ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION
SERVICE DEPARTMENT
MAINTENANCE INSTRUCTION

# TRACTION MOTOR STATOR INSPECTION AND MECHANICAL RECONDITIONING

## INTRODUCTION

This bulletin is concerned specifically with inspection and mechanical reconditioning of traction motor stators. Included is information concerning the rebuilding of brush holder assemblies.

The dimensional and other inspections should be carefully made and all rework performed according to the procedures outlined. Attention to these details will ensure that only those stators capable of satisfactory performance will be placed in service.

## STATOR CLEANING

The first step involved in cleaning the stator assembly is to blow away dust and dirt with clean, dry, compressed air. The brush holder assemblies should then be removed and set aside before continuing the cleaning operation.

After cleaning with air, the next step is to thoroughly clean the stator inside and out with a suitable solvent such as Stoddards solvent (ASTM-D474-40). This is generally used by wiping the frame and insulation with a clean cloth dampened with the solvent.

CAUTION: Adequate ventilation should be provided during use of solvents. The usual precautions should be observed when handling inflammable fluids (Stoddards solvent has a flash point of 115° F.).

In the event that the stator is extremely dirty or oily, the inside and outside may be washed using hot water to which a small amount of caustic has been added. After such cleaning, the stator should be thoroughly rinsed with clear water to remove all traces of the caustic.

After such washing and rinsing, it is advisable to dry the stator by placing it in a hot oven set at 125° C. for 4 hours. This should result in a thorough drying of the stator after which it can be removed and cooled to room temperature.

## FRAME INSPECTION

1. Check to see that ventilating screens (if used) are not broken, or have cracked welding. Replace or tack weld as necessary.

2. Inspect support cap nut welds. Replace nut or weld as needed.

3. Check oil filler caps on support caps and replace if necessary.

4. Observe that internal condition of support caps is satisfactory.

5. Inspect and recondition felt wicks and carriers as outlined in Maintenance Instruction 3900 under "Motor Support Bearings — Felt Wick Lubricators."

6. Check commutator inspection covers replacing felt seals if necessary.

7. Check the spot weld of field pole cap screw on support side of frame. Apply spot welds if found cracked.

## SUPPORT CAP MOUNTING TO FRAME

During manufacture, the two support bearing caps are installed with .018" shims between them and the motor frame.

After being securely fastened in place, the assembly is then line bored to achieve the 9.250" + .003" – .001" axle bore dimension identified in Fig. 1.

