KS-15532 RINGING MACHINE

REPLACEMENT PARTS AND PROCEDURES

1. GENERAL

1.01 This section covers the information necessary for ordering parts to be used in the maintenance of the KS-15532 ringing machine. It also covers approved procedures for replacing these parts.

1.02 This section is reissued to update supplier information and add a note concerning illustrations.

1.03 This ringing machine is used in the 804C ringing plant.

1.04 Part 2 of this section covers the various parts which may be replaced in the field in the maintenance of this equipment. Aside from screws, nuts, bolts, and other small parts which can be obtained locally, the parts not designated herein should not be replaced by the regular maintenance personnel. Part 2 also contains explanatory illustrations showing the different parts.

1.05 Part 3 of this section covers the approved procedures for the replacement of parts listed under Part 2.

1.06 ▶Replacement parts for Electric Specialty Company manufactured units should now be ordered from Tech Systems Co., Inc, Thomaston, Conn. Parts for the Holtzer-Cabot Co. units should be ordered from Commercial Electric Products Corp., Cleveland, Ohio.◀

2. REPLACEMENT PARTS

2.01 The illustrations (Fig. 1 through 8) included in this part show the various replacement parts in their proper relation to other parts of the apparatus with their corresponding names.

> ***Note:*** ▶Due to the similarity of the ac motor driven and the dc motor driven ringing machines, only the dc motor driven ringing machines are shown in Fig. 1 through 8.◀

2.02 When ordering replacement parts other than brushes, give the name of the part as shown in the illustrations of this section, the complete nameplate data of the ringing machine including the manufacturer's name, serial number, and the KS and list number.

2.03 Brush replacements should be ordered in accordance with Section 171-110-802.

2.04 Miscellaneous parts, such as screws, nuts, washers, etc, which are not named in the illustrations and which cannot be obtained locally, should be ordered by giving a description of the part and reference to its use.

3. REPLACEMENT PROCEDURE

3.001 ***List of Tools and Materials***

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	Typewriter Brush
KS-14440 L3	Copper Soldering
KS-2663	File
—	Ball Peen Hammer, 1-Pound
R-2806	Reversible Ratchet Handle, 10 Inches, 1/2-Inch Square Drive (part of R-2792 wrench set)
R-2975	Snap Ring Adjustable Pliers, Truarc
—	Puller, Grip-O-Matic, Owatonna Tool Co, No. 1002
	4-Inch E Screwdriver
R-1542	Adjustable Single-End Wrench, 6-Inch

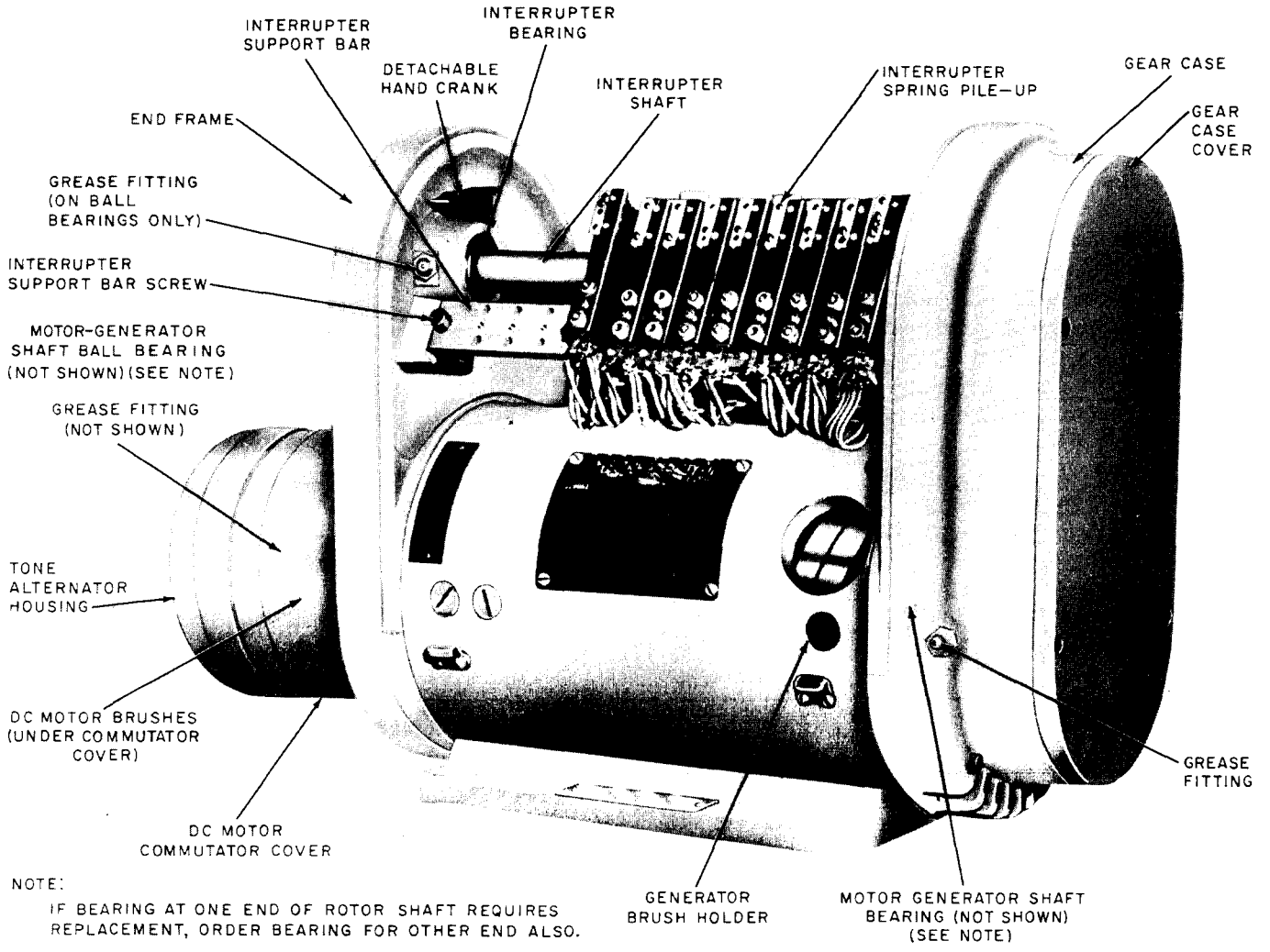

Fig. 1—KS-15532 DC Motor-Driven Ringing Machine—Interrupter Cover Removed—Tech Systems Company (formerly Electric Specialty Company)

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
R-2958	Wrench, Allen Socket Screw, 1/16-Inch
R-2659	Wrench, Allen Socket Screw, 5/64-Inch
R-2670	Wrench, Allen Socket Screw, 3/32 Inch
R-2671	Wrench, Allen Socket Screw, 1/8-Inch
P-431479	Wrench, Allen Socket Screw, 5/32-Inch
R-2812	Wrench, Allen Socket Screw, 3/16-Inch
R-2819	Wrench, Socket, Det. 6, 11/16-Inch (part of R-2792 wrench set)
—	Screwdriver, torque, No. B12 with BS1 square bit and No. 825 holder with No. 185-0 socket head bit, Apco-Mossberg Co.

