner, except in this case the tool is inserted through the bushing from the top of the bushing instead of the bottom, and the shank of the knurled cap screw is inserted in the bushing from the bottom.

Installation of Bushings

3.10 *General:* The bushing (P-154295 for 149-, 152-, 160-, 161-, and 164-type interrupters and P-173136 for 165-, 166-, and 167-type interrupters) provided for the upper bearing hub has a smaller diameter hole (7/16 inch instead of 15/32 inch) than the bushing (P-147152 for 149-, 152-, 160-, 161-, and 164-type interrupters and P-173137 for 165-, 166-, and 167-type interrupters) for the lower bearing hub. Install the bushings in the hubs starting with the lower one.

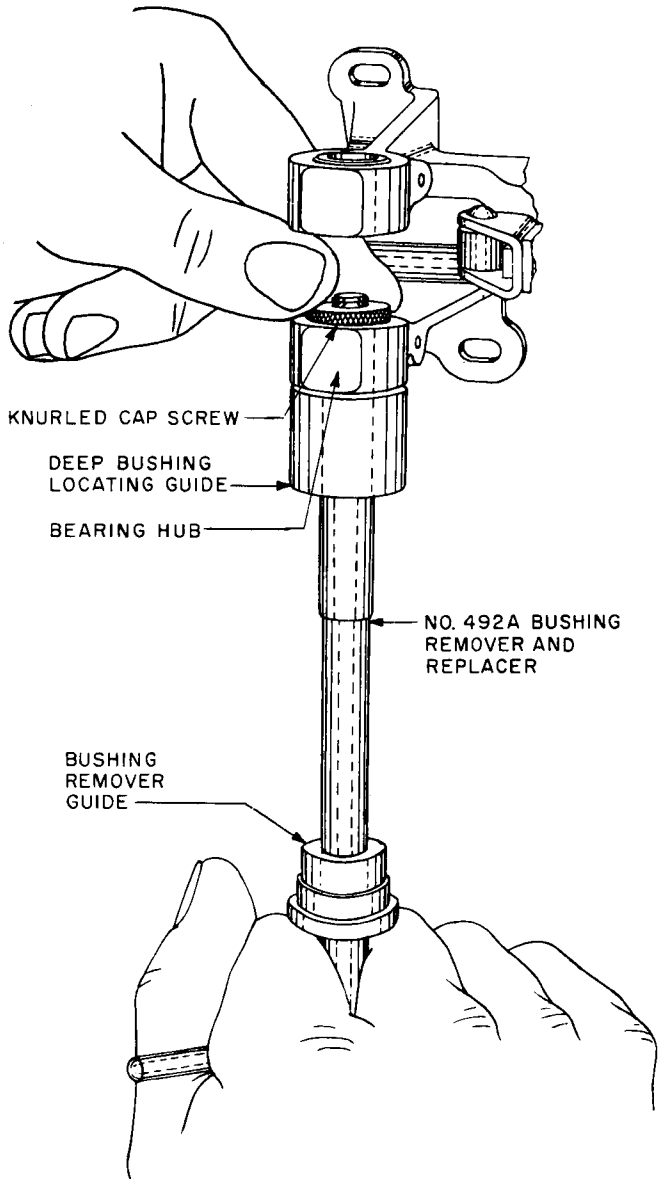

Fig. 1 – Method of Removing Bushing from Lower Bearing Hub of Reciprocating Bar-type Interrupter Using the No. 492A Bushing Remover and Replacer

3.11 ***Location of Bushings in Bearing Hubs:*** When installing bushings in the bearing hubs of 149-, 152-, 160-, 161-, and 164-type interrupters, do not permit the bushings to extend beyond the inner surfaces of the bearing hubs, and, when installing the bushings of 165-, 166-, and 167-type interrupters, make sure that the bushings extend beyond the surfaces of the bearing hubs approximately 1/64 inch. This difference in method of locating the bushings is due to differences in design of the interrupters, the separation between the hubs being larger for 165-, 166-, and 167-type interrupters than for the other types of interrupters.