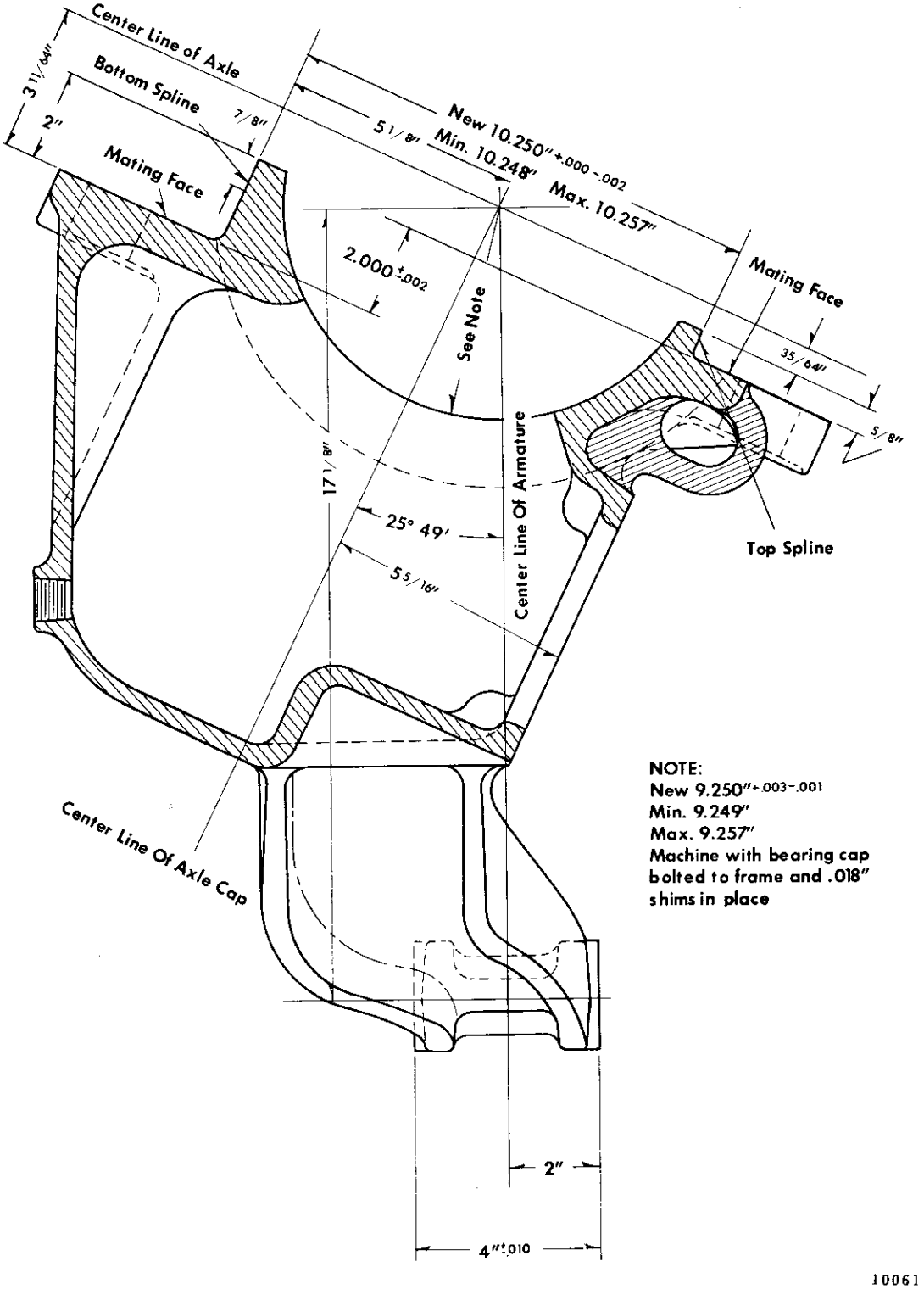


Fig. 1 – Pinion End Support Bearing Cap

The .018" shims are used only for machining purposes. These shims are removed and .010" shims are used at the time the motor is installed in a truck. When assembled and tightened in place this will result in the support bearings being clamped approximately .008".

By line boring, the support bearing caps are thus "mated" to their specific motor frame to preserve the close axle bore tolerances and are thus not interchangeable with other caps. For purposes of identification, each cap is stamped to indicate the motor serial number. During assembly the numbers on the support bearing caps should be checked to make sure that they match the number stamped on the motor frame.

## CAP TO FRAME SPLINE CONNECTION

The support bearing caps should be assembled to the motor frame with the .018" shims. After tightening securely in place, check the spline fit on each side of the caps with a feeler gauge. This measurement is taken between the support cap and its junction with the frame. Top and bottom readings taken on one side of individual caps should be totaled. The measured total clearance should not exceed .015" (loose) or the interference should not exceed .006" (tight).

The interference fit, if present, can be determined by measuring individual components with micrometers and determining the dimensional difference.

## SPLINE TOLERANCE

Using appropriate micrometers the individual splines on the motor frame and support bearing caps should be measured. These tolerances are as follows:

| | |
|---|---|
| Frame Spline | 10.244" to 10.257" |
| Support Cap Spline | 10.248" to 10.257" |

## AXLE BORE DIAMETER

With the .018" shim in place and the support bearing caps drawn up tight, check the axle bore diameter in several places.

