

DRIVE EQUIPMENT

The 27 cars covered in these instructions are equipped with complete Spicer drives. Spicer Manufacturing Corporation's model 6-1 with No. 70001-3 gear assembly and 3.44 to 1 gear ratio is used.

The other assemblies used in the complete drive on New York - New Haven and Hartford cars are as follows:

| ASSEMBLY | WHERE USED | SPICER PART NO. | PULLMAN NO. |
|--|-----------------|------------------------|-------------|
| Axle Mounting..... | 6" x 11" Axle | 72052-3X | KE-12917 |
| Torque Arm..... | All Cars | 72041-15X | KE-13307 |
| Torque Arm Mounting..... | All Cars | 72032-1X | KE-13308 |
| Drive Shaft..... (49" compressed) Tubular Type. | All Cars | 7983-2-3F | K 8 |
| Automatic Clutch..... | All Cars | 50009-1 | KE-12911 |
| Automatic Clutch Nut..... | Genemotor Shaft | S-884 (1-1/8" x 12) | KE-13822 |

A general description of the Spicer drive and the component parts is given on the following pages. This general information applies to all post-war styles of Spicer equipment and should be used in conjunction with the tabulation above covering specific types used on these new NY.- NH.- & H Cars.

NOTE: The Safety Arm is not an original installation on NY.- NH. & H cars. Instructions on Safety arms in the following pages, however will apply if later installation is made.

SPICER GEAR DRIVES

The complete Spicer Manufacturing Co. drive consists of the gear unit mounted on car axle, drive shaft and clutch. The Spicer drive was designed for transmission of power from railroad car axle to generator. Several models have been in use for a number of years, and most yards are somewhat familiar with the old Models 3-2, 3-3 and 3-4. The older models are gradually being replaced by Models 6, 6-1 and 6-2, which are also being applied in large numbers to the new postwar lightweight sleeping cars. On all models the first number indicates the general design while the number following the dash indicates a style difference for that particular model. All models are equipped with hypoid gears running in a bath of oil and all bearing and gear adjustments are made at the factory. Figure 1 shows a typical application of the gear unit to car axle and Figures 2 and 3 show a detailed drawing of this application.

The Model 6 drive is a modification of the older Model 3's incorporating an improved quill bearing arrangement and the use of roller bearing at the pinion gear in place of ball bearing. This model has a quill diameter or bore of 7-7/8" which made it possible to mount the gear unit on all axles in use at the time it was designed. However, the wheel seat diameter on 6" x 11" axles was increased to 8-1/4" which was too large to allow mounting of the Model 6 gear unit. Therefore, the Model 6-1 was designed, and it has a quill diameter or bore of 8-9/32" so it can be mounted on the 6" x 11" axle with increased wheel seat diameter. In addition, axle mounting assemblies were designed so that the Model 6-1 can also be used on 5-1/2" x 10" as well as other special size axles. The Model 6-2 is a recently designed unit having the same general characteristics as the 6-1 but adapted to different truck arrangement. From the above it should be noted that the Model 6-1 can be used on any axle to replace a 6, but the Model 6 can only replace the 6-1 on an axle with wheel seat of 7-3/4" or less; the Model 6-2 cannot replace the 6 or 6-1 or vice versa. The model number on each unit can be found at the location indicated on Figure 14.

The preceding paragraph deals with the interchange of gear units on axles as this applies when mounting in the shop. The interchangeability of the complete mounted units will affect all yards where wheel exchanges are made and must be carefully watched. Most important is that all models come in several gear ratios; the four most commonly used are 2.54, 3.09, 3.44 and 3.76 to 1. Gear ratio of each unit is plainly marked on the inspection cover at the top of the unit as shown in Figure 14. Whenever it becomes necessary to remove this cover, it must be replaced on the same unit from which it was taken. The gear ratio on original drive for each car has been determined for the particular type generator used, and therefore only gear units of proper ratio should be used so that correct generator speed is obtained. Torque and safety arms used must always be the same style as original equipment because of the truck dimensions.

The major units making up a Spicer drive are explained in the following paragraphs covering maintenance of the various parts.

GEAR UNIT ASSEMBLY. To install the gear unit, one wheel is pressed on axle, axle is inserted in quill, the second wheel is pressed on, and unit is then secured to axle by means of axle mounting assembly. When the gear unit is centered equal distance from both wheels, the center line of pinion gear will actually be 11/16" closer to one wheel, as the pinion assembly is not located in the exact center of gear box assembly. Gear units are usually shipped less oil, and local arrangements must be set up to be sure oil is placed in unit before it is placed in service. Local arrangements should also be set up to exchange the oil in gear unit at each wheel turning.

Proper lubrication of the gear unit is extremely important. A bayonet type oil gauge, located at right-hand side of unit near the safety arm, is used on all units to measure the oil level. The oil gauge has one marking "FULL", as shown in Figure 4. Add only Catalog No. K-12141 gear oil if level as shown on gauge is 1/4" or more below "FULL" mark on gauge. Oil is added through filler opening just below gauge, and the total capacity of unit is 7 quarts. **CAUTION.** Do not overfill! A drain plug in bottom of unit is provided to drain out oil. This drain plug is wired to gear case and the wire must be replaced whenever drain plug is re-applied so that plug will not come out.

An air breather is located on top left side of gear unit, and its function is to prevent excessive pressure being built up inside the unit. The breather must be kept clean at all times, as excessive pressure in the gear unit will cause oil leaks at the pinion flange seal or quill flange seals.

AXLE MOUNTING ASSEMBLY. The axle mounting assembly consists of two tapered rubber bushings (halves), split clamp housing, and split compression ring for each end of gear unit. These mounting assemblies are made in three standard sizes: 5" x 9", 5-1/2" x 10" and 6" x 11", also several special sizes. These sizes are plainly marked on each assembly, and can be used only with axles of corresponding sizes. In each assembly are six bolts 3/4" - 16 x 2-1/8", Catalog No. KE-11621, hexhead cap screws 3/4" - 16 x 2", Catalog No. KE-11622, and two bolts 1" x 6-1/8", Catalog No. KE-11616, with nuts Catalog No. KE-11617. These bolts with nuts, cap screws, lock washers and cotters are the same on all mountings. Figure 5 shows the detail.

Figure 1

Reproduced West Islip Schools - 32
EXHIBITION DRIVE WITH CUTAWAY SECTIONS

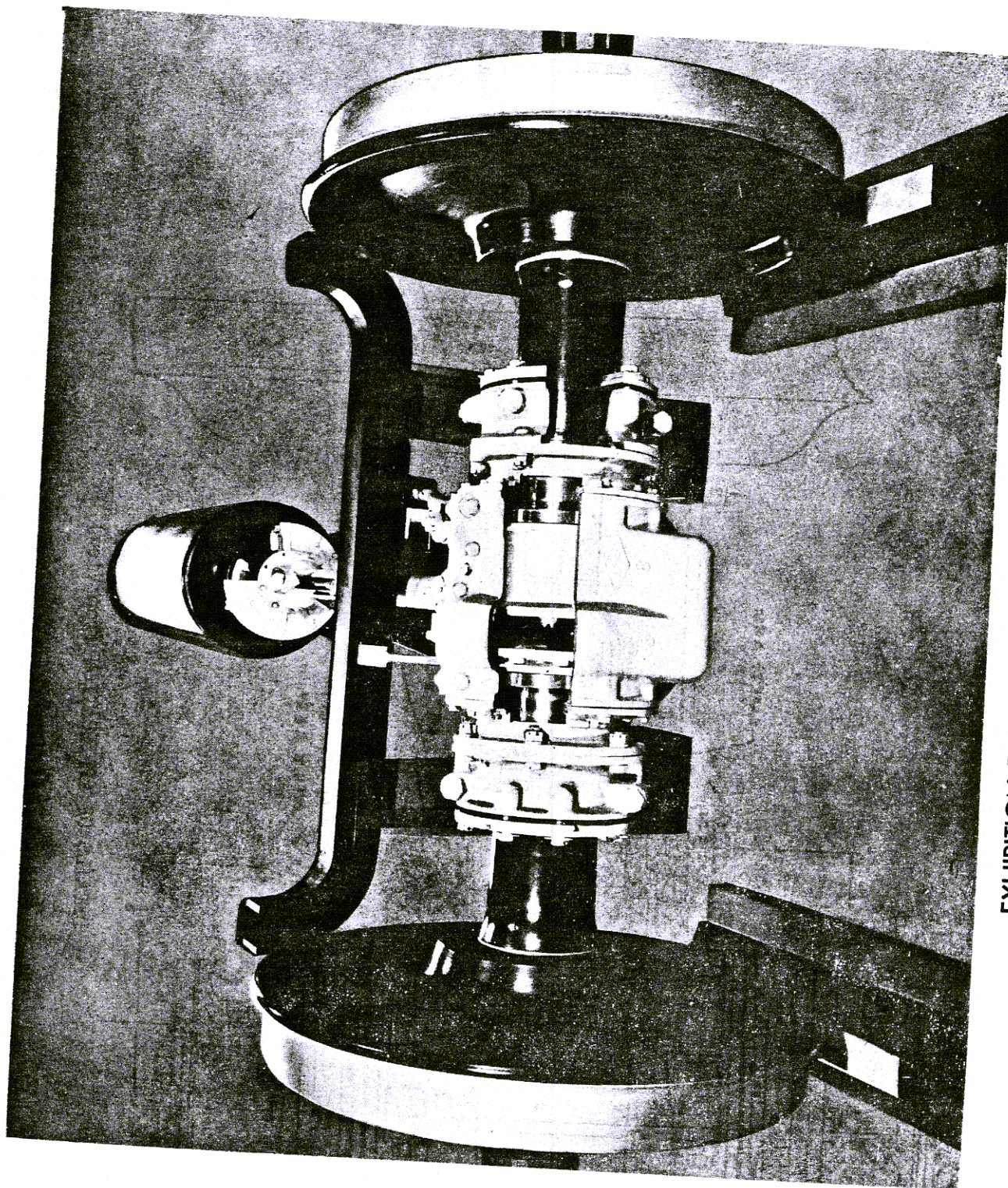
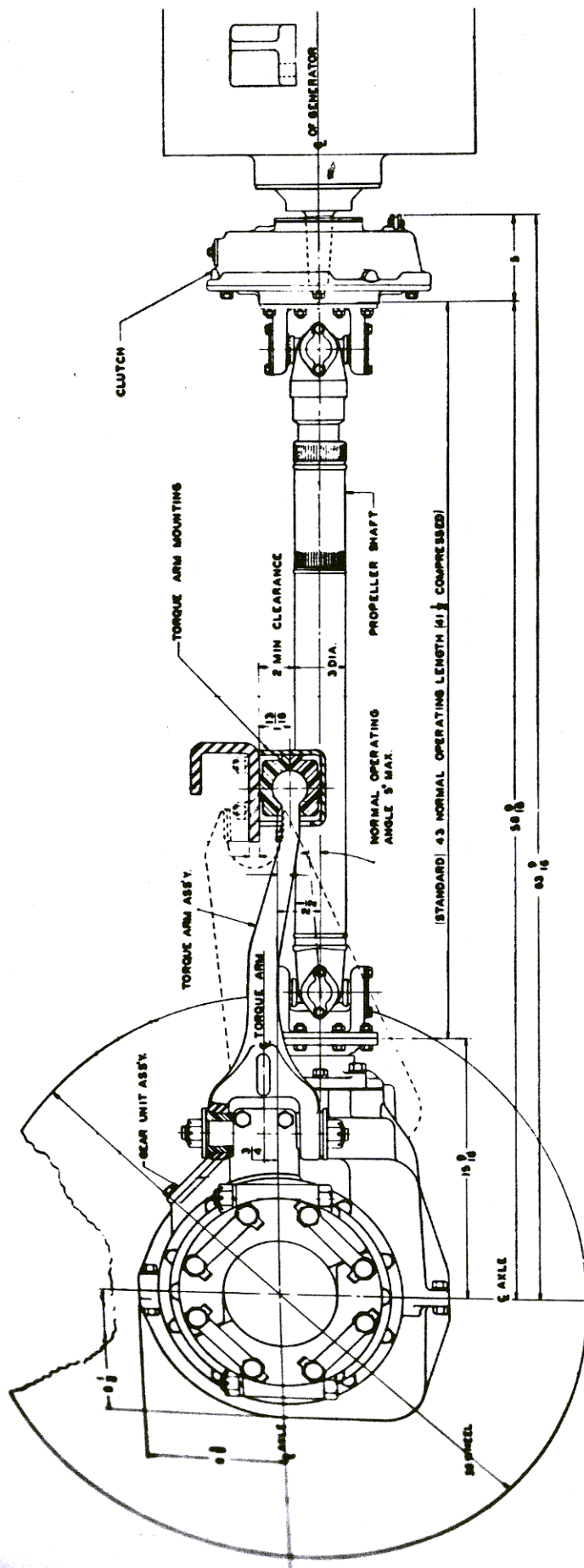