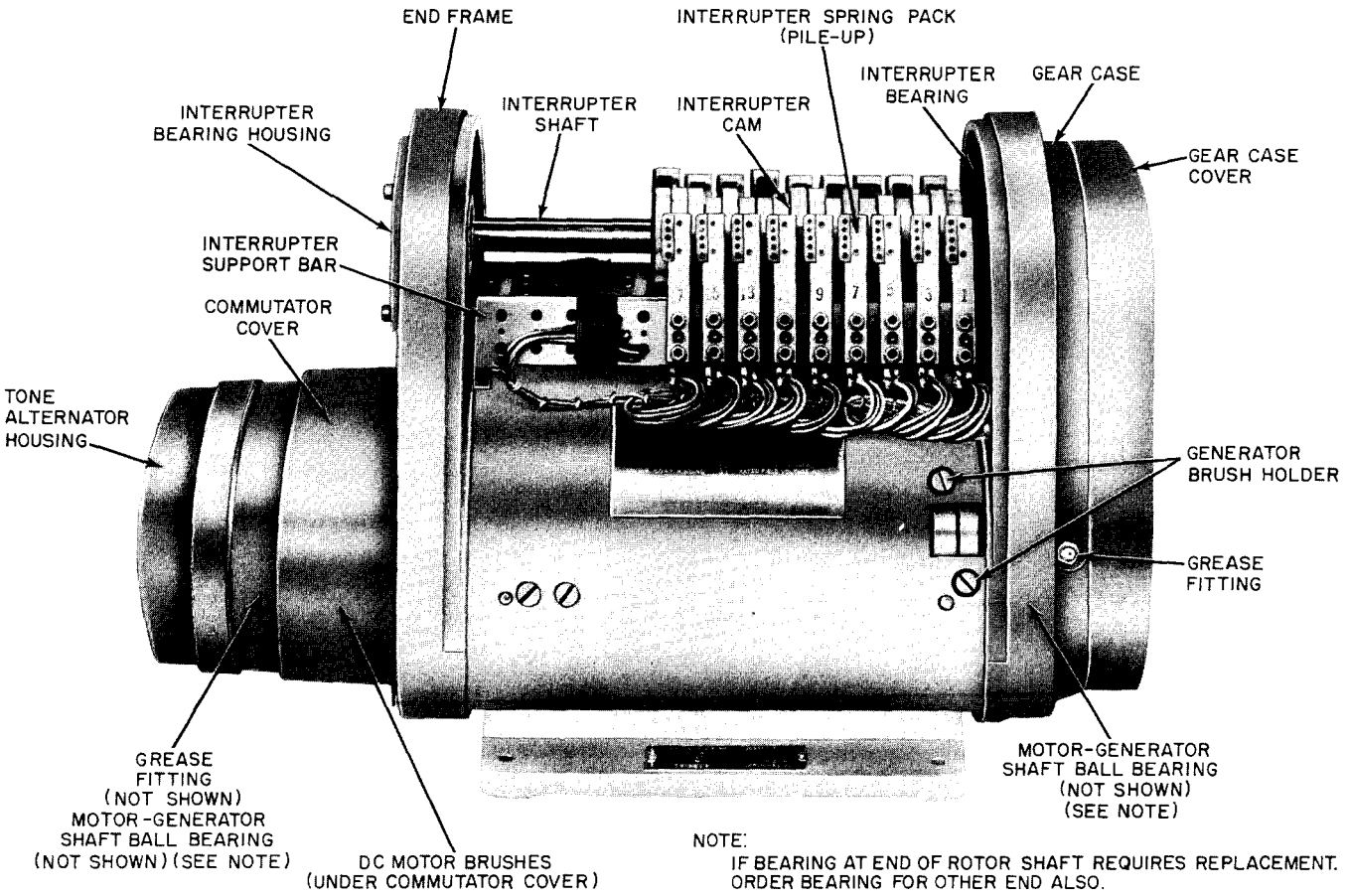

Fig. 2—KS-15532 DC Motor Driven Ringing Machine—Interrupter Cover Removed—Commercial Electric Products Company (Same design previously manufactured by Holtzer-Cabot)

CODE OR SPEC NO. MATERIALS	DESCRIPTION
K-14666	Cleaning Cloth
—	Light Mineral Oil
—	Sandpaper, 4/0
—	Solder, Rosin Core
—	Petroleum Spirits
—	Wooden Block

3.002 Remove the apparatus from service before making any replacements. ***Observe all operating procedures necessary to insure that the ringing plant cannot transfer to the ringing machine being serviced.*** See Bell System Practice on the associated ringing plant.

3.003 After making any replacements of parts, the apparatus shall be checked and, when necessary, readjusted to meet the requirements specified in the section covering the Apparatus Requirements and Adjusting Procedures for this equipment.

3.004 ***Clearance:*** When reassembling parts, ensure that there is a clearance between current-carrying parts and metallic parts at ground potential of a minimum of 0.016 inch.

3.005 No replacement procedures are specified for screws or other small parts when the procedure consists of a simple single operation.

3.006 Care should be exercised when using petroleum spirits in power rooms where there are dc machines, since commutation may be adversely affected by softening of commutator film by the fumes. To avoid the need for burnishing the commutators of dc machines after doing any cleaning called for in this section, provide adequate

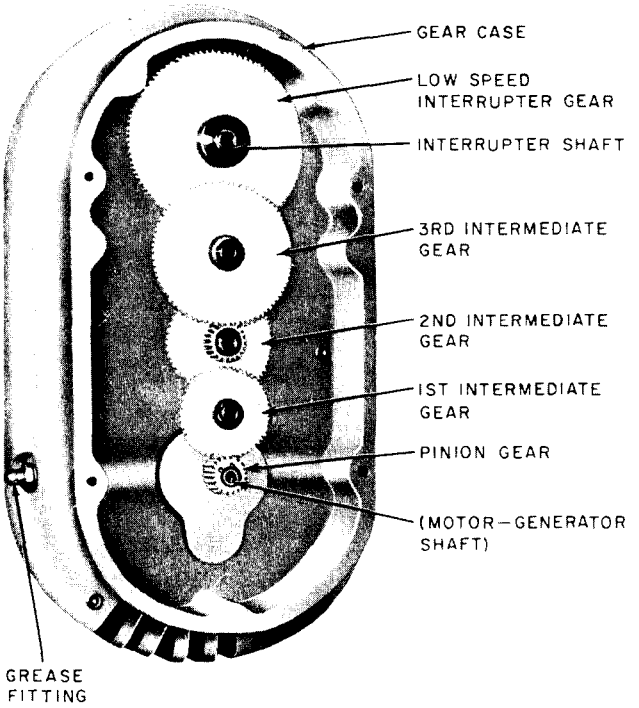

Fig. 3—Interrupter Gears—Gear Case Cover Removed—Tech Systems Company (formerly Electric Specialty Company)