The axle bore diameter must be between 9.249" and 9.257".

## GENERAL WELDING PROCEDURE

All welding referred to in this section should be done in accordance with the following general procedure.

1. The use of A.W.W. Class E-6012 1/8" to 3/16" diameter welding rod is recommended, and a welding machine with a capacity of 80-110 amperes (AC or DC current) should be used.
2. All weld deposits should be free of slag inclusions, undercuts or crater cracks.
3. Position work whenever possible so that welding can be done in down hand position.
4. To minimize distortion associated with weld shrinkage, proper welding sequence is important, such as back step sequence or the staggering of weld passes.
5. Peening with an air hammer and blunt nosed tool is very effective as partial stress relief of the welded area, especially if done immediately after laying a weld bead while the metal is still hot. Peening also helps to control weld shrinkage. For example, during weld build up of axle bores, shrinkage or closing-in of bore at the split line can be controlled by peening. Whether peening is employed for partial stress relieving or shrinkage control, caution should be taken not to peen excessively.
6. In general there are no restrictions with respect to areas where weld metal build up may be employed. To avoid overwelding, however, it should be confined to areas and/or contour of mating surfaces.

## CORRECTION OF WORN SPLINE FIT

In the event that the axle bore diameter is acceptable but the spline fit is out of limits, this may be restored as follows:

### SUPPORT CAP SPLINE (Fig. 1)

1. The 5/8" wide surface on the top spline should be completely built up with weld deposit.

2. On the 2" wide surface of the bottom spline, only apply a 7/8" wide weld build up to the area next to the cap bore, across the full length of the cap.

3. Machine welded areas of the cap to provide a fit with the frame spline that is between .007" tight (interference) and .015" loose (clearance). This step should be taken after the frame spline has been properly rebuilt or determined to be dimensionally satisfactory.

4. Take a light machine cut from the support cap mounting (vertical) face. This will allow cap to move in toward the frame bore so stock will be available for machining the bore to size.

### FRAME SPLINE

1. When worn oversize, the frame spline can be repaired by welding, using the same general procedure as that used in building up the cap sline.

2. Remachined spline on the frame should be brought back to print tolerance of 10.250" + .002" — .006".

CAUTION: Before removing stock from spline mounting faces on pinion end caps or frame, a check must be made on both cap and frame to hold the accumulative machining on these mating faces to a maximum of 1/16". The 17-1/8" dimension between the gear case mounting bolt and axle bore centerline must not be less than 17-3/64" after machining mating face for the pinion end cap. The accumulative machining of mating faces for the commutator end cap must not exceed 1/8".

## OVERSIZE AXLE BORE

When the axle bore is beyond acceptable limits it can be rebuilt by completely welding the frame portion of the bore, or partial welding depending on the extent of wear or distortion. If, by inspection, it is found that the bore has closed in at the spline fits and requires only partial welding, this type of correction can be made by removing the key and welding a 5" wide area the full length of the bore, at the top next to and parallel with the spline. Also, weld a 2" wide area at the bottom in the same manner.

If the interior bore is worn oversize, stock for machining can be applied by welding the complete frame side of the bore prior to machining.

In either a partial weld or complete weld of an axle bore, the frame spline will have to be rebuilt as instructed under "Frame Spline" before the axle bores can be rebored.

## OUTSIDE AXLE BORE FACE DIMENSION

When there is evidence of wear on the axle bore faces, the 41.875" ± .005", Fig. 3, should be checked. Condemning limit is 41.815". When the dimension is beyond condemning limit, build up faces with weld. In most cases it will only be necessary to apply weld material to the commutator end bore face. However, if the pinion end armature housing bore face is to be welded, it is advisable to weld the face of the pinion end axle bore.

NOTE: A 1/32" step is permissible between the P.E. bore face and the P.E. axle bore face.