Figure 2

DETAILS OF APPLICATION (Top View)



TYPICAL INSTALLATION COMPLETE SPICER DRIVE—MODEL 6 AND 6-1

DETAIL OF APPLICATION (Side View)

Figure 3

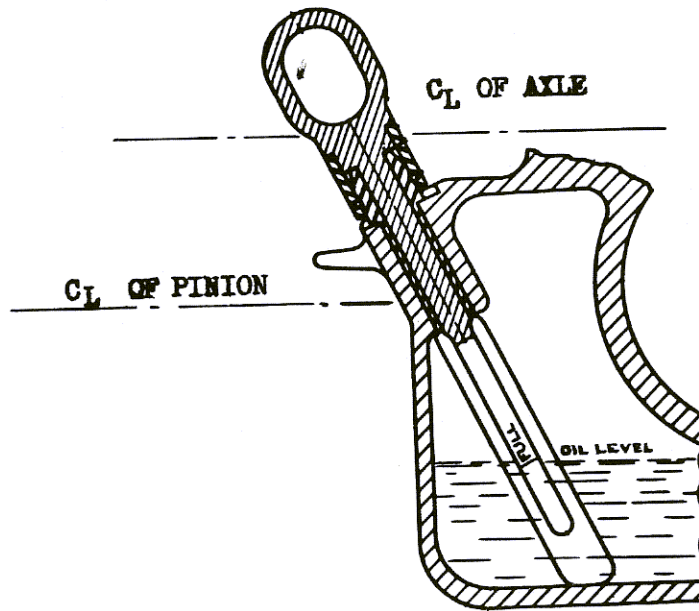
APPLICATION OF THE AXLE MOUNTING ASSEMBLY

1. Check size of axle requiring new mountings and select mounting units having proper size stamped on compression rings and clamps as shown in Figure 5.
2. Dis-assemble the two axle mounting units. (The clamp halves are mated having the same mating number stamped on each half and only halves marked with the same number should be used together.
3. Fasten the two halves of the clamp to quill flange loosely with $3/4"$ - $16 \times 2 \frac{1}{8}"$ bolts and nuts provided. Next, apply the $1" \times 6 \frac{1}{8}"$ bolts and nuts to clamp and pull up tight. Then tighten the quill flange bolts. All bolts are provided with lock washers and cotter pins. (Before making application of clamps, clean the machined surface on both clamp and quill flange).
4. Apply other clamp to opposite end of quill in same manner described in operation No. 3 above.
5. Insert rubber halves in the clamps at both ends of quill. (The rubber halves are factory selected for size; mated and marked; only halves marked with the same number are to be used together in same clamp. The rubbers are marked from 1 to 12 according to thickness variation, the lowest numbers indicating the thinnest rubber.).
6. Center the gear unit on the axle in relation to the wheels, using special gauge and expanding bolts shown in Figure 6. Tolerance is $1/4"$ either way. Expanding bolts must be placed in position to block gear unit against both wheels so that unit cannot shift off center when remaining parts are applied. See Figure 7.
7. Force the rubbers into the clamps and keep both halves of the rubber the same distance from clamp. If there is any space at the meeting edges of the rubbers between the two halves, this space should be filled with leather shims. See Figure 5.
8. Apply compression rings, lock plates and cap screws. See Figures 2 and 3. (It is important that overlapping joints of compression rings be staggered in order not to come over joints in clamps). Tighten two opposite bolts on compression rings at each end of unit. All bolts on one end should be drawn up a few turns and then repeat operation on other end. Continue this by alternately tightening both ends using torque wrench. Tightening up too much on one end will pull unit off center, even though the unit is blocked between the wheels. When average of 60 ft. lbs. per screw is reached, a check should be made through inspection hole to see if rubber has bottomed. If rubber has not bottomed a thinner set of rubbers will have to be used.
9. Check for concentricity. Place blocks under journal boxes so wheels can be rotated, see Figure 8. Hold gear unit stationary and place dial indicators against quill bearing retainer at location on Figure 8. Rotate the axle and check total run-out on indicators at D & E. See Figure 9. The total run-out must not exceed .015" at either end and this can be controlled by the final tightening of compression screws. At points where highest run-out shows on the indicator, the screws directly opposite require the most tightening. All screws are to be tightened until a wrench torque of 90 to 120 ft. lbs. is reached.
10. Check clearance between the compression ring and clamp. It is very important that this is never less than $1/64"$ at any point as rubbers will wear quickly if set under compression. See Figure 5. Dimension "C".
11. Lock the compression screw plates and see that all screws, nuts, lock washers and cotter pins are in place.

REPLACING RUBBERS IN AXLE MOUNTING

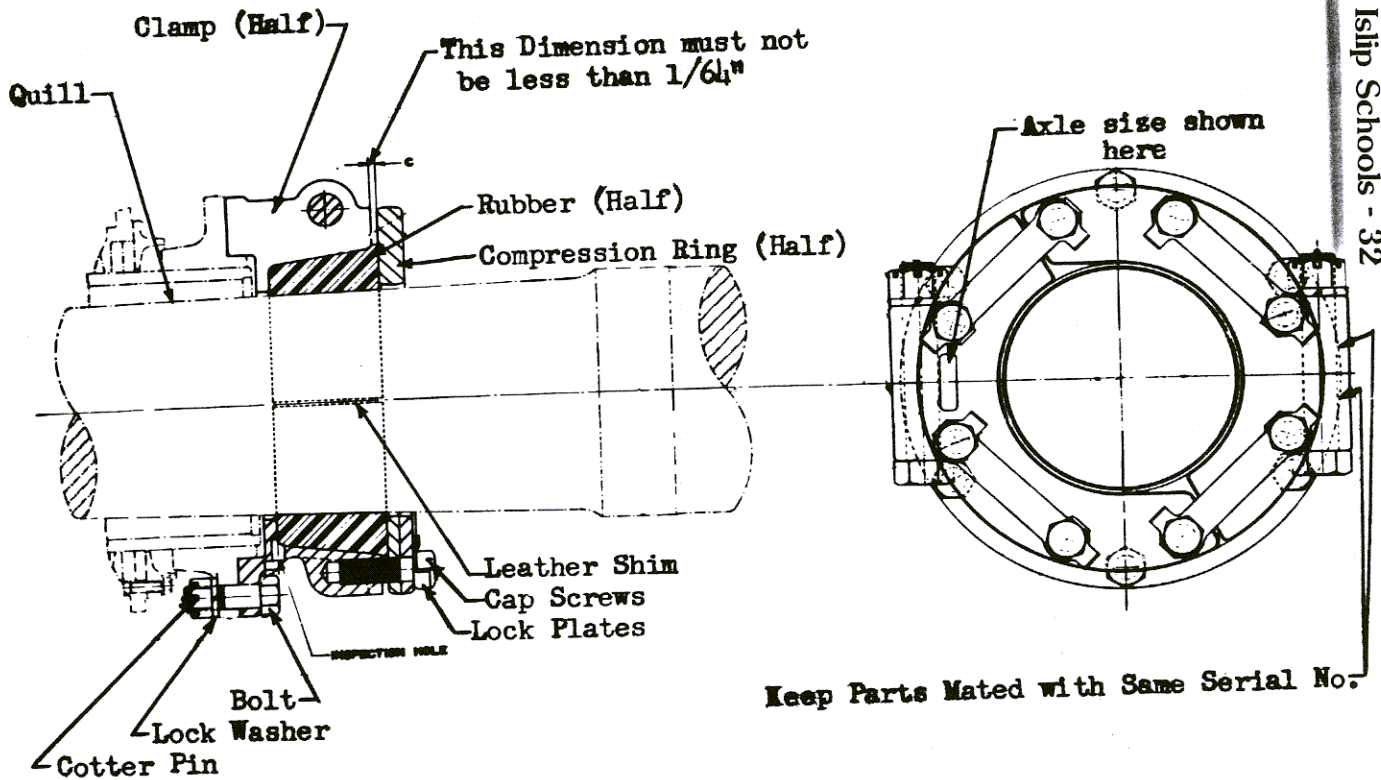
1. Place block under gear unit to support the weight.
2. Release lock plates and remove compression ring cap screws using $1 \frac{1}{8}"$ socket with ratchet wrench.
3. Remove two clamp bolts using $1 \frac{7}{16}"$ socket with ratchet wrench and $1 \frac{1}{2}"$ open end wrench.
4. Remove quill flange bolts using $1 \frac{1}{8}"$ open end wrench. The mounting will now come apart and old rubbers can be removed.

The same operation applies on each end of gear unit. Check number marked on old rubbers and obtain new rubbers from stock as close to this number as possible. Then follow operations Nos. 3 through 11 outlined under "Application of the Axle Mounting Assembly" to complete the assembly.