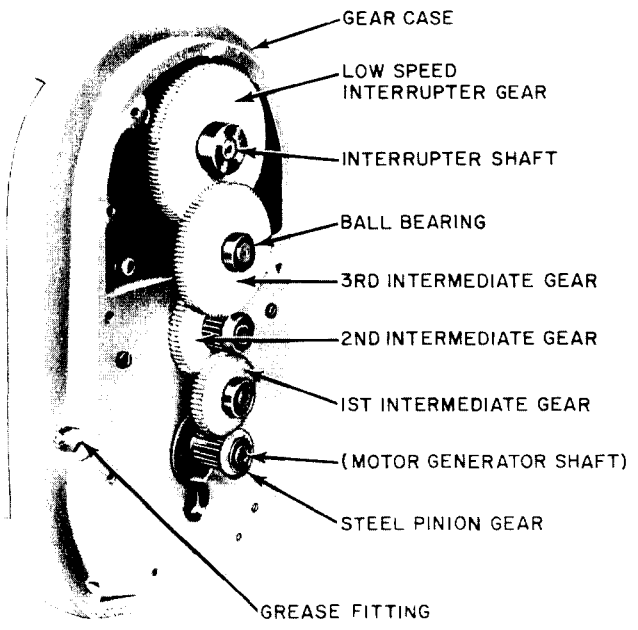

Fig. 4—Interrupter Gears—Gear Case Cover Removed—Commercial Electric Products Company (Same design previously manufactured by Holtzer-Cabot)

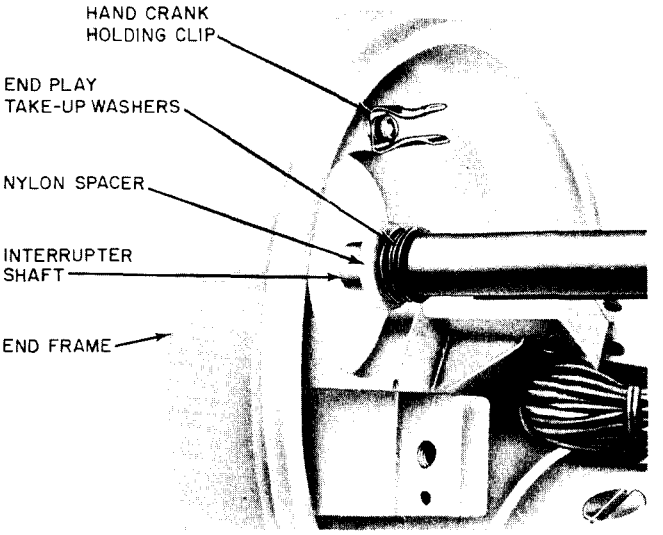

Fig. 5—Tech Systems Company (formerly Electric Specialty Company) End Interrupter Shaft Details—Sleeve Bearing Type

ventilation, use the absolute minimum amount of petroleum spirits required for the cleaning operation, and keep the container closed when not in use.

3.01 *Brushes (See Fig. 7 and 8)*

DC Motor-Driven Ringing Machine

(a) ***AC Generator Brushes:*** Using a screwdriver, remove the brush holder screw cap which holds the brush and spring in place. Withdraw the old spring and brush, insert a new brush and spring, and restore and tighten the brush holder screw cap.

(b) ***DC Motor Brushes With Box-Type Brush Holders:*** Using a screwdriver, loosen the four screws holding the commutator cover. Rotate the cover counterclockwise (as viewed from the tone alternator end of the ringing machine) and remove. Remove the holding screw which fastens the pigtail to the brush holder, raise the brush finger, and withdraw the old brush and pigtail. Insert the new brush and see that the brush finger holds the brush firmly in place. Restore and tighten the screw which fastens the pigtail to the brush holder. Check that the brush pigtail does not touch any part of the machine frame, and restore the commutator cover. Tighten the four cover screws.

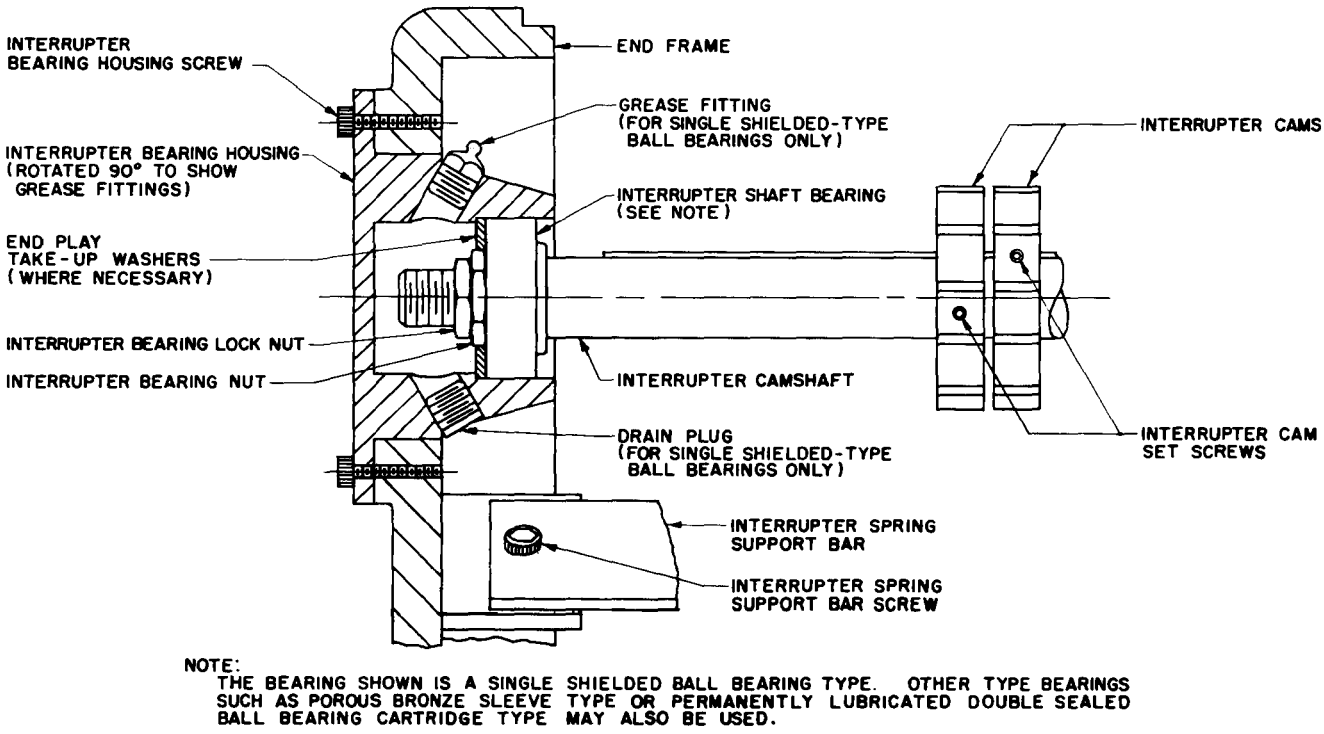

Fig. 6—Tech Systems Company (formerly Electric Specialty Company) Sectional View of Interrupter Shaft Support—Ball Bearing Type

(c) ***DC Motor Brushes With Cartridge-Type Brush Holders:*** Remove commutator cover as described in (b) and replace brushes as in (a).