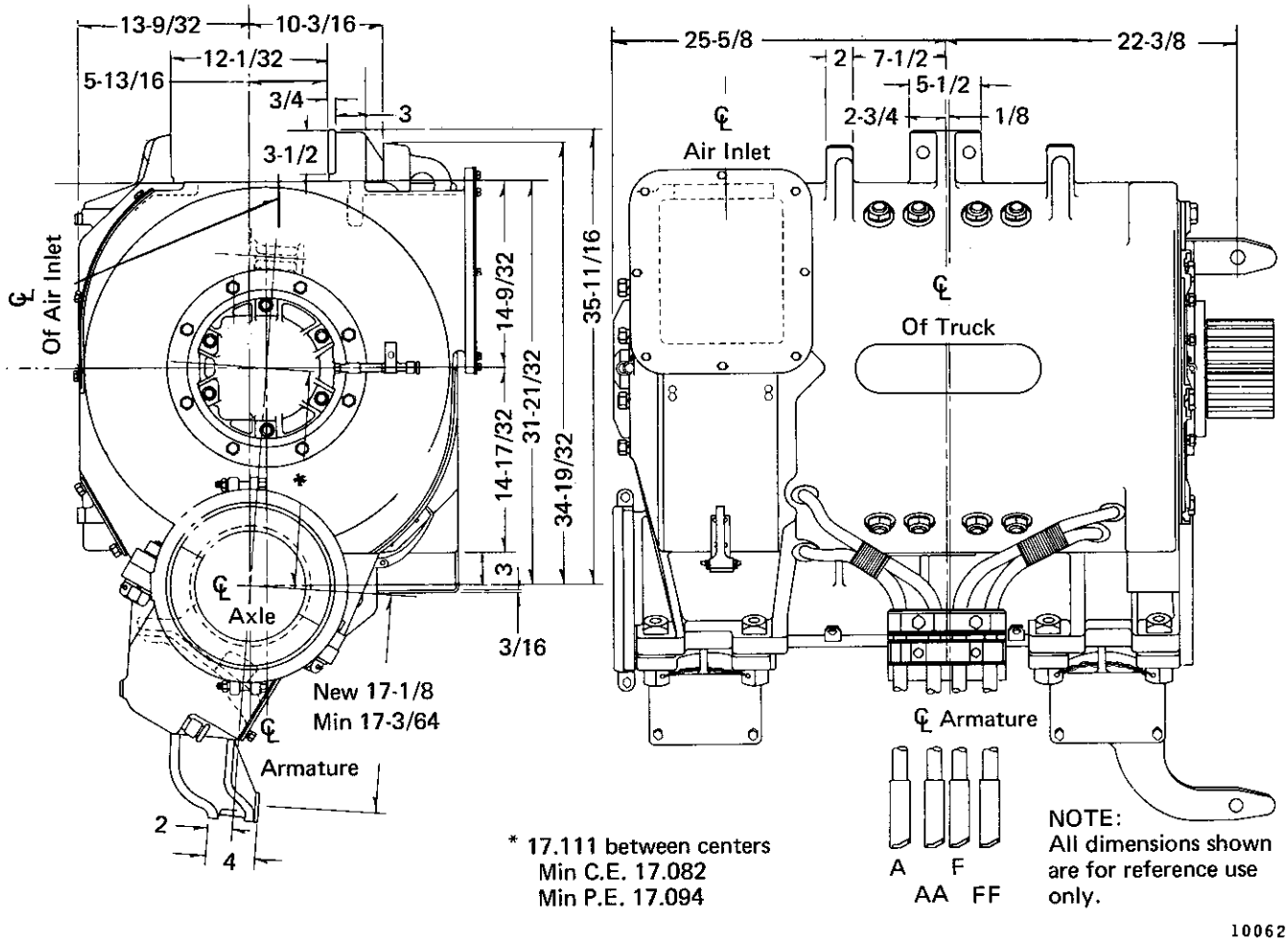


Fig. 2 – Traction Motor Outline

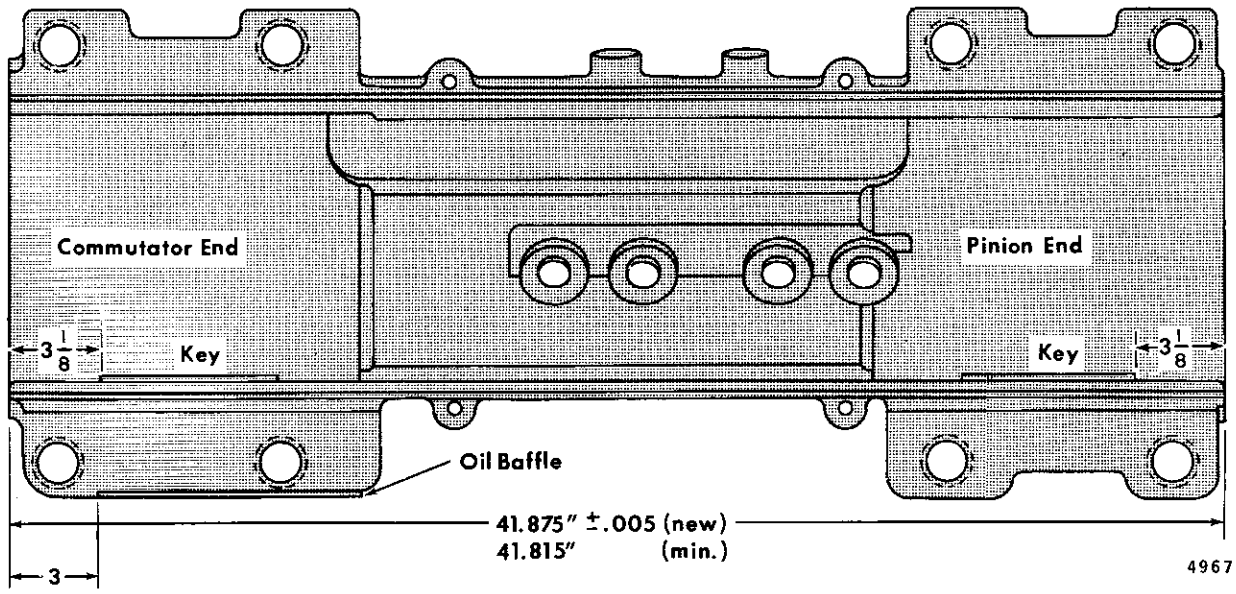


Fig. 3 – Axle Side Of Motor Frame

With the welding and milling completed on the frame and support caps, assemble support caps to frame with .018" shims. Serial number on caps must correspond to serial number on frame. Rebore axle bore or bores to 9.249" to 9.253".

Axle bores must be parallel to frame bores within .012". The 17.111" + .005" – .000" dimension, Fig. 2, from centerline of armature bore to centerline of axle bore shall not be less than 17.094" on the P.E., and 17.082" on the C.E. when the P.E. is on the low limit of 17.094". Centerline of axle bore shall be determined from the original spline machined surface between axle bores, in order to maintain the 1.250" ± .005" dimension between the P.E. axle and P.E. housing bore as close as possible.

## PINION END HOUSING BORE

When checking the pinion end housing bore diameters, it is recommended that measurements be the average reading of four diameters taken at 45° apart. This average must fall within the listed condemning limits. Maximum allowable out-of-round to be .012" total indicator reading. The outer bore face must be perpendicular to axial centerline within .006" total indicator reading. Check measurements at the solid portion of the face, or opposite the main pole pads of the frame.