OIL LEVEL GAUGE

Figure 4



AXLE MOUNTING ASSEMBLY

Figure 5

GAUGE FOR CENTERING SPICER GEAR UNITS ON AXLE

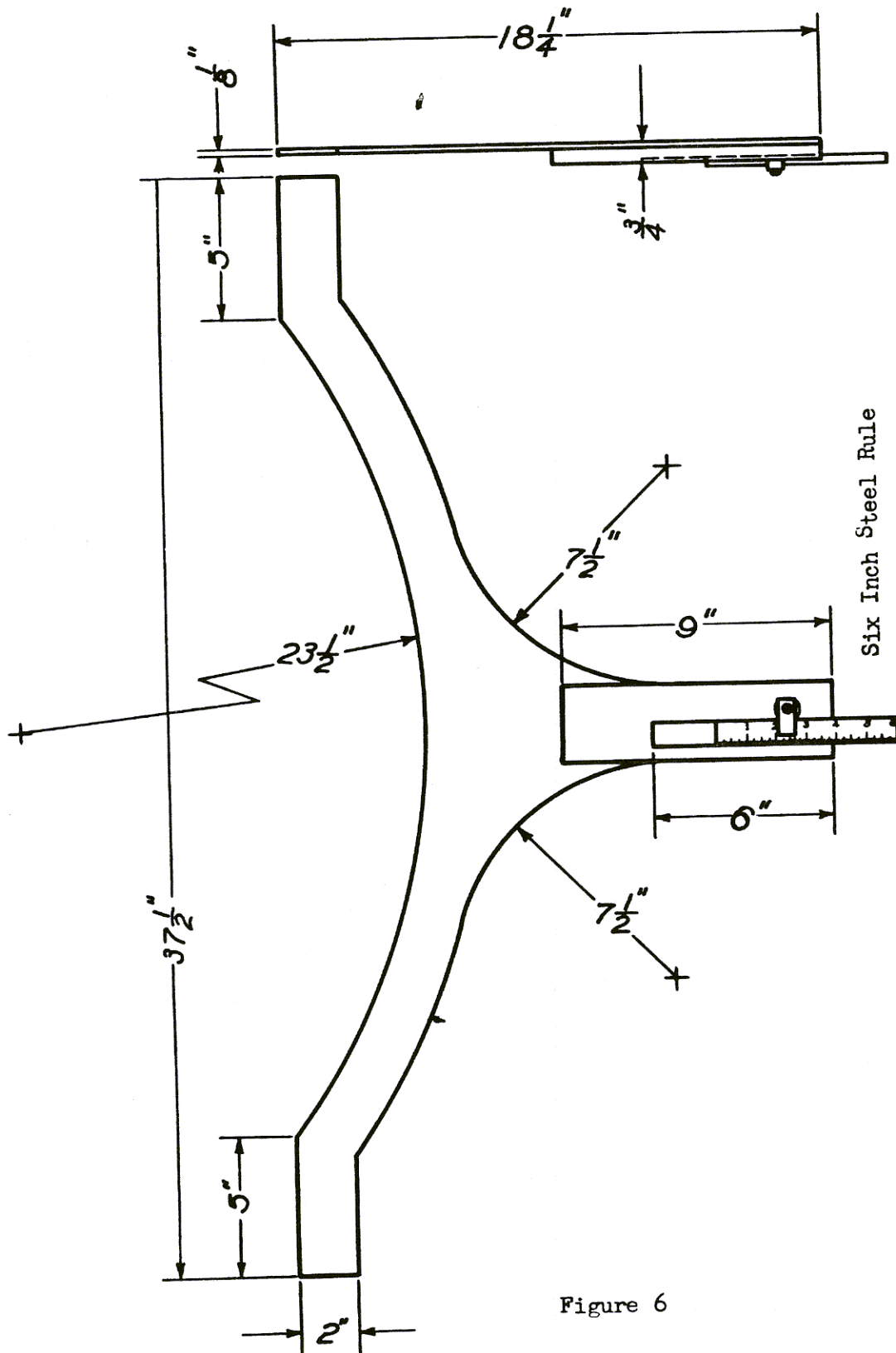
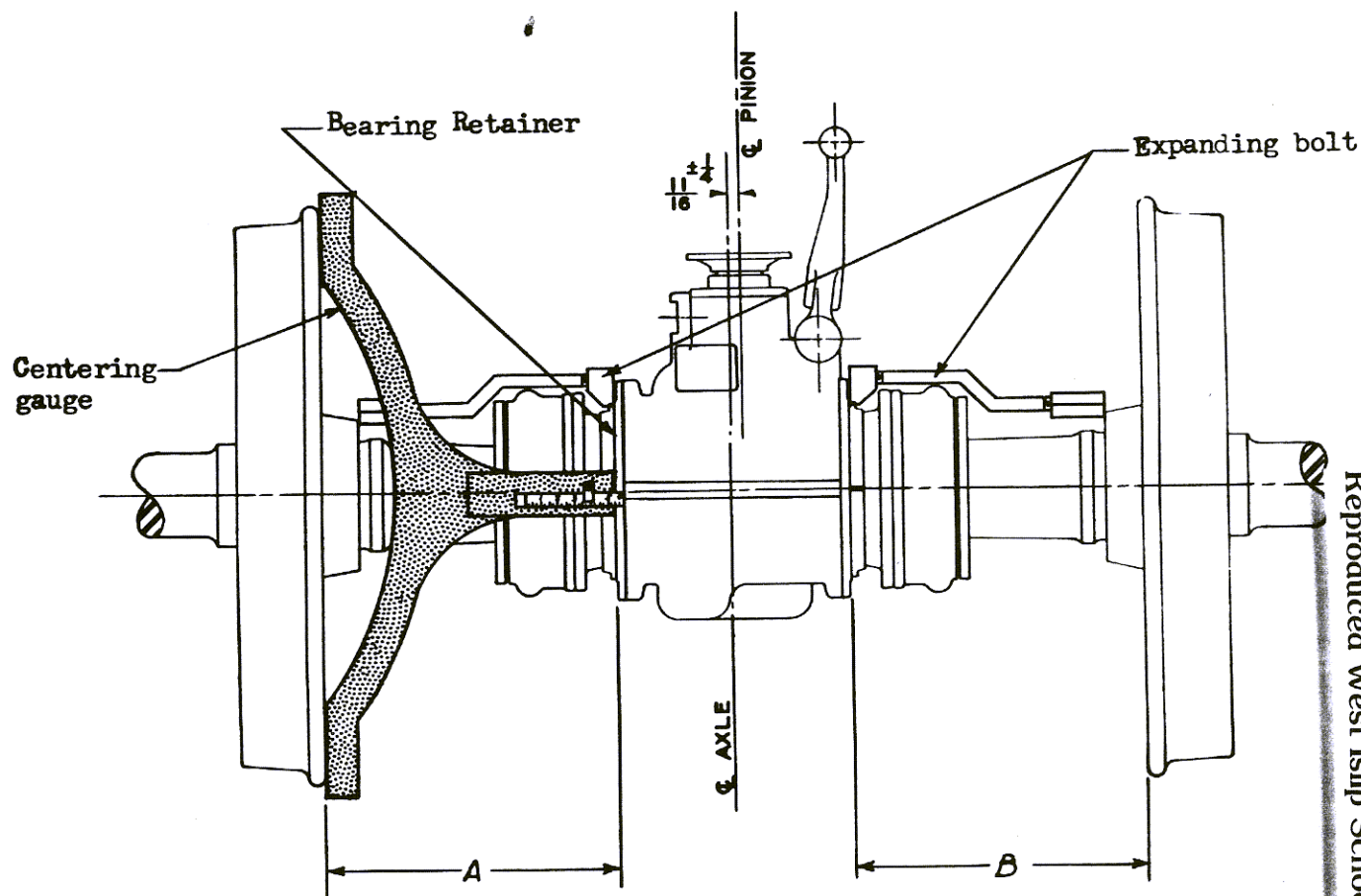


Figure 6

CENTERING TOOLS, SPICER DRIVE



Dimensions A and B should not differ more than $1/4$ inch.

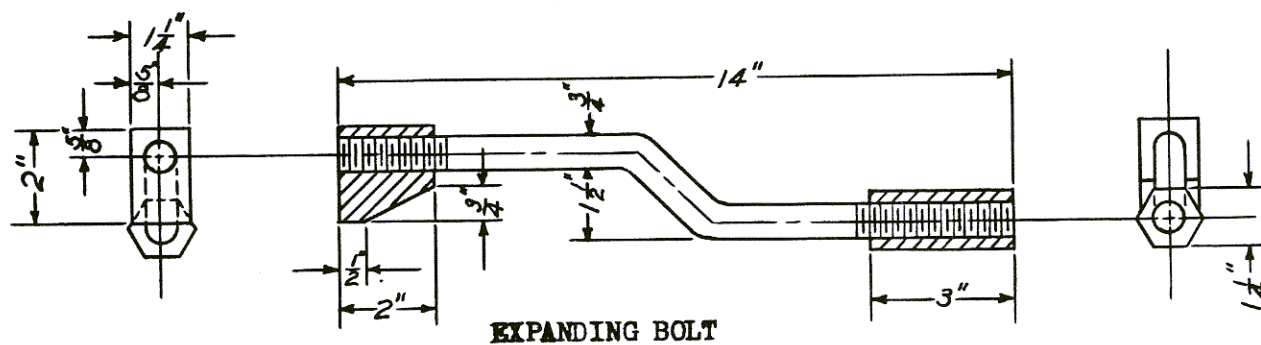


Figure 7
CENTERING GEAR CASE ON AXLE

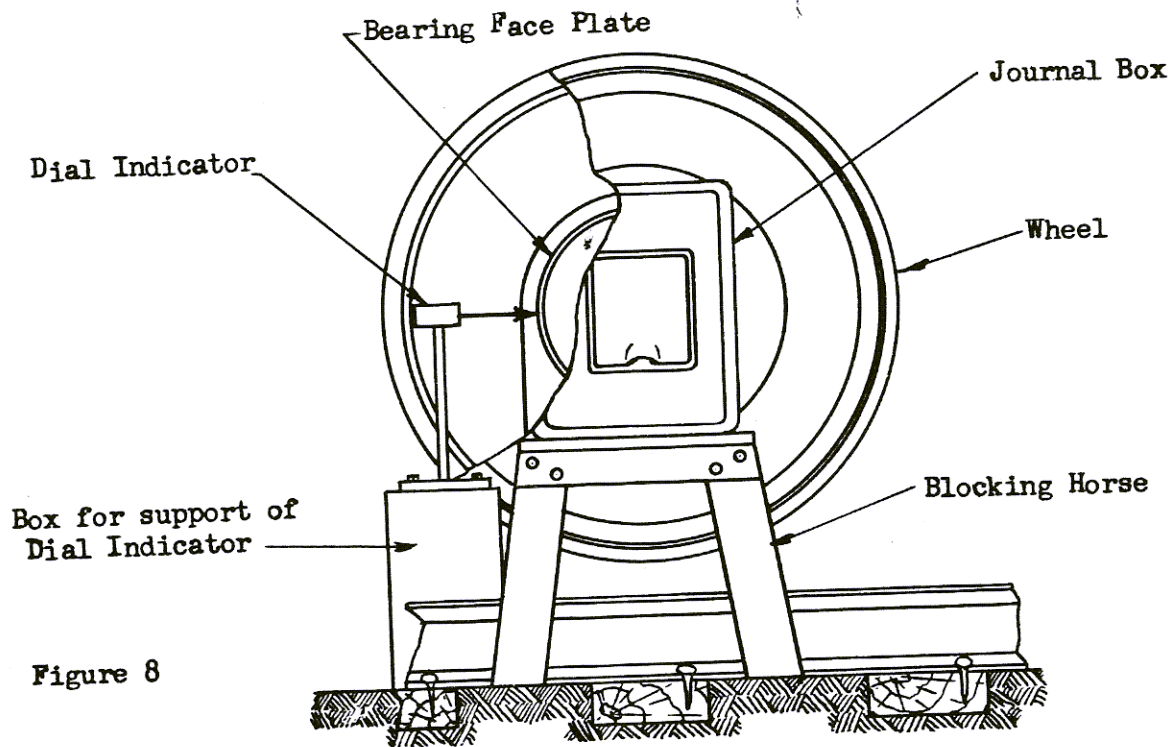
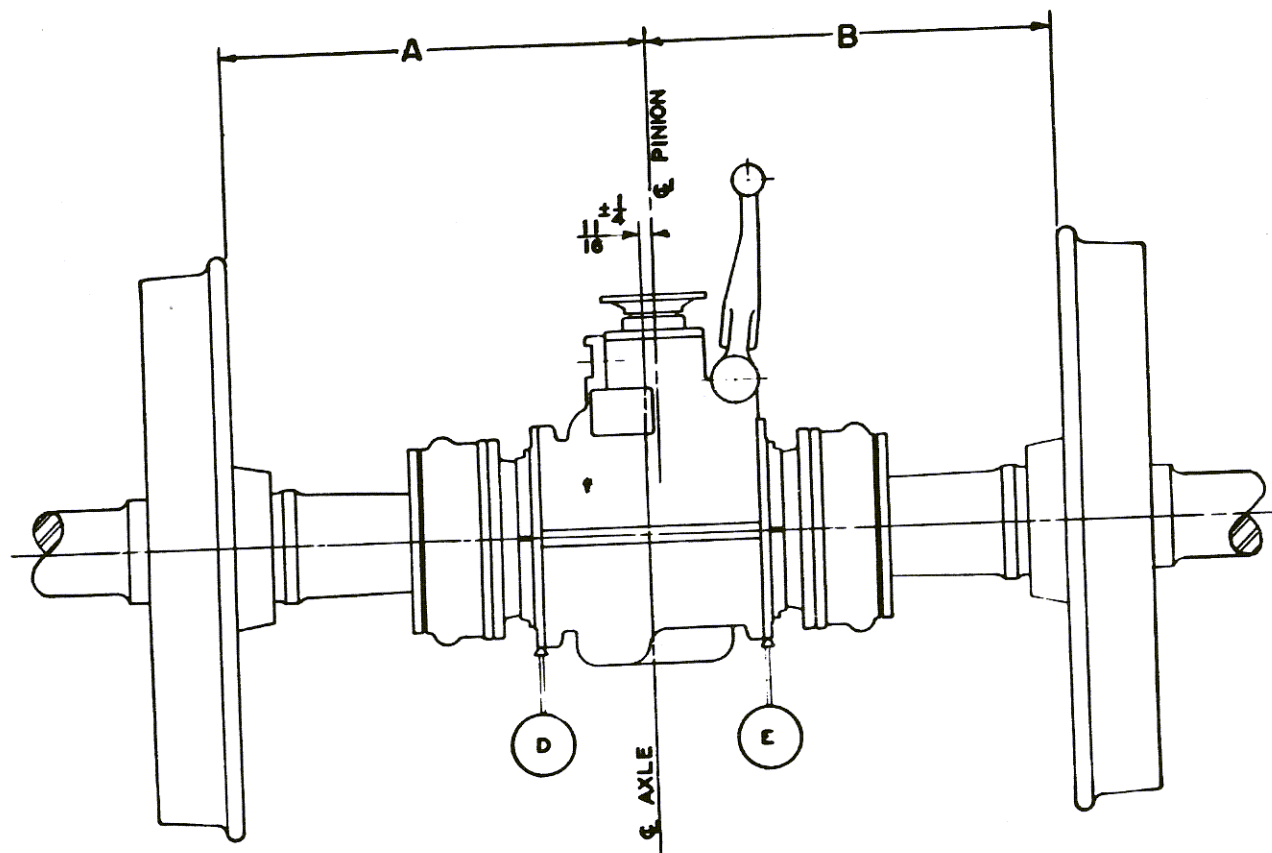