3.12 ***Installing Lower Bushings:*** Fig. 2 — On 149-, 152-, 160-, 161-, and 164-type interrupters, place the flat surface of the shallow bushing locating guide on the upper surface of the lower bearing hub, and, on 165-, 166-, and 167-type interrupters, place the undercut surface

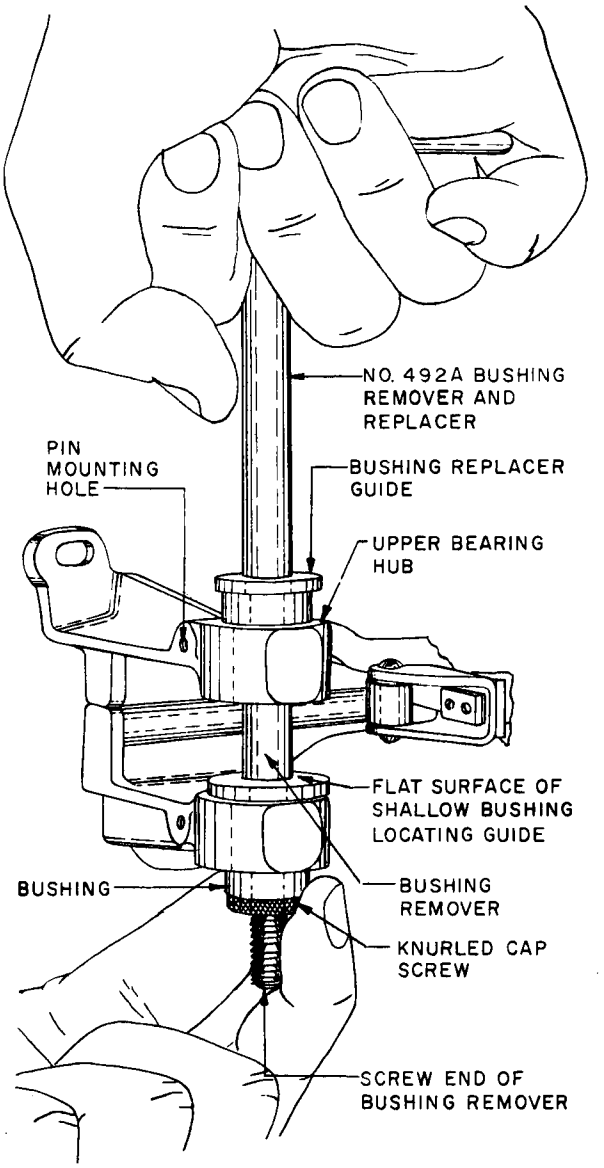

Fig. 2 – Method of Installing Bushing in Lower Bearing Hub of Reciprocating Bar-type Interrupter

of the shallow bushing locating guide on the upper surface of the lower bearing hub. Insert the threaded portion of the No. 492A bushing remover and replacer down through the upper bearing hub, the guide, and the lower bearing hub. Place the new bushing and then the proper size knurled cap screw over the threaded end of the tool. Place the bushing replacer guide of the No. 492A bushing remover and replacer so that its shoulder rests on the surface of the upper bearing hub. Turn the cap screw until the bushing is just at the opening in the lower bearing hub. Move the shaft from side to side until the edge of the bushing is centered in the hole in the lower hub. Slowly turn the handle of the No. 492A bushing remover and replacer in a clockwise direction until the bushing is forced in place in the bearing hub. Then turn the handle in the opposite direction to remove the tool. Remove the cap screw and guide.

3.13 ***Installing Upper Bushings:*** On 149-, 152-, 160-, 161-, and 164-type interrupters, place the flat surface of the shallow bushing locating guide against the lower surface of the upper bearing hub, and on 165-, 166-, and 167-type interrupters, place the undercut surface of the shallow bushing locating guide against the lower surface of the upper bearing hub. While holding the guide in position, insert the threaded end of the No. 492A bushing remover and replacer up through the bottom bushing and slide it up through the upper bearing hub. Place the new bushing and the proper size knurled cap screw over the end of the shaft and proceed as covered above except that the guide on the tool is not used in installing the upper bushing.

3.14 ***Checking Position of Bushings:*** After assembling the bushings in the bearing hubs, if the bushings are to project beyond the bearing hubs, place the cam and cam shaft gear assembly in approximately the position it normally assumes. If difficulty is experienced in doing this the separation between the bushings is insufficient. Remove the assembly and raise the bushing in the upper bearing hub as covered in 3.08 until a satisfactory separation exists or until the bushing is flush with the bearing hub. If this occurs lower the bushing in the lower bearing hub until a satisfactory separation is obtained.