AC Motor-Driven Ringing Machine

(d) ***AC Generator Brushes With Box-Type Brush Holders:*** To replace an ac generator box-type brush, follow the procedure described in (b).

(e) ***AC Generator Brushes With Cartridge-Type Brush Holders:*** Remove commutator cover as described in (b) and replace brushes as in (a).

(f) If a dc motor brush or an ac generator brush of an ac motor-driven machine requires fitting, cut a strip of 4/0 sandpaper or abrasive cloth slightly wider than the width of the brush and at least as long as the circumference of the commutator or slip ring. Place the strip of sandpaper or abrasive cloth under the brush with the abrasive side next to the brush and hold so that it will bear on approximately 180 degrees of the mating surface. Draw the sandpaper or abrasive cloth back and forth under the brush until the brush has the same curvature as the mating part. The final cut should be made in the direction of commutator rotation. Poor commutation is likely if less than half of each brush surface is in contact with the commutator. After sanding, blow the dirt away and wipe with a dry, clean cloth. On dc machines, fit the ac generator brushes by shaping the curvature of the new brush as closely as possible to match the curvature of the old brush. Smooth off all sharp edges of the brush face and clean the contact surfaces of the brush before putting it back in its holder.

3.02 ***Interrupter Spring Pile-Up:*** Unsolder the spring pile-up leads and mark each lead to ensure proper replacement. Using the 3/32-inch Allen wrench, loosen and remove the holding (center) screw of the spring pile-up. Remove the spring pile-up and the cam follower with its associated spring leaf. To restore the pile-up, set the cam follower and associated spring leaf on the new spring pile-up and, using the holding screw,

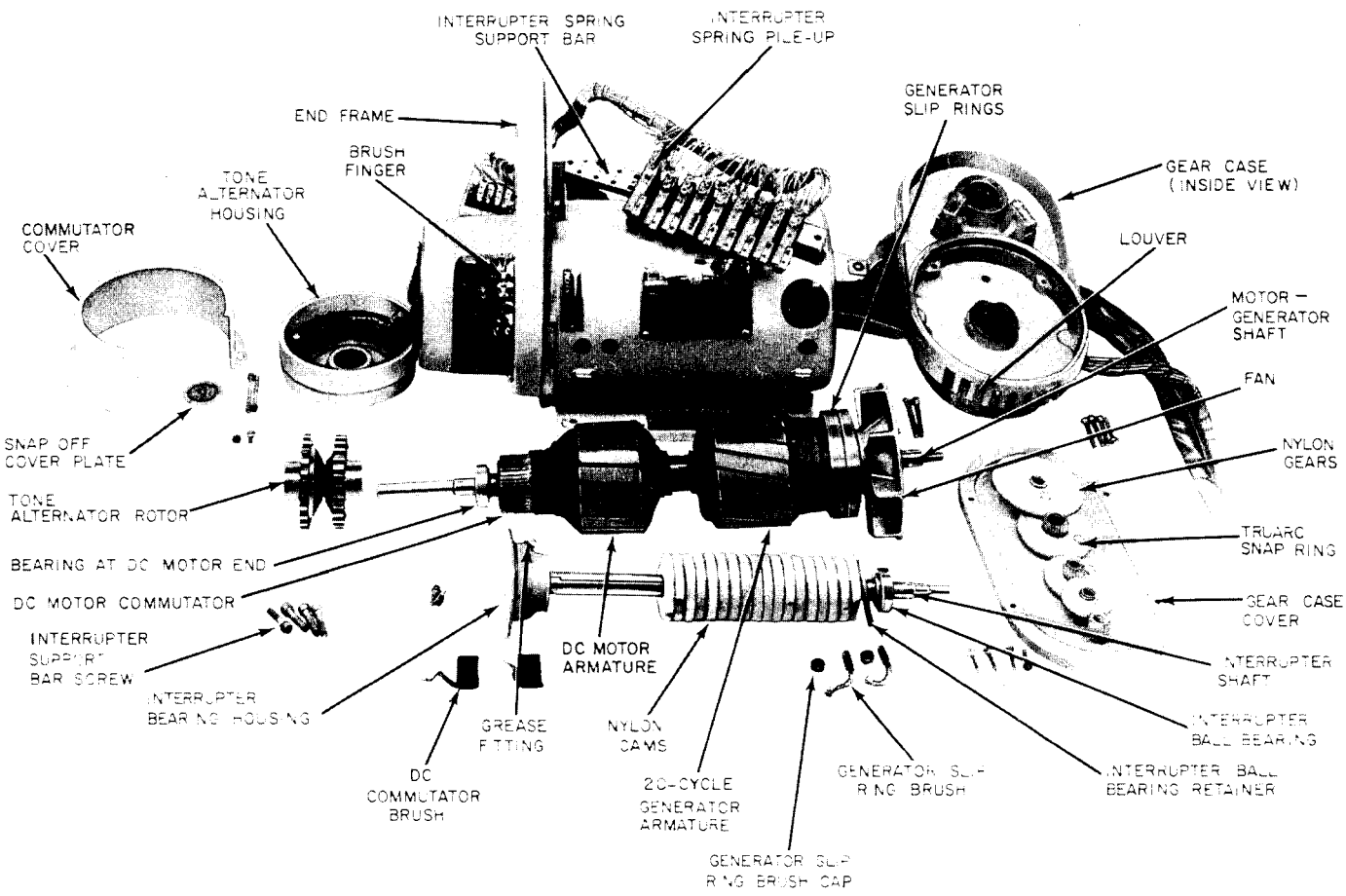

Fig. 7—DC Motor-Driven Ringing Machine—Detailed Disassembly—Tech Systems Company (formerly Electric Specialty Company)

attach the spring pile-up and cam follower assembly to the spring support bar. Tighten the holding screw and solder the associated leads to the spring pile-up.

3.03 ***Interrupter Gears (See Fig. 3 and 4):*** **▮Tech Systems Company (formerly Electric Specialty Company)▮**

(a) ***Intermediate Gears:*** To replace an intermediate gear, proceed as follows.

(1) Remove the gear case cover by removing the four Allen head screws (one located in each corner of the gear case cover) using a 1/8-inch Allen wrench for early model machines or 3/32-inch Allen wrench on later model machines. With the adjustable Truarc snap ring pliers, remove the snap ring from the intermediate gear shaft to permit removal of the gear. Observe if a washer is assembled on the shaft with the gear, and if so, what side of the gear it is on. Remove the washer and gear.

Note: If the adjustable snap ring pliers are not available, a screwdriver, putty knife, or similar tool may be used. However, when using these tools, care should be exercised to avoid personal injury.