Figure 8



CONCENTRICITY TEST - SPICER DRIVE

Figure 9

REPLACING QUILL OIL SEAL:

1. Remove 1/2" cap screws in quill retainer. The quill retainer is in two halves with five cap screws in each half. See Figure 10.
2. Removing quill retainers exposes felt seal, which can be pulled out. Felt seal is in two pieces, each piece completely around the quill, with the ends fastened together by staples.
3. Soak new felts in light oil, and drain off surplus.
4. Wrap inner felt completely around quill, forcing in position, and trim to proper length. Fasten ends with staples, and keep the ends near top side of gear unit.
5. Assemble outer felt in same manner as for inner felt, but stagger the ends from those on inner felt.
6. Re-apply quill retainers and cap screws for same.

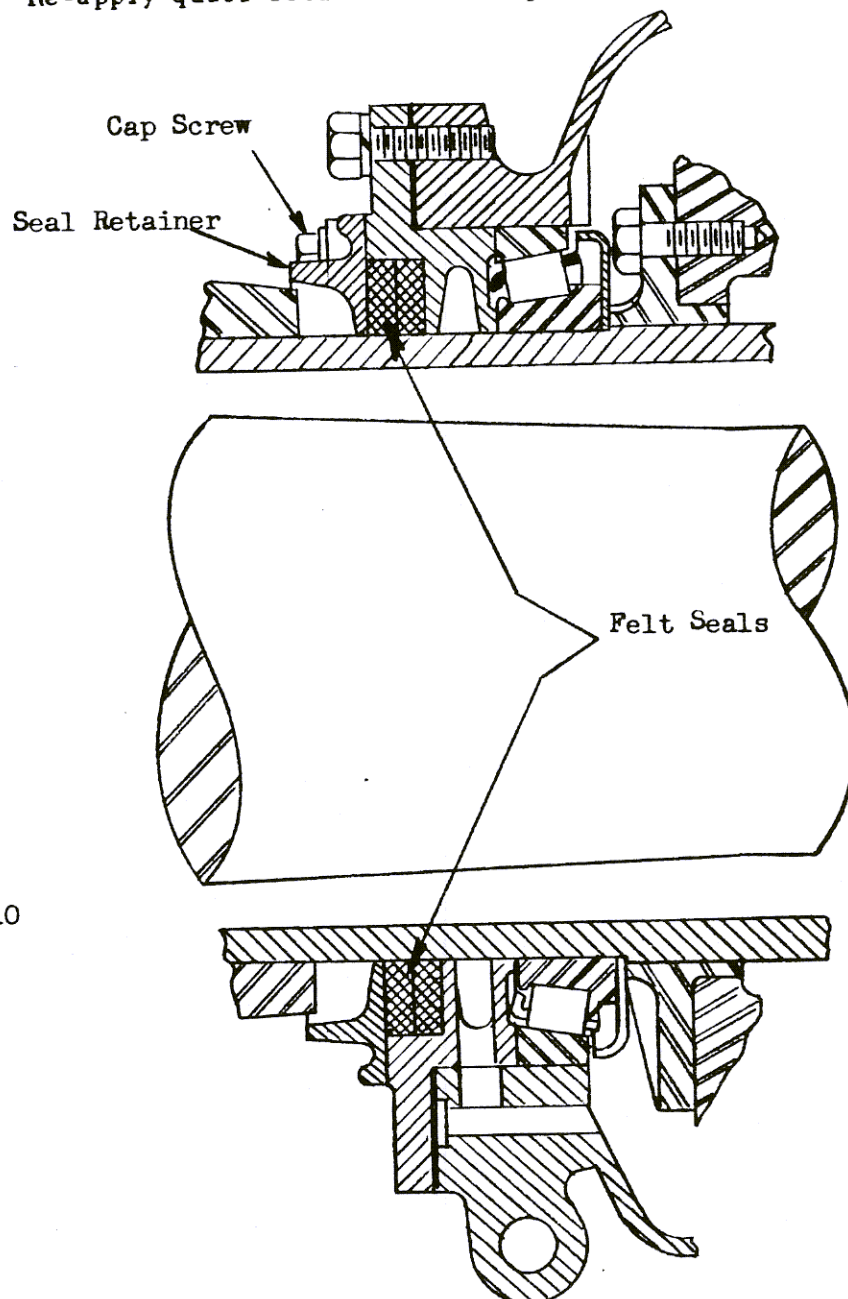


Figure 10

SPICER GEAR UNIT QUILL SEAL

REPLACING THE PINION OIL SEAL:

1. Disconnect drive shaft.
2. Remove pinion flange cotter key and nut using 2-1/8" socket and ratchet wrench.
3. Remove pinion flange with puller, shown in Figure 12.
4. Remove pinion bearing cap screws using 3/4" box or socket wrench.
5. Remove bearing cap and pry out old seal and gasket which is in bearing cap.
6. Apply new gasket in back of seal and then press in the new seal so that sealing edge is facing inward toward the bearing.
7. Apply new bearing cap gasket and apply bearing cap to gear unit.
8. Apply pinion flange with pusher tool shown in Figure 13.
9. Apply pinion flange nut and cotter.
10. Re-connect drive shaft.