The pinion end bore may fall into five nominal sizes as follows:

| | | |
|---|---|---|
| Standard size | 22.875" | + .002"<br>– .001" |
| 1/32" oversize | 22.906" | + .002"<br>– .001" |
| 1/16" oversize | 22.941" | + .002"<br>– .001" |
| 3/32" oversize | 22.971" | + .002"<br>– .001" |
| 1/8" oversize | 23.001" | + .002"<br>– .001" |

Condemning limit is + .004" – .001" of nominal drawing diameter.

When the bore diameter is outside the listed limits due to wear and/or distortion, the bore may be machined to one of the oversizes or built up by welding and machining to the standard size. Machine light cut on outside face at pinion end bore in order to obtain squareness to the bore. At the same time machine a light cut on the inner face at the commutator bore to obtain the 41.125" ± .003" dimension between faces, see Fig. 4. These face surfaces must be parallel and concentric to each other within .005" total indicator reading.

The number of machine cuts permissible on bore faces is limited to 1-1/16" minimum thickness of the commutator end bore.

A pinion end bore machined to an acceptable oversize diameter will require an oversize pinion end housing for assembly.

## COMMUTATOR END HOUSING BORE

Check frame bore diameter by measuring across the bore at points 60° apart. The average of the readings taken for commutator end frame bore must be within the acceptable tolerance of 12.124" to 12.128", maximum allowable out-of-round to be .008". Commutator bore inside face must be perpendicular to axle centerline within .003" total indicator reading.

When the bore diameter is beyond acceptable tolerance, it may be built up by welding. Stagger weld passes throughout area to be built up to avoid local heat concentration.

After welding, machine bore to 12.125" + .002" – .001". This bore must be concentric with the pinion end bore within .005" total indicator reading and parallel to axle bore within .012".

Pinion end bore and commutator end bore to be concentric to each other within .005" total indicator reading. Bore faces must be perpendicular to axial centerline within .003" indicator reading for commutator end and .006" for pinion end.