(2) When restoring an intermediate gear to its shaft, a slight amount of light mineral oil, such as may be applied by putting one drop of oil on a finger and rubbing it on the shaft, should be put on the gear shaft. Then the gear, washer, and snap ring, which were removed when the old gear or gears were taken off, should be restored. Restore the

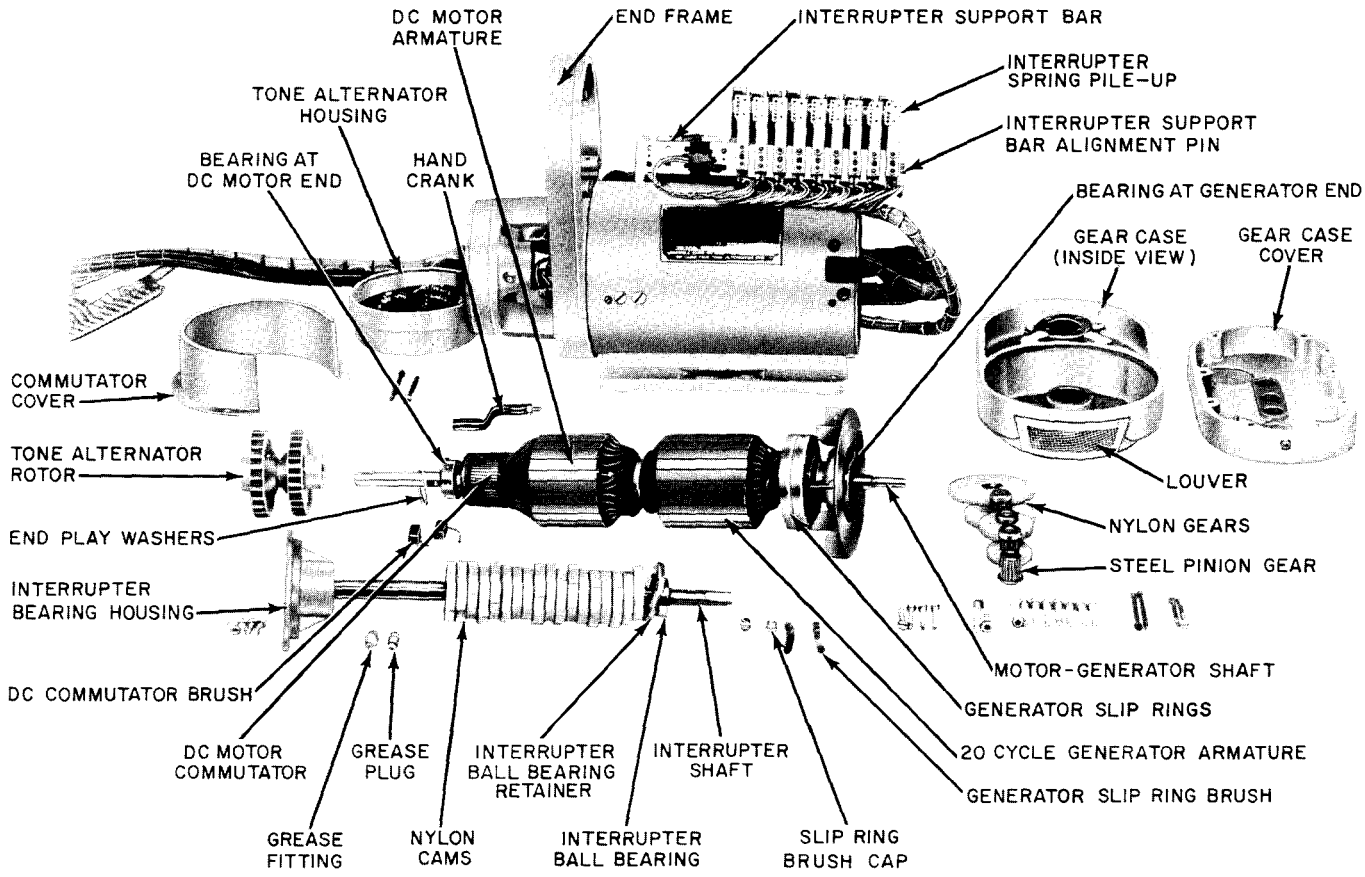

Fig. 8—DC Motor-Driven Ringing Machine—Detailed Disassembly Commercial Electric Products Company (Same design previously manufactured by Holtzer-Cabot)

gear case cover; insert and tighten the four gear case cover screws.

Note: To prevent possible binding, it is important when restoring the gears that the associated washers be restored in the position from which they were removed.

(b) ***Low-Speed Interrupter Gear:*** To replace the low-speed interrupter gear, remove the gear case cover and uppermost intermediate gear as described in 3.03(a) and proceed as follows.

(1) Loosen the two setscrews located on the low-speed interrupter gear hub using the 3/32-inch Allen wrench. Remove the low-speed interrupter gear. If the gear cannot be removed using finger pressure, it may be removed with the Grip-O-Matic puller provided that a new low-speed interrupter gear is installed when reassembling the ringing machine.

(2) When restoring the low-speed interrupter gear to its shaft, align the low-speed interrupter gear with the key on the interrupter shaft and slip on the gear. On gears having an axial roll pin between the gear hub and the interrupter shaft, slip the gear on the shaft, rotate the gear until the half holes in the gear hub and shaft match, and insert the roll pin. If force is necessary when restoring the roll pin, only light tapping pressure should be used and the camshaft held by one hand to avoid any lateral movement of the camshaft. After installing the roll pin, check the interrupter camshaft for lateral movement. If the end play is found to be greater than 1/16 inch, add shims as described in 3.08(a)(2). Then restore the intermediate gear, washer, and snap ring on the intermediate gear shaft. Tighten the two setscrews on the low-speed interrupter gear hub and restore the gear case cover and associated screws.

(c) ***High-Speed Pinion Gear:*** Remove the gear case cover as described in 3.03(a). With the adjustable Truarc snap ring pliers, remove the snap ring from the motor-generator shaft. Remove the high-speed pinion gear. If the gear cannot be removed with finger pressure, use the Grip-O-Matic puller, being careful not to damage the gear teeth or the driving pin in the motor-generator shaft. To restore the high-speed pinion gear to the shaft, align the slot in the high-speed pinion gear with the driving pin on the shaft. Slide the gear on the shaft to engage the driving pin. Restore the snap ring to the shaft. Restore the gear case cover. Insert and tighten the four gear case cover screws.

▶Commercial Electric Products Company (Same design previously manufactured by Holtzer-Cabot Company)◀

(d) ***Intermediate Gears:*** To replace an intermediate gear, proceed as follows.

(1) Remove the eight gear case cover holding screws using the 3/16-inch Allen wrench. The gear case cover is also held to the gear case by two dowel pins, one located in the upper left-hand corner and the other in the lower right-hand corner of the gear case (as observed from the gear case end of the ringing machine). If the gear case cover is not readily removable, it may be freed using a hammer and a block of hard wood. Tap the wooden block lightly, moving the block about the periphery of the gear case cover between blows until the cover is forced off. Remove the gear case cover.

(2) Remove and set aside the end play spring washers from the intermediate gear bearing housings in the gear case cover. Using the 5/64-inch Allen wrench, loosen the two setscrews on the motor-generator shaft pinion gear. Pull the pinion gear out along the shaft as far as it will go (about 1/4 inch). Grasp the two lowest intermediate gears and pull them forward until their associated ball bearings slip out of the bearing housings in the gear case and release the gears. Using a 1/8-inch Allen wrench, loosen the setscrew on the low-speed interrupter gear hub. Remove the low-speed interrupter gear and uppermost intermediate gear.