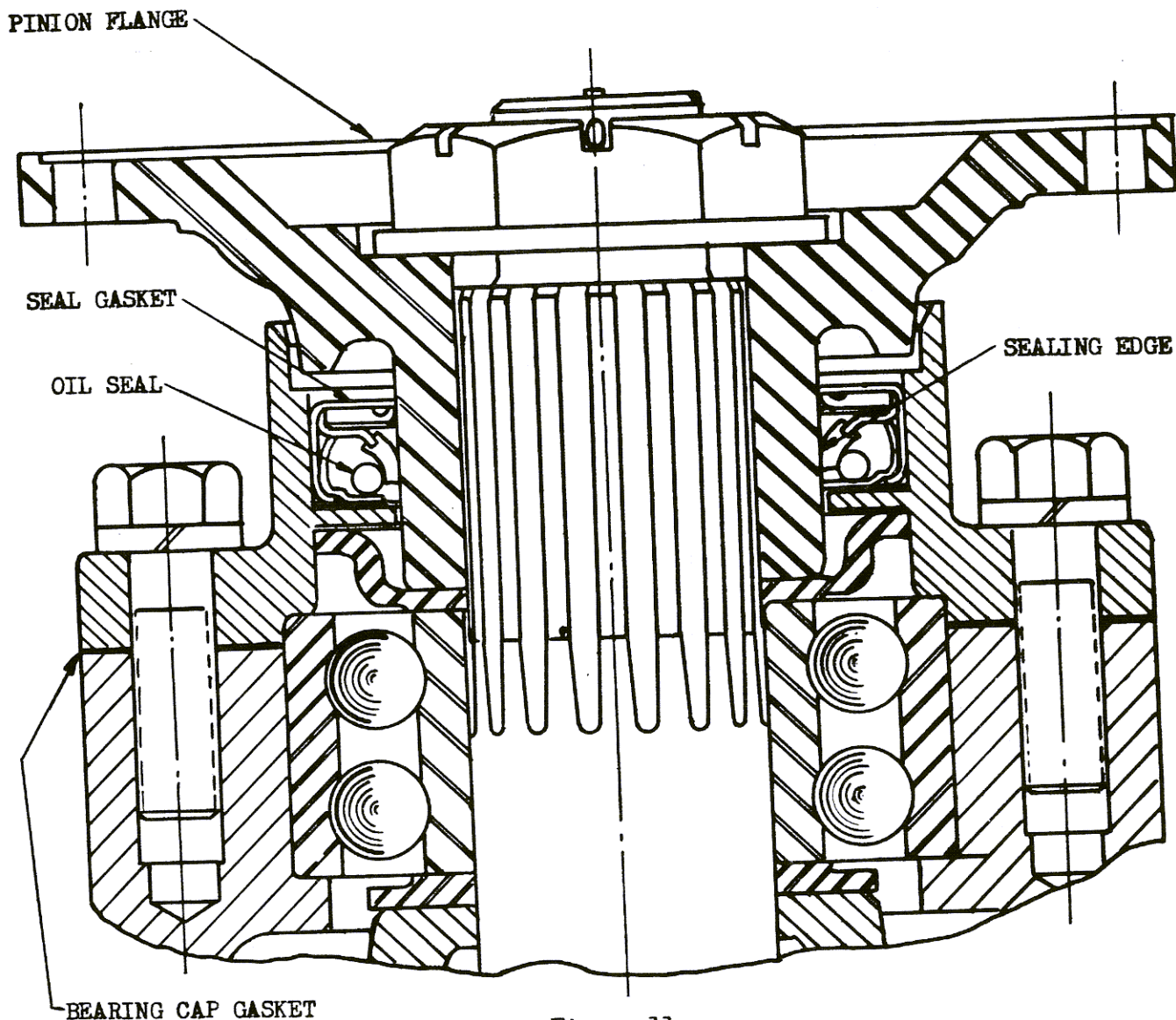


Figure 11

PINION ASSEMBLY

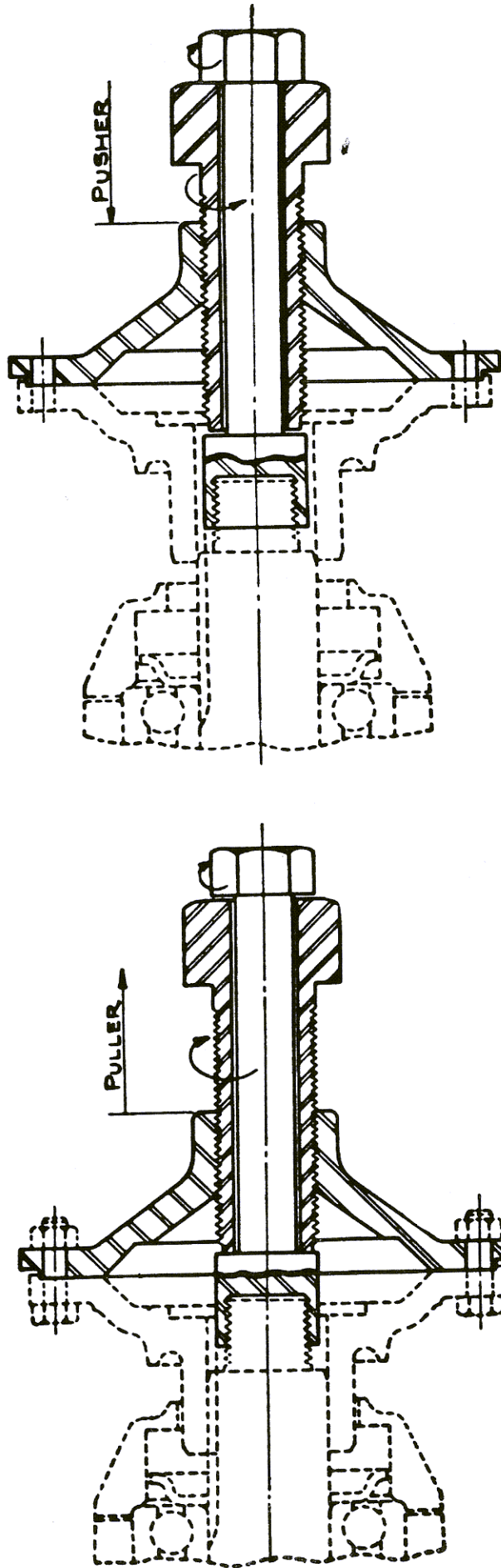


Figure 12

COMPANION FLANGE PULLER AND PUSHER

Figure 13

The COMPANION FLANGE PULLER AND PUSHER is used to remove and replace the companion flange on the gear unit and should always be used to remove or replace the companion flange. Never attempt to drive the flange on or off as this is likely to damage the gears or bearings.

To use as a puller, first remove the pinion cotter, nut and washer, then screw the inner nut of the puller on

to the threaded end of the pinion as far as it will go. Turn the puller flange until it mates with the holes in the companion flange and fasten the two together with bolts. Now turn the large screw clockwise. When replacing the flange, first align the splines with those on the pinion then turn the large screw counter-clockwise forcing the flange on to the pinion. Apply washer and nut, pull down tight and lock with cotter.

REPLACING PINION BEARING: Whenever a Spicer Gear Drive is removed from a car for wheel turning, the gear case must be thoroughly cleaned out with flushing oil, Catalog No. K-13077. Drainings will be carefully screened with a mesh screen of No. 16 or finer to detect metallic particles. If any are found, the inspection plate, which is secured with 4 cap screws, should be removed after first cleaning the adjacent area of any loose dirt. The ring and pinion gears should then be inspected as closely as possible to determine their condition. If a defect such as a broken tooth or an uneven wearing of the teeth is found, the unit must be returned to the manufacturer for repairs. Should this inspection reveal no apparent defect, it will be necessary to remove the pinion assemblage, proceeding as follows: (See Figure 14)

1. REMOVE cap screws on pinion half of gear case and LOOSEN these cap screws on the rear half of the gear case. Also remove 9 housing bolts.
2. Lift off the entire pinion half of the drive. (This can be accomplished by utilizing a Yale 'Pul-Lift'.
3. Remove the pinion flange and press out the pinion shaft from the case. The roller bearing inner raceway and rollers will come out with the shaft, but the outer raceway of the roller bearing must be removed from the gear case with a puller shown in Figure 15.
4. Should the roller bearing be defective, apply a new bearing and install the pinion shaft into the assemblage and apply to gear case.
5. Re-assemble the gear drive. CAUTION. Care must be exercised to prevent bending or distortion of the gear case shims. These shims determine the proper fit of the large tapered roller bearings on the quill.
6. On drives that have had the pinion roller bearing replaced, the letter 'B' at least 1/4" high will be stamped adjacent to the serial number on plate for permanent identification.

Whenever a bearing is installed, this office must be advised of car name, date, drive serial number and wheel numbers.

It must be understood that no drive is to be taken apart until a representative from this office goes over this matter with your Foreman personally and, therefore, if any foreign matter, as described above, is found after flushing, this office is to be notified immediately.

TORQUE ARM ASSEMBLY. The main part of the torque arm assembly, shown in Figure 16 is the torque arm which takes the torque reaction of the gears. One end of torque arm is attached to gear housing by two tapered rubber bushings. Catalog No. KE-12555, which absorb shocks, vibrations and all movement by the flexing of the rubber. Torque arms are furnished in several lengths and types of bends to suit the location of truck end sill. All other parts of torque arm assemblies are interchangeable.

TORQUE ARM MOUNTING ASSEMBLY. The torque arm mounting assembly attaches the ball end of the torque arm to the truck end sill. The ball is surrounded by two rubber blocks, Catalog No. KE-12554, which are enclosed in metal housing which bolts to end sill. See Figure 17. In the standard flex type of mounting all movement, shock and vibration are absorbed by the rubber. Various special slide type mountings are used where extra movement is required. See Figure 17. This horizontal movement is taken by sliding action on manganese steel plates. The rubber blocks are interchangeable between the standard and special types, but the other parts are not.

The condition of the torque arm rubber blocks can be checked by noting the position of the safety arm. The end of the safety arm which is located in the truck end sill should be normally at center vertically. If there is any indication that the safety arm is striking the end sill either on the top or bottom, the rubber blocks on the torque arm should be renewed.

REPLACING THE TORQUE ARM.

1. Remove the bolts which fasten torque arm mounting assembly to truck end sill and remove assembly from ball end of torque arm. See Figure 2.
2. Remove the nut and washer from top of torque arm pin at gear unit and lift out the tapered rubber bushing. See Figure 16.

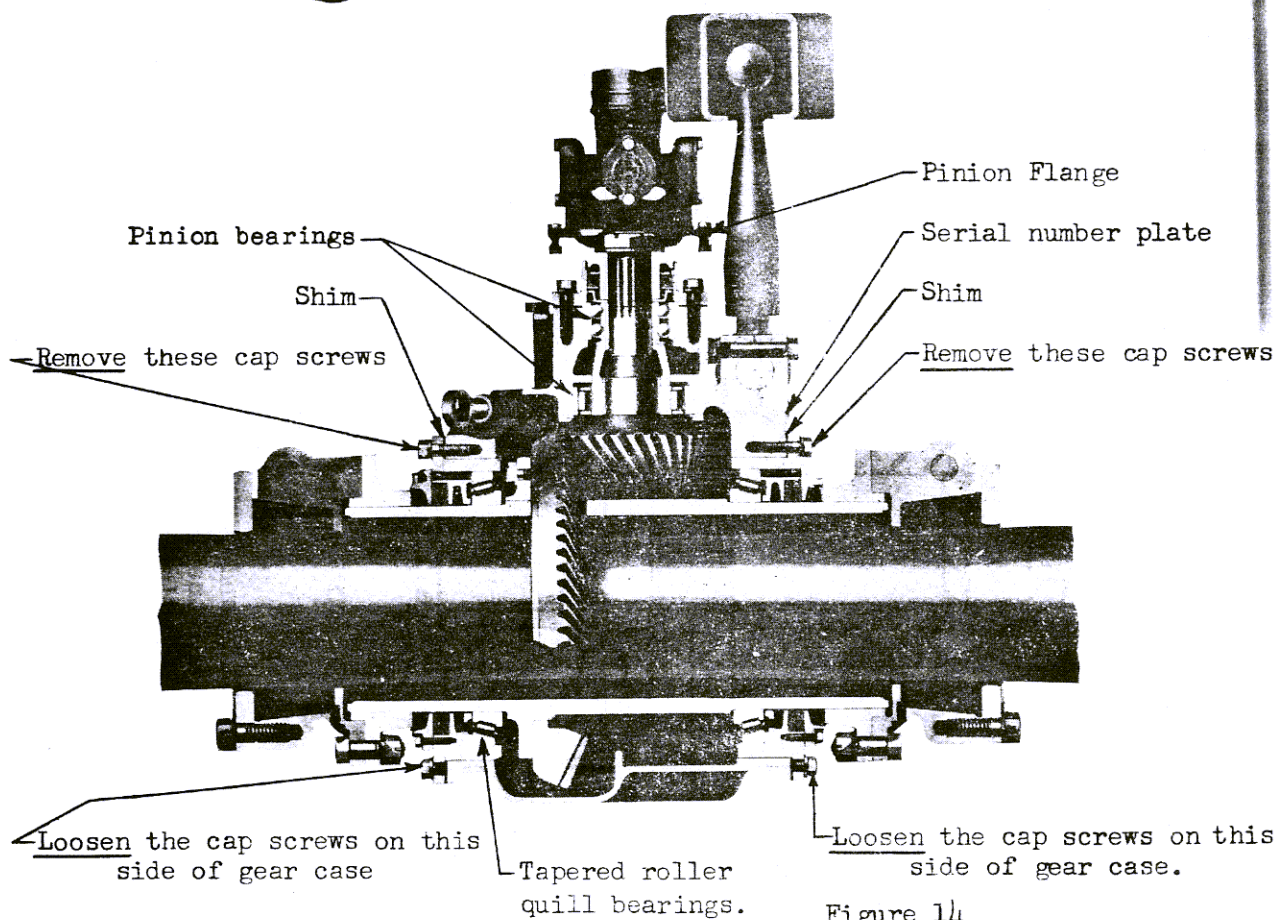
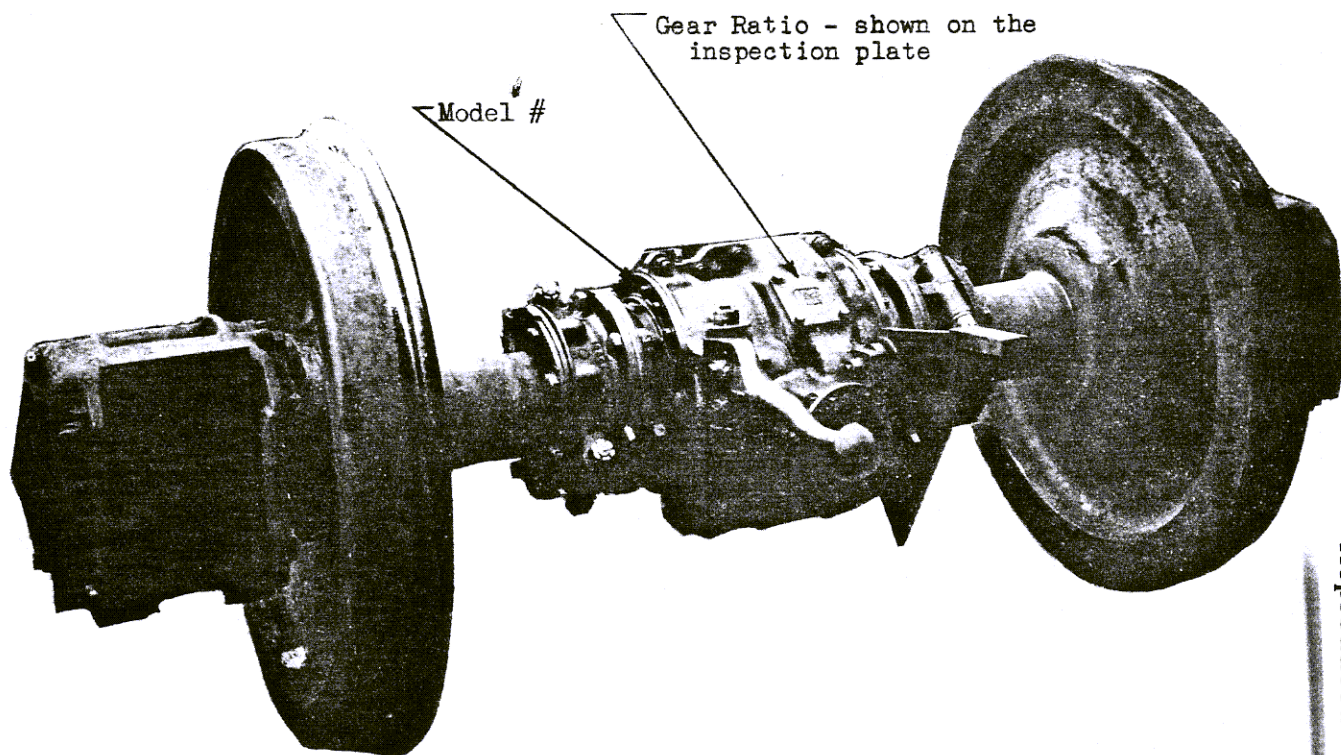