3.15 ***Reaming Bushings:*** Fig. 3 — Insert the end of the No. 491A reamer up through the lower bushing. Ream the bushings by turning the handle of the reamer slowly in a clockwise direction. As the first set of blades moves through and beyond the bushings, continue the reaming operation up through the upper bushing. The first set of blades is of a smaller diameter than the second set, and serves to give the lower bushing an initial reaming and the upper bushing a complete reaming, while the second set of blades gives the lower bushing its final reaming. After reaming both bushings, continue turning the reamer in a clockwise direction, but instead of applying pressure to the handle, withdraw the reamer slowly from the bushings. The reamer should not be turned in a counterclockwise direction, as the handle will be loosened. This design is done to prevent chipping the blades of the reamer if the reamer is turned counterclockwise.

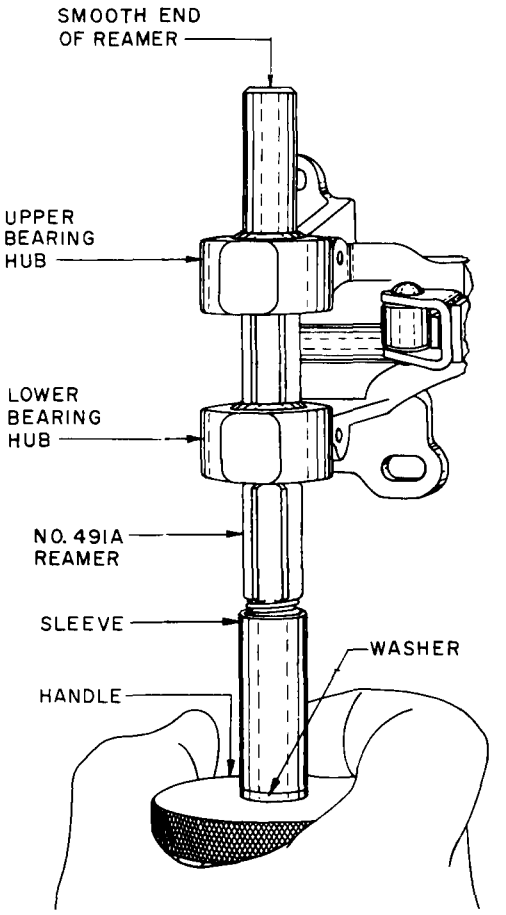

Fig. 3 – Method of Reaming Bushings Installed in Bearing Hubs of Reciprocating Bar-type Interrupter Using the No. 491A Reamer

3.16 ***Installing Pins in Bushings:*** Insert the No. 31 drill mounted in the hand drill in the pin mounting hole and turn the drill slowly in a clockwise direction. After drilling the hole through the side of the bushing, withdraw the drill still turning it in a clockwise direction. If the pin previously used is not satisfactory, replace it. Insert the pin in the hole in the left-hand side of the bearing hub when the pin is inserted lengthwise to the interrupter or in the front when the pin is crosswise and tap it in place lightly with the hammer.

3.17 ***Cleaning No. 491A Reamer, 492A Bushing Remover and Replacer, and Hand Drill:*** Clean the blades and threads of the tools with a dry KS-14666 cloth and then apply a light film of KS-16326 oil to these parts and to the end of the reamer near the pin to prevent rusting before storing them away for future use.

3.18 ***Reassembling Apparatus:*** After the bushings are satisfactorily assembled in the frame, reassemble the cam and cam shaft as covered in Section 163-651-801. Mount the interrupter on the frame and check its location as covered in Section 163-651-701. Then start the drive and restore to service any circuits that had been made busy.

REASONS FOR REISSUE

1. To revise the list of tools and materials. (Part 2)
2. To revise the procedure covering general preparation of tools to revise the information for the use of knurled cap screws. (3.03)
3. To add the procedure covering removal of bushings to specify a method for removing the bushing pins where, due to incomplete drilling of the bushing holes, the pins cannot be removed as covered in 3.07. (3.08)