(3) When restoring the gears, hold the low-speed interrupter gear and the uppermost intermediate gear together, properly aligned, and simultaneously put the interrupter gear on the interrupter shaft and the intermediate gear bearing into the gear case bearing housing. Do not tighten the setscrew on the low-speed interrupter gear, as it may be necessary to adjust its position on the interrupter shaft after the assembly of all of the intermediate gears. Restore the two lower intermediate gears, held together to their correct positions. Push in the pinion gear so as to be centered on the lowest intermediate gear. Tighten the 1/8-inch Allen head setscrew on the low-speed interrupter gear and tighten the two 5/64-inch Allen head setscrews on the pinion gear.

(4) Place the end play spring washers carefully in the three intermediate gear-bearing housings of the gear case and restore the gear case cover to the gear case. Insert and tighten the eight gear case cover holding screws.

Caution: When restoring the gear case cover, do not use the holding screws to draw the gear case cover to the gear case, but tap the cover in place using a hammer and a wooden block to protect the cover.

(e) ***Low-Speed Interrupter Gear:*** To replace the low-speed interrupter gear, follow the procedure described in 3.03(d).

(f) ***High-Speed Pinion Gear:*** To replace the high-speed pinion gear, remove gear case cover and the two lowest intermediate gears as described in 3.04(d). Further loosen the two setscrews on the pinion gear to clear the notch in the shaft and slip the pinion gear off the shaft. If the gear cannot be removed using finger pressure, it may be removed using the Grip-O-Matic puller. Reassemble in reverse order of removal.

3.04 ***Interrupter Shaft Ball Bearing (Where Provided)***

Tech Systems Company (formerly Electric Specialty Company)

(a) ***Tone Alternator End:*** To remove the interrupter shaft ball bearing, proceed as follows (see Fig. 1 and 6).

(1) With the 3/16-inch Allen wrench, remove the four interrupter spring support bar screws (two screws in each bar). Move the spring support bars to provide a clear working area. With a clean cloth, wipe the area around the pressure fitting and grease drain plug. Using the R-1542 adjustable wrench, loosen and remove the grease pressure fitting and the grease drain plug.

Note: It will not be necessary to remove the grease drain plug if it does not project far enough to hit the end frame as the bearing housing is being removed.

(2) With the 5/32-inch Allen wrench, remove the two screws which secure the interrupter shaft bearing housing to the end frame. Support the interrupter shaft at the tone alternator end, using a wooden block or equivalent, to prevent any stress on the ball bearing at the gear case end of the interrupter shaft when the bearing housing is removed.

(3) The bearing housing can now be removed, using a hard wooden block (approximately 1/4 inch by 1 inch by 6 inches) and a hammer. Tap the wooden block lightly, moving the block about the periphery of the bearing housing (interrupter cam side) between blows. Using the ratchet handle and 11/16-inch socket wrench, remove the interrupter shaft bearing locknut and then the bearing nut. To prevent undue strain on the gears, it is recommended that a counter force be applied to the interrupter shaft by gripping the cams in one hand while turning off each nut with the other. Remove any end play take-up washers. Slip the ball bearing off the shaft. Use the Grip-O-Matic puller, if necessary.

(4) On reassembly, if the ball bearing is of the single-shielded type, install it with the shielded side inward (toward the interrupter cams). If the ball bearing is of the double-shielded cartridge type, this point need not be checked.

(5) When installing a new bearing, tap or press it into place using a sleeve or pipe of a size to fit against the bearing inner race. Do not apply pressure to the bearing outer race as this will damage the bearing. The sleeve or pipe end should be squared off so that pressure is applied equally to the whole inner race surface and the bearing is driven straight on the shaft. It is important to keep all tools and parts clean while working and to keep the new bearing in its protective package until ready to install. Clean the shaft and bearing chamber thoroughly using a clean cloth and petroleum spirits. Reassemble in reverse order of removal and remove blocking. If the ball bearing is of the single-shielded type, relubricate it in accordance with Section 163-720-701. Check that the ball bearing rotates without binding.

(b) ***Gear Case End:*** To replace the interrupter ball bearing located at the gear case end of the ringing machine, it will be necessary to remove the camshaft from the ringing machine. Proceed as described in 3.04(a) to set aside the support bars and to remove the bearing housing at the tone alternator end. Remove the gear case cover and low-speed interrupter gear as described in 3.03(b) and proceed as follows.

(1) Using a screwdriver, remove the four screws directly behind the low-speed interrupter gear in the gear case housing. This will release the interrupter bearing retainer and enable removal of the camshaft. Remove the camshaft from the ringing machine by drawing it out the tone alternator end of the machine. Remove the ball bearing from the interrupter shaft. If necessary, use the Grip-O-Matic puller.

(2) When installing a new ball bearing, follow the installation procedure as described in 3.04(a)(4). Reassemble in reverse order of removal and remove blocking. If the ball bearing is of the single-shielded type, relubricate the bearing in accordance with Section 163-720-701. Check that the ball bearing rotates without binding.

▶Commercial Electric Products Company (Same design previously manufactured by Holtzer-Cabot Company)◀

(c) ***Tone Alternator End:*** To replace the interrrupter shaft ball bearing, proceed as follows.

(1) Remove the grease fitting and grease drain plug on the bearing housing, if present, using the R-1542 adjustable wrench. Support the interrupter shaft at the tone alternator end, using a wooden block or equivalent, to prevent any stress on the ball bearing at the gear case end of the interrupter shaft when the bearing housing is removed.

(2) Using the 5/32-inch Allen wrench, remove the four screws which secure the interrupter bearing housing to the end frame. The bearing housing can now be removed by using a hard wooden block (approximately 1/4 by 1 by 6 inches) and hammer. Tap the wooden block lightly, moving the block about the periphery of the bearing housing (interrrupter cam side) between blows. Remove the bearing housing. Using the ratchet handle and 11/16-inch socket wrench, remove the interrupter shaft bearing locknut and then the bearing nut. To prevent undue strain on the gears, it is recommended that a counter force be applied to the interrupter shaft by gripping the cams in one hand while turning off each nut with the other. Remove any end play take-up washers. Slip the ball bearing off the shaft. Use the Grip-O-Matic puller, if necessary.

(3) When installing a new bearing, follow the procedure described in 3.04(a)(4) and (5). Reassemble in reverse order of removal and remove blocking. If the ball bearing is of the single-shielded type, relubricate in accordance with Section 163-720-701. Check that the bearing rotates without binding.

(d) ***Gear Case End:*** To replace the interrupter ball bearing located at the gear case end of the interupter shaft, it will be necessary to remove the camshaft from the ringing machine. With the low-speed interrupter gear removed as described in 3.03(d), proceed as follows.

(1) Remove the bearing housing, locknut, and bearing nut as in 3.04(c).

(2) In the gear case housing, remove the four screws located directly behind the low-speed interrupter gear. This will release the interrupter bearing retainer and enable removal of the camshaft.

(3) Place a sheet of sturdy cardboard, such as may be found on the back of an 8-3/8 by 11-7/8 inch paper pad or equivalent, on each side of the camshaft between the interrupter cams and their associated spring pile-ups. Remove the camshaft from the ringing machine by drawing it out the tone alternator end of the machine. Remove the ball bearing from the shaft. If the bearing cannot be removed using finger pressure, use the Grip-O-Matic puller.