Figure 14

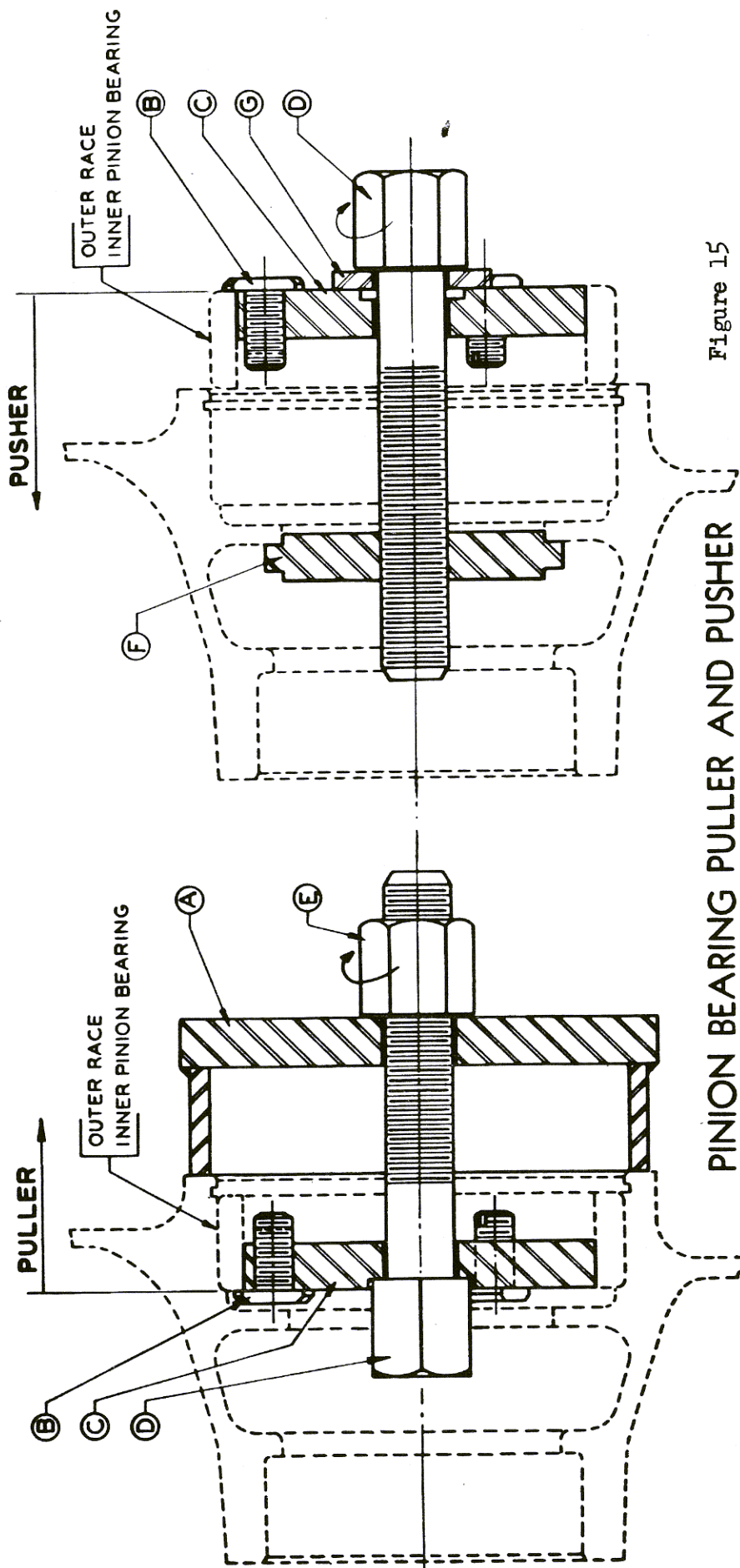


Figure 15

PINION BEARING PULLER AND PUSHER

This PINION BEARING PULLER and PUSHER is used to remove and replace the outer race of the inner pinion bearing on the gear unit. To use as a puller for removing the outer race, turn the three T head screws B so that they clear the bore of the race and insert plate C into position shown. Now turn the T head screws B with a screw driver so that the tangs on all three screws are squarely in the recess back of the race. Insert screw D, plate A and nut E clockwise forcing the race out of the housing. To use as a

pusher for replacing the race, first start the race into the housing by lightly tapping it. Now insert plate C with the tangs against the outer edge of the race and put plate F inside as shown, then insert screw D through hardened washer F and screw into plate F. Turn screw D clockwise forcing the race into the housing until it is firmly seated against the shoulder.