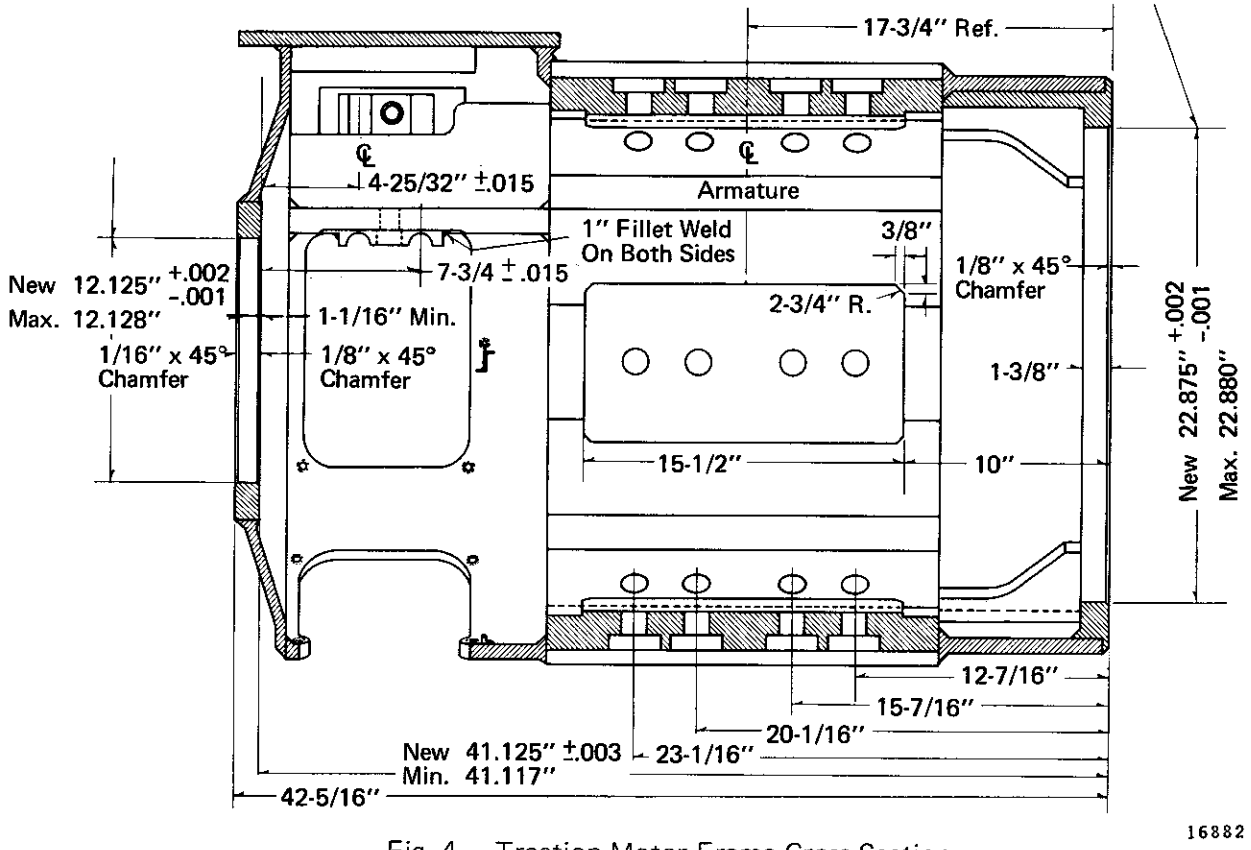


Fig. 4 — Traction Motor Frame Cross-Section

Machine light cut on inside face at commutator end bore in order to obtain squareness to bore. At the same time machine light cut on outer face at pinion end bore to obtain 41.125"±.003" dimension between faces. Condemning limit for this dimension is 41.117", see Fig. 4.

NOTE: When machining off pinion end bore face, care must be exercised not to exceed the 7-3/4" ± .015" (or 4-25/32" ± .015") dimension from centerline of brush holder support hole to inside face of commutator bore, Fig. 4.

The number of machine cuts permissible on bore faces is limited to 1-1/16" minimum thickness on the commutator end bore face.

Commutator end bore faces may be built up with weld as required to maintain the 41.125" ± .003" dimension from commutator bore inside face to pinion end outside face before machining.

## BRUSH HOLDERS

### CLEANING

Brush holders may be cleaned by washing in either solvent 8137548 or Stoddards solvent (ASTM-D474-40).

Both solvents are nontoxic. Solvent 8137548 has a flash point of 88° F. and Stoddards solvent has a flash point of 115° F. Solvent 8137548 is preferred as it has a faster rate of evaporation.

CAUTION: The usual safety precautions that apply to inflammable fluids should be observed. Provide adequate ventilation when any type of solvent is being used.

Since some time is required for solvent to evaporate, no electrical test should be attempted after washing. Brush holders should be dry and free from solvent before installation to brush holder mounting in the motor frame.

## MISCELLANEOUS INSPECTION AND REPAIR

Inspect brush holder terminal lug seat for roughness, rework as necessary.

Check dowels securing the brush holder pins to ensure that the casting is peened over at both ends.

Remove all arc burns and smooth off surfaces facing the commutator where metal buildup has taken place.

## BRUSH SLOTS

Inspect carbonways for wear using gauge 8259133. The brush slot width should be between .628" and .635" in each brush slot section. The length of the short brush slot should be within 2.004" to 2.013" and the large brush slot should be within 4.004" to 4.013".

When brush slots are worn or distorted beyond acceptable limits it is possible, providing the wear is not too great, to rework the slots to gauge size by inserting the gauge into the slot and gently peening the outer surface of the slot to close it in, thus by peening and filing as necessary, the slot can be reworked.

## STUD REPLACEMENT

If further inspection indicates any insulated studs need to be replaced, it will be necessary to drive out the pin locking the stud in place, Fig. 5. After removing the pin, support the brush holder and press out insulated stud from the bottom.