(4) When installing a new ball bearing, follow the procedure as described in 3.04(a)(4) and (5). Reassemble in reverse order of removal and remove cardboard from between cams and spring pile-ups. If the ball bearing is of the single-shielded type, relubricate in accordance with Section 163-720-701. Check that the ball bearing rotates without binding.

3.05 ***Intermediate Gear Ball Bearing—▶(Same design previously manufactured by Holtzer-Cabot Company):◀*** To replace an intermediate gear ball bearing, proceed as follows.

(1) Remove the intermediate gears as described in 3.03(d). Using the Grip-O-Matic puller, remove the ball bearings from the gear shaft.

(2) Before installing a new bearing, clean the gear shaft and bearing housings using a clean cloth and petroleum spirits. Install the new ball bearing on each end of the gear shaft as described in 3.04(a)(5). Reassemble in reverse order of removal and check that the ball bearings rotate without binding.

3.06 ***Motor-Generator Shaft Ball Bearings (See Fig. 7 and 8):***

▶Tech Systems Company (formerly Electric Specialty Company)◀

(a) ***DC Motor-Driven Ringing Machine:*** When replacing a motor-generator shaft ball bearing, it is recommended that both bearings be replaced at the same time. To replace both bearings, it

will be necessary to remove the motor-generator shaft from the ringing machine from the gear case end. Proceed as follows.

(1) Remove the interrupter gears as described in 3.03(a) through 3.03(c).

(2) With the 3/16-inch Allen wrench, remove the four interrupter bar support screws (two screws in each bar). Move the spring support bars to provide a clear working area. Using a block of hard wood, or equivalent, support the interrupter camshaft at the gear case end of the ringing machine.

(3) Using a screwdriver, remove the four screws directly behind the low-speed interrupter gear in the gear case housing.

(4) Remove the brushes as described in 3.01. Mark each brush in a manner to insure that, when replaced, it will be returned to its original position.

(5) Using the 1/8-inch Allen wrench, remove the four screws which secure the gear case to the ringing machine frame. Two of the screws are located on the outside of the gear case, adjacent to the louvers. The other two are located inside the gear case, to the left and right of the intermediate gears. Remove the gear case.

Note: The gear case is located on the frame by a rabbet on the gear case which fits on a shoulder of the ringing machine frame. If the gear case is not readily removable, it may be freed using a block of hard wood and a hammer. Tap the wooden block lightly, moving the block about the periphery of the rabbet between blows until the gear case is forced off the shoulder.

(6) Remove the tone alternator rotor as follows.

Note: Due to a loss in magnetism when the parts are separated, all work on the tone alternator should be planned so as to reduce to a minimum the time during which the rotor and stator are separated. Whenever possible, the rotor should be restored to the stator housing.

(7) Remove the two screws located on the outer edge of the tone alternator housing. Use the 5/32-inch Allen wrench. Remove the tone alternator housing carefully to avoid damaging the tone alternator stator leads.

Note: The tone alternator housing is located by a rabbet which engages a shoulder on that part of the tone alternator which is integral with the end frame. If the tone alternator housing is not readily removable, it may be freed using a block of hard wood and a hammer. Tap the wooden block lightly, moving the block about the rabbet between blows until the tone alternator housing is forced off the shoulder.

(8) Mark the longitudinal position of the rotor on the motor-generator shaft so that on reassembly the rotor will be restored to the same position. Loosen the two setscrews on the rotor hub using the 3/32-inch Allen wrench. Remove the rotor from the motor-generator shaft.

(9) Carefully work the armatures clear of the pole pieces and remove the motor-generator shaft from the gear case end of the ringing machine. Care must be taken not to damage the collector ring brush holders.

(10) After removing the motor-generator shaft, it should be placed with its shaft resting on V-grooved blocks, keeping the armatures, collector rings, and commutator clear of all supports.

(11) Remove the end play washers, where provided, from the tone alternator end of the motor-generator shaft.

(12) Remove the ball bearings using the Grip-O-Matic puller.

(13) When installing the new ball bearings, follow the procedure as described in 3.04(a)(3) and (4). If the ball bearings are of the single-shielded type, the shielded side should face the armatures. If the ball bearings are of the sealed type, this point need not be checked. Reassemble in reverse order of removal and remove blocking. Where end play washers are provided, it will be necessary to guide these washers into the bearing housing

at the tone alternator end. If the ball bearings are of the single-shielded type, relubricate them in accordance with Section 163-720-701. Check that the ball bearings rotate without binding.

(14) On reassembly, to facilitate restoring the rotor to the motor-generator shaft, a slight amount of light mineral oil, such as may be applied by putting one drop of oil on a finger and rubbing it on the shaft, should be put on the motor-generator shaft extension. Slip the rotor of the tone alternator on the motor-generator shaft extension. Take care not to damage laminations on the rotor or stator. Tap the rotor on the shaft carefully with a hammer, placing a hard wooden block on the end of the rotor to protect it against the direct blow of the hammer. Tap the rotor back until it rests in the marked position. Tighten the setscrews that secure the rotor to the motor-generator shaft extension. Insure that the rotor rotates freely and restore the tone alternator housing and housing screws.

(b) ***AC Motor-Driven Ringing Machine:*** When replacing a motor-generator shaft ball bearing, it is recommended that both bearings be replaced at the same time. To replace both bearings it will be necessary to remove the motor-generator shaft from the ringing machine from the tone alternator end. Proceed as follows.

(1) Remove the interrupter gears, brushes, gear case, and tone alternator rotor as described in 3.06(a)(1) through (6).

(2) Remove the fan blade from the fan hub, if the machine is equipped with a fan, by removing the two holding screws which secure the fan blade to its hub. Use a screwdriver.

(3) At the tone alternator end of the ringing machine, remove the four screws located behind the commutator cover which hold the end frame to the ringing machine frame. Use the 5/32-inch Allen wrench.

Note: The end frame, similar to the gear case, is located on the ringing machine frame by a rabbet on the end frame which fits on a shoulder of the machine frame and is attached by two alignment pins. If the end frame is not readily removable, it may be freed in the same manner as the gear case.

(4) Carefully work the armatures clear of the pole pieces and remove the motor-generator shaft from the tone alternator end of the ringing machine.

(5) Proceed as in 3.06(9) through (14) to replace the ball bearings and reassemble the ringing machine.

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(c) ***AC and DC Motor-Driven Ringing Machines:*** When replacing a motor-generator shaft ball bearing, it is recommended that both bearings be replaced at the same time. To replace both bearings, it will be necessary to remove the motor-generator shaft from the ringing machine from the gear case end. Proceed as follows.

(1) Remove the interrupter gears as described in 3.03(d) through 3.03(f).

(2) Remove the interrupter camshaft as described in 3.04(d).

(3) Remove the brushes as described in 3.01. Mark each brush in a manner to insure that, when replaced, it will be returned to its original position.