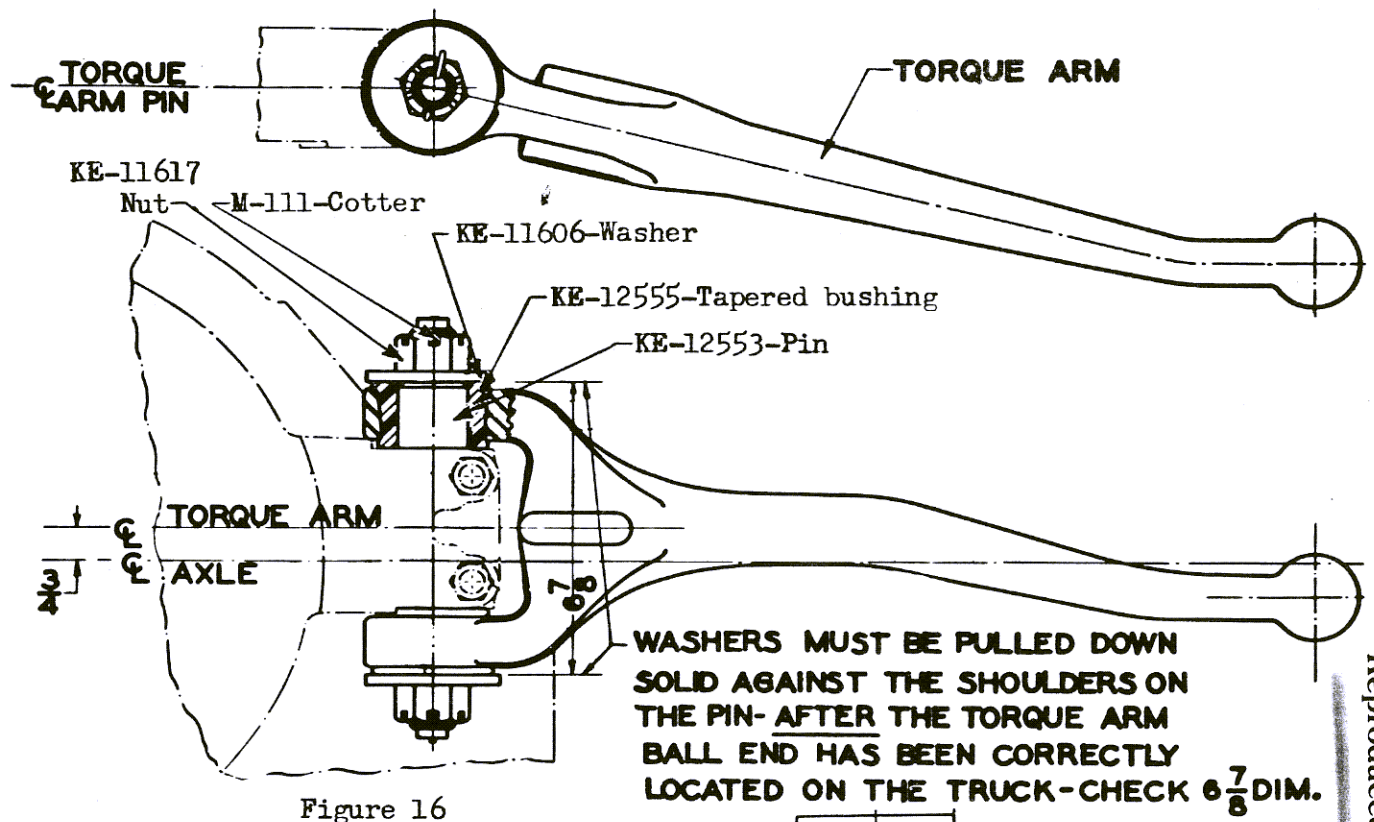


Figure 16

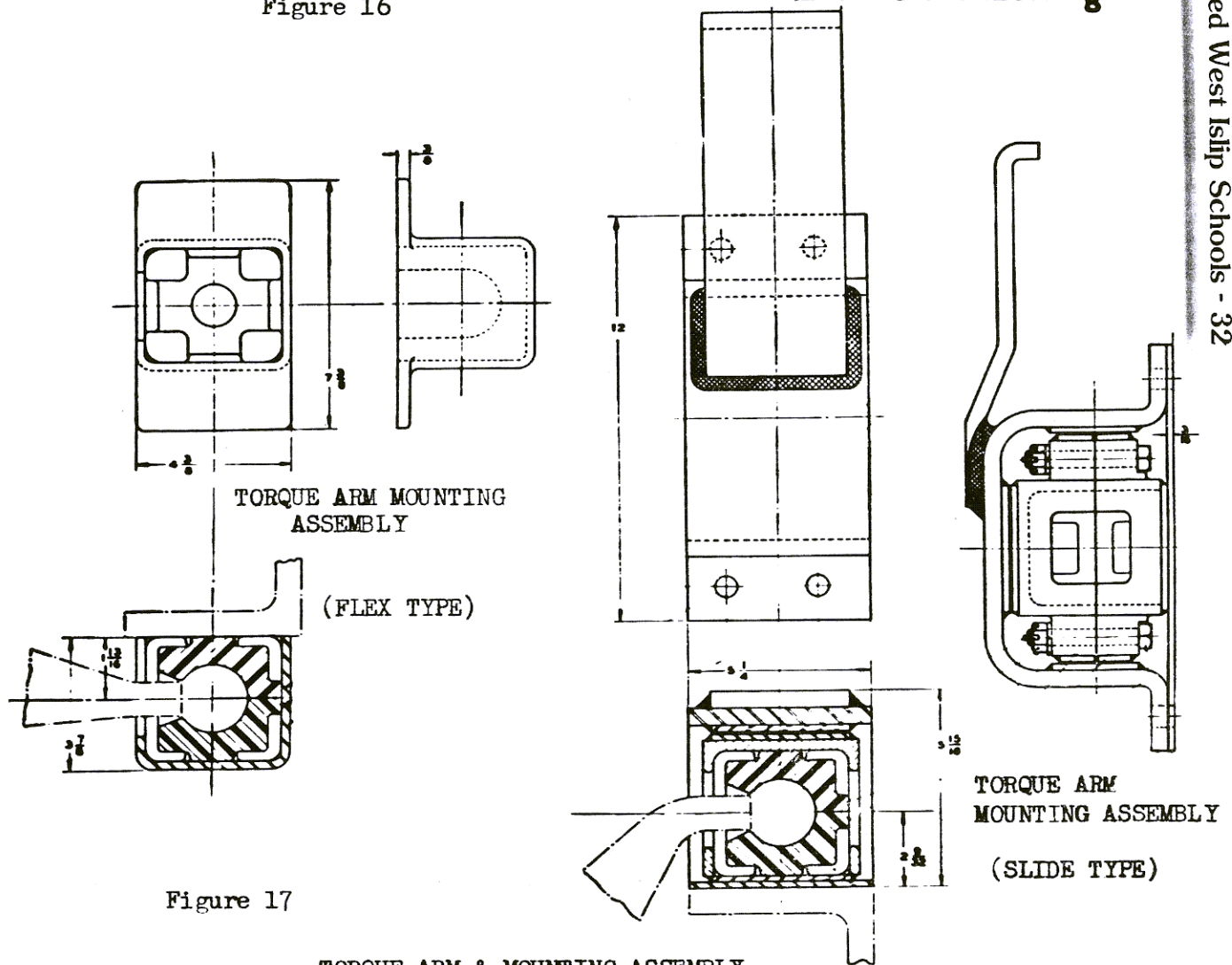


Figure 17

TORQUE ARM & MOUNTING ASSEMBLY

3. Remove nut and washer from bottom of torque arm pin at gear unit and lift out the tapered rubber bushing.
4. Loosen two 1/2" bolts which hold torque arm pin in clamp.
5. Remove torque arm pin from clamp and lift off torque arm.
6. Re-assemble with new parts by reversing the disassembly operation.

In the re-assembly it is important that nuts on torque arm pin are not drawn up tight until after the ball end of torque arm is securely fastened at truck end sill. In the final tightening, the washers must be drawn down solid against the shoulders on torque arm pin and dimension of 6 7/8" between washers must be maintained. See Figure 16.

REPLACING RUBBER IN TORQUE ARM MOUNTING ASSEMBLY: See Figure 17.

- FLEX TYPE:**
1. Remove the bolts which fasten the assembly to truck end sill.
 2. Remove top half of rubber from housing.
 3. Remove ball end of torque arm from housing.
 4. Remove bottom half of rubber from housing.
 5. Re-assemble with new parts by reversing the disassembly operation.

- SLIDE TYPE:**
1. Remove the bolts which fasten the assembly to truck end sill.
 2. Remove bracket.
 3. Remove bolts holding upper and lower housings together and the rubber mountings can be lifted out.
 4. Re-assemble with new parts by reversing the disassembly operation.

SAFETY ARM ASSEMBLY: The safety arm, Figure 18, is provided solely as protection in case of torque arm failure. It is attached to gear housing with two bolts, 3/4" x 4 1/2" Catalog K E-11598, four rubber bushings, Catalog No. K E-11601, two mounting plugs, Catalog No. K E-11600, and standard nuts, and washers. Safety arms are furnished in several types of ends and lengths to suit location and construction of end sill, examples of which are shown in Figure 18. All other parts of the assembly are interchangeable.

REPLACING THE SAFETY ARM: Remove nut and lock washer from top and bottom mounting bolts and remove the complete safety arm assembly.

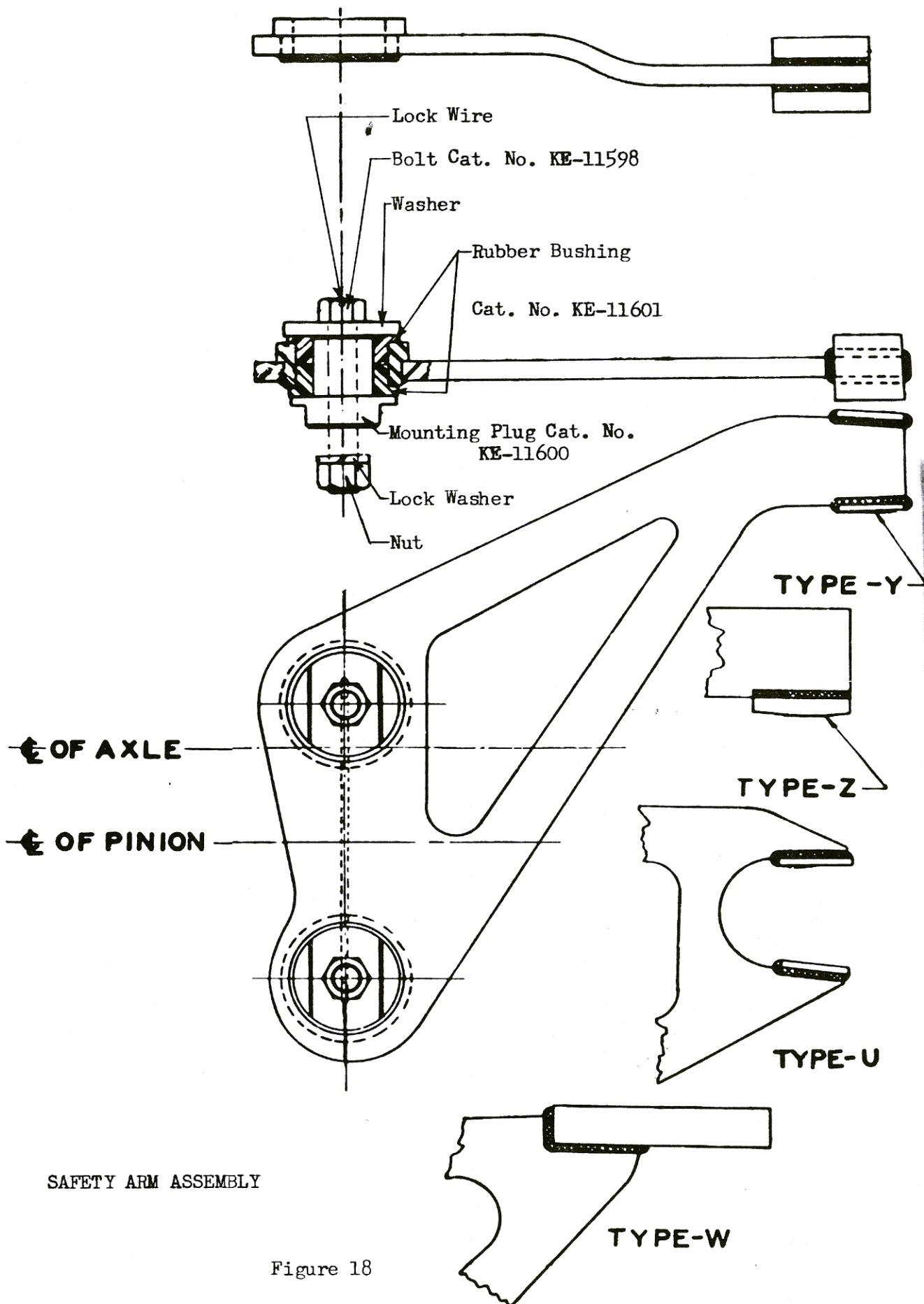
The assembly consists of the outside washers and rubber bushings and mounting plugs, safety arm and the 3/4" x 4 1/2" bolts with nuts. The mounting plugs, rubber bushings and bolts are assembled to safety arm before bolts are fastened to gear unit housing. See Figure 18.

NOTE: See Figure 18 for Parts List.

DRIVE SHAFT: The Standard Spicer shaft shown on Figure 20 is of tubular construction with plain bushings in the universal joints. A special feature is the double seating arrangement at the spline which prevents entrance of dirt, dust, water, etc. All shafts are dynamically balanced at the factory. Certain special shafts of the solid type, an example of which is shown in Figure 21, are designed for special duty and should not be interchanged as a unit with standard type. The journal assembly, bearing assembly and alemite fittings are interchangeable. The shafts are furnished in various lengths to suit the location of generator and truck parts.

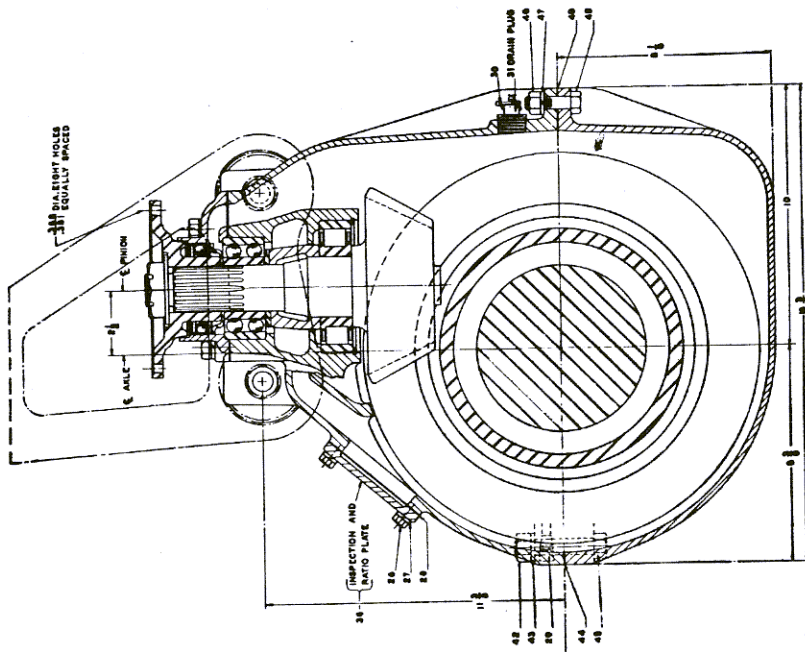
Proper lubrication of the drive shaft is necessary and only Catalog No. K-618, SAE 140 oil is to be used. There is one alemite fitting provided at each universal joint and one for the spline. The universal joints will be lubricated until oil comes through the pressure relief valve at center of journal. Spline will be lubricated until oil comes out the vent at end of shaft. A high pressure type gun should be used.