(4) Using the 3/16-inch Allen wrench, remove the two screws located in the gear case to the left and right of the intermediate gears. Using a screwdriver, remove the four screws which secure the gear case to the frame. Two screws are located on the outside of the gear case, adjacent to the louvers. The other two screws are located inside the gear case, to the left and right of the intermediate gears. Remove the gear case.

Note: The gear case is located on the frame by a rabbet on the gear case which fits a shoulder on the frame and is attached to the interrupter support bar by two alignment pins (one in each bar). If the gear case is not readily removable, it may be freed using a block of hard wood and a hammer. Tap the

wooden block lightly, moving it about the rabbet on the gear case between blows.

(5) Remove the tone alternator as described in 3.06(a)(6).

(6) Carefully work the armatures clear of the pole pieces and remove the motor-generator shaft from the gear case end of the ringing machine.

(7) After removing the motor-generator shaft, it should be placed with its shaft on V-grooved blocks, keeping the armatures, collector rings, and commutator clear of all supports.

(8) Remove the end play washers, where provided, from the tone alternator end of the motor-generator shaft.

(9) Remove the ball bearings to be replaced, using the Grip-O-Matic puller.

(10) When installing a new ball bearing, follow the procedure as described in 3.04(a)(4) and (5). If the ball bearings are of the single-shielded type, the shielded side should face the armatures. If the ball bearings are of the double-shielded type, this point need not be checked. Reassemble the ringing machine in reverse order of removal. Where end play washers are provided, it will be necessary on reassembly to guide these washers into the tone alternator end bearing housing. If ball bearings are of the single-shielded type, relubricate the ball bearings in accordance with Section 163-720-701. Reassemble the tone alternator as described in 3.06(a)(14).

Note: When reassembling the gear case to the frame, insure that the interrupter support bar alignment pins engage the associated mating holes of the gear case.

3.07 ***Interrupter Cams (See Fig. 7 and 8)***

▶Tech Systems Company (formerly Electric Specialty Company)◀

(a) To replace an interrupter cam, proceed as follows.

(1) Remove the bearing housing, and ball bearing where provided, as described in 3.04(a), except that the support for the shaft should be placed next to the first cam to be removed. Where the ringing machine is equipped with sleeve bearings, the same procedure as in 3.04(a) may be used to remove the bearing housing. For sleeve bearings, remove the nylon spacer and end play take-up washers after the bearing housing has been removed.

Note: If it is necessary to remove a ball bearing from the camshaft, a new ball bearing shall be installed on reassembly.

(2) Loosen sufficient interrupter cam setscrews to permit removal of cam or cams, using the 5/64-inch Allen wrench. Slide the cams off the shaft.

Note: If cam does not slide off freely, it may be due to a burr on the interrupter shaft resulting from overtightening the interrupter cam setscrew. Gently nudge the cam until it is free. After removal of the cam, file the burr.

(3) When restoring the cams, assemble them on the shaft so that the stamping on the cams faces the gear case end of the ringing machine. After the cams have been restored to the shaft, reassemble in the reverse order. Do not tighten the interrupter cam setscrews until the interrupter support bar is restored. Then align the cams so that the associated cam followers center on each cam, and tighten the cam setscrews, using the torque screwdriver, to 3 to 5 inch-pounds torque.

▶Commercial Electric Products Company (Same design previously manufactured by Holtzer-Cabot Company)◀

Note: Both cam and follower should be replaced when either is worn and requires replacement.

(b) To replace an interrupter cam, proceed as follows.

(1) Remove the bearing housing and ball bearing as described in 3.04(c), except that the shaft should be supported next to the first cam to be removed. Place a sheet

of sturdy cardboard, such as may be found on the back of an 8-3/8 by 11-3/8 inch paper pad, or equivalent, on each side of the camshaft between the interrupter cams and their associated spring pile-ups. Cut the cardboard as required.

(2) Loosen sufficient interrupter cam setscrews to permit removal of the cam or cams, using the 5/64-inch Allen wrench. Remove the cams from the interrupter shaft.

Note: If cam does not slide off freely, it may be due to a burr on the interrupter shaft resulting from overtightening the interrupter cam setscrews. Gently nudge the cam until it is free. After removal of the cam, file the burr.

(3) When restoring the cams to the shaft, assemble them so that the stamping on the cams faces the tone alternator end of the ringing machine. After the cams have been restored to the shaft, reassemble in reverse order of removal. Before tightening the cam setscrews, check that the associated cam follower centers on each cam and tighten the cam setscrews, using the torque screwdriver, to 3 to 5 inch pounds torque.

3.08 ***Interrupter Camshaft (See Fig. 5, 7, and 8):***

▶Tech Systems Company (formerly Electric Specialty Company)◀

(a) ***Ball Bearing Type***

(1) To replace an interrupter camshaft equipped with ball bearings, follow the procedure as described in 3.04(b).

Note: If a camshaft is replaced, it should be provided with new ball bearings.

(2) After installing the camshaft and reassembling the ringing machine, check for lateral camshaft movement. If the end play is found to be greater than 1/16 inch, remove the bearing housing as described in 3.04(a)(2) and (3). Insert a sufficient number of shim washers in the bearing housing to hold the end play between 1/32 and 1/16 inch. After adding the shim washers and restoring the bearing housing, the interrupter cam followers should line up with the cams on the shaft. These shim washers can be ordered through Western Electric Company as follows:

(Quantity) Washer, Shim, 1 Inch X 1-1/4 Inches X 0.0010 Inch, for KS-15532 Ringing Machine.

(b) ***Sleeve Bearing Type:*** To replace an interrupter camshaft equipped with sleeve bearings, proceed as follows.

(1) With the 3/16-inch Allen wrench, remove the four interrupter spring support bar screws (two screws in each bar). Move the spring support bars to provide a clear working area.

(2) With the 5/32-inch Allen wrench, remove the two screws which secure the interrupter shaft bearing housing to the end frame. Remove the bearing housing using a block of hard wood (approximately 1/4 by 1 by 6 inches) and a hammer. Tap the wooden block lightly, moving the block about the periphery of the bearing housing (interrupter cam side) between blows, until the bearing housing is forced off the shaft. Remove the nylon spacer and any end play take-up washers provided.

(3) At the gear case end of the machine, remove the low-speed interrupter gear as described in 3.03(b).

(4) Remove the camshaft from the ringing machine by drawing it out the tone alternator end of the machine. Reassemble in reverse order of removal.

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(c) ***Ball Bearing Type:*** To replace an interrupter camshaft equipped with ball bearings, follow the procedure as described in 3.04(d).

Note: If a camshaft is replaced, it should be provided with new ball bearings.

3.09 ***Interrupter Shaft Conversion Kits.*** A kit for converting a 5/16 inch interrupter shaft to a 1/2 inch stepped interrupter shaft is available for KS-15532 Ringing Machines manufactured by Holtzer-Cabot. Table A gives the conversion kit list number for the appropriate KS-15532 Ringing Machine list number. The conversion kit contains an instruction sheet with the detailed replacement procedure.

TABLE A

CONVERSION KIT LIST NO.	KS-15532 RINGING MACHINE LIST NO.
101	19, 20
102	21, 22, 31
103	23, 24, 32
104	25, 26
105	27, 28
106	29, 30, 33
107	34