Major repairs to drive shaft should not be made except in yard shop. A new shaft should be applied in cases where shafts are found to have defective bearings, journals or seals.



SAFETY ARM ASSEMBLY

Figure 18

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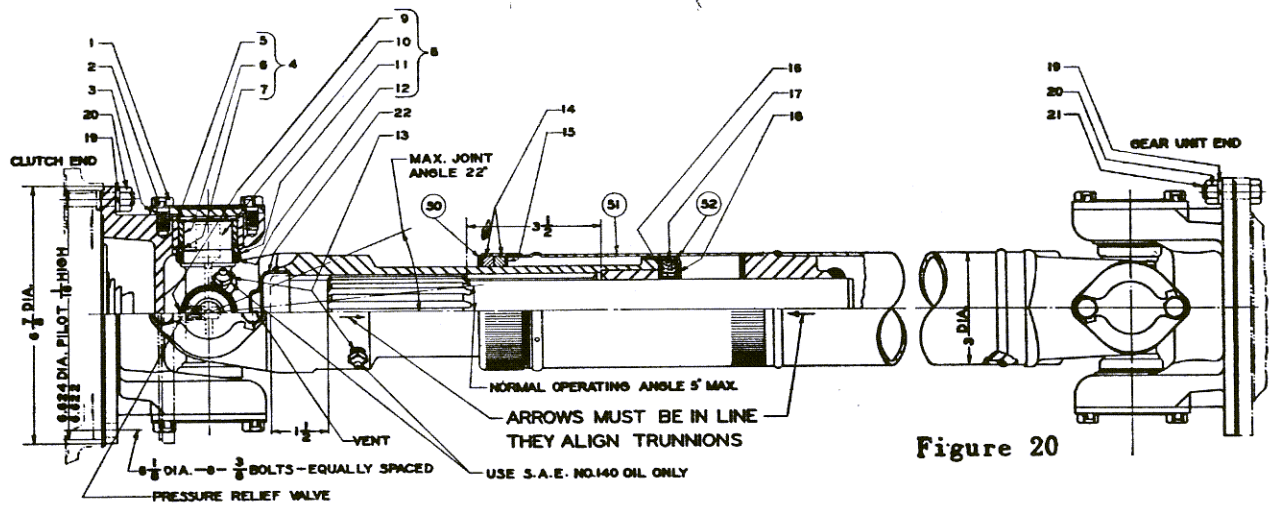


Figure 20

DRIVE SHAFT TUBULAR TYPE

| ITEM NO. | DESCRIPTION | PART NO. | PULLMAN NO. | ITEM NO. | DESCRIPTION | PART NO. | PULLMAN NO. |
|---------------|-----------------------|----------|-------------|----------|---|----------|-------------|
| 1 | Screw | 5-73-109 | | 16 | Steel Washer | 6-15-13 | |
| 2 | Lock Strap | 98-741 | | 17 | Cork Washer | 6-16-73 | |
| 3 | Bearing Cap | 5-70-49 | | 18 | Steel Washer | 6-15-29 | |
| 4(5,6,7) | Bearing Assembly | 5-6-108X | | 19 | Lock Washer | 6-75-29 | |
| 8(9,10,11,12) | Journal Assy. | 5-5-108X | | 20 | Nut | 294-J | |
| 11 | Bearing Seal Retainer | 5-76-17 | | 21 | Bolt | S-617 | |
| 12 | Bearing Seal Cork | 5-86-79 | | 22 | Cup Assembly (Tackweld after assembling) | 5-68-18X | |
| 13 | Alemite Fitting | 99-29 | | | | | |
| 14 | Felt Washer | 4-16-103 | | 50 | Dust Cap | 4-14-49 | |
| 15 | Steel Washer | 4-15-93 | | 51 | Dust Shield Tube | 98-991 | |
| | | | | 52 | Dust Cap | 6-14-29 | |

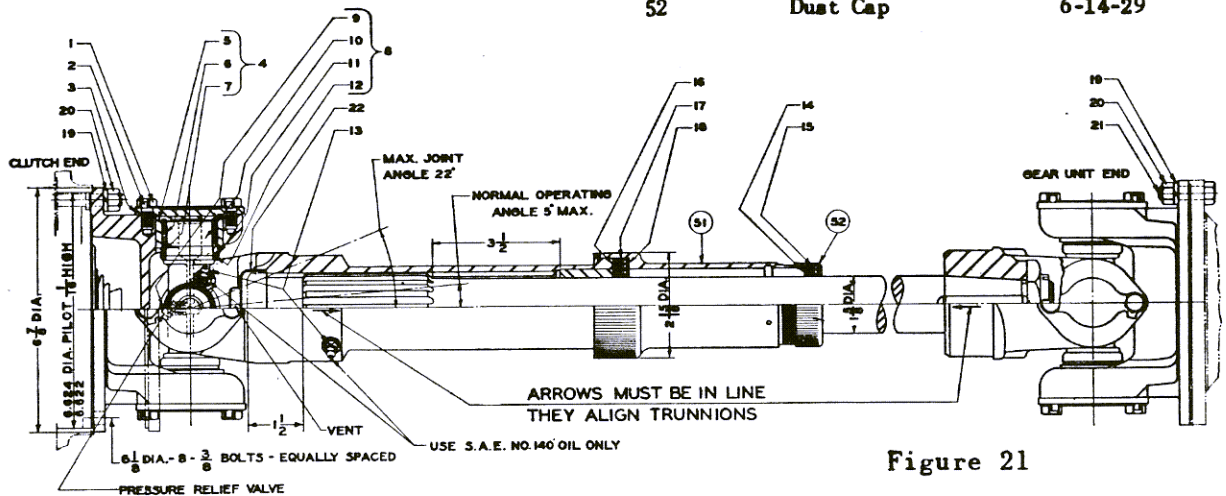


Figure 21

DRIVE SHAFT SOLID TYPE

| ITEM NO. | DESCRIPTION | PART NO. | PULLMAN NO. | ITEM NO. | DESCRIPTION | PART NO. | PULLMAN NO. |
|------------|-----------------------|----------|-------------|----------|---|----------|-------------|
| 1 | Screw | 5-73-109 | | 16 | Steel Washer | 6-15-13 | |
| 2 | Lock Strap | 98-741 | | 17 | Cork Washer | 6-16-73 | |
| 3 | Bearing Cap | 5-70-49 | | 18 | Steel Washer | 6-15-53 | |
| 4(5,6,7) | Bearing Assembly | 5-6-108X | | 19 | Lock Washer | 6-75-29 | |
| 8(9,10,11) | Journal Assy | 5-5-108X | | 20 | Nut | 294-J | |
| 11 | Bearing Seal Retainer | 5-76-17 | | 21 | Bolt | S-617 | |
| 12 | Bearing Seal Cork | 5-86-79 | | 22 | Cup Assembly (Tackweld after assembling) | 5-68-18X | |
| 13 | Alemite Fitting | 99-29 | | | | | |
| 14 | Steel Washer | 5-15-23 | | 51 | Dust Shield | 98-1016 | |
| 15 | Felt Washer | 5-16-43 | | 52 | Dust Cap | 4-14-19 | |

YARD SHOP REPAIRS TO DRIVE SHAFTS: Refer to Figures 20 and 21. No repairs which might effect the balance of shaft will be made in the Districts.

Before removing any parts from a drive shaft, be sure that they are marked so that they may be replaced in the EXACT relationship that existed before removal; otherwise, an out-of-balance condition is likely to occur.

Bearings and Journals: Items 4 and 8. When bearings appear to be worn, it is advisable to replace both the bearings 4 and journal 8 to obtain the best results. To remove, bend down the locking lugs on strap 2 and remove screws 1 and bearing cap 3. The bearing 4 can now be removed by tapping lightly on the outside of the flange. The journal 8 can be removed by sliding to one side and tipping to clear the yoke. Cup assembly (22) should be tack welded to the journal. Before assembling the new parts, dip the bearings in light oil. Be sure all screws are tightened and locked.

Oil and Dust Seals: Items 14, 15, 16, 17, and 18. Parts for the oil and dust seals are split to provide an easy means of assembling around the shaft. To remove, pry loose locks and remove dust shield 51 and dust cap 52, then remove oil seals, 14 (or 15) and 17. If steel washers 15 (or 14), 16 and 18 are not damaged, they need not be removed. Insert new felt and cork washer and screw on dust shield and dust cap locking in place. Both the felt and cork washer should be soaked in light oil before assembling. Be sure to lubricate the universal joints and spline in accordance with instructions.

CLUTCH: There are two types of Spicer clutches, Safety and Automatic. Figure 22 shows the Safety type. Figure 23 shows the Automatic type. These clutches are interchangeable and are used to transfer the torque from drive shaft to the generator. They have tapered bore with keyway and are mounted on end of generator shaft. The safety clutch is a single plate friction clutch with the capacity controlled by spring pressure. The torque load is transferred from the drive shaft and through the clutch cover, housing, pressure plate and safety plate to driven disc, then through the hub to generator shaft. Release wedges are provided to release pressure plate when it is necessary to motor the generator. A safety overload feature is built in the clutch so that when clutch starts slipping at the friction surfaces, heat is generated in a safety plate. This heat transfers to soft metal safety plugs which melt and allow safety plate to move out of engagement. This clutch runs free on its bearings and no damage results. Figure 23 shows the details.

The Automatic clutch is similar to Safety Clutch and has the same safety overload feature. In addition, this clutch engages and releases automatically at 280 R.P.M. or car speed of 8 to 12 M.P.H., depending on ratio of drive. This feature eliminates starting load on the locomotive, permits quick motoring of generator in the yards; and in case of emergency, stops the high inertia load of the generator armature is not placed on the gear unit. Shock loads caused by coupling cars are also avoided. The engagement and disengagement of clutch is controlled by centrifugal force acting on fly weights balanced against retracting springs. The fly weights are limited in their travel, and the maximum capacity of the clutch is controlled by the retracting springs. The clutches operate the same for either rotation and are statically and dynamically balanced. Three inspection plugs are provided for checking position of the safety plate.

CLUTCH LUBRICATION: Safety clutch bearings are of the prepacked lubricated type and no provision is made for yard lubrication. Automatic clutch bearings require lubrication when the regular six month inspection is performed.

The automatic clutch should be removed from the generator and disassembled for bearing lubrication in the yard shop. Remove retainer plates No. 15 and 25 shown in Figure 24. Carefully pack each bearing one-third full of U.S. No. 508 grease. Do not put in any more than this amount. Otherwise the bearings will run hot and the excess lubricant will get on the facings, resulting in the failure of the clutch.

YARD REPAIRS TO AUTOMATIC CLUTCH:

No major repairs affecting balance will be made in the districts. The clutch is of disc type controlled by centrifugal force. It is disengaged with car standing still and up to speed of 8 to 12 M.P.H. Motor generator can therefore be motored in the yard without clutch interference. In all cases of motor generator trouble where clutch might be in operative, the inspection plug on side of clutch should be removed. If clearance between safety plate and disc is greater than $1/16$ " the safety plugs have probably melted and a new clutch should be installed. See Figure 23.

REMOVING THE AUTOMATIC CLUTCH:

1. Disconnect drive shaft.
2. Remove cotter pin and shaft nut.
3. Attach special puller and remove clutch. See Figure 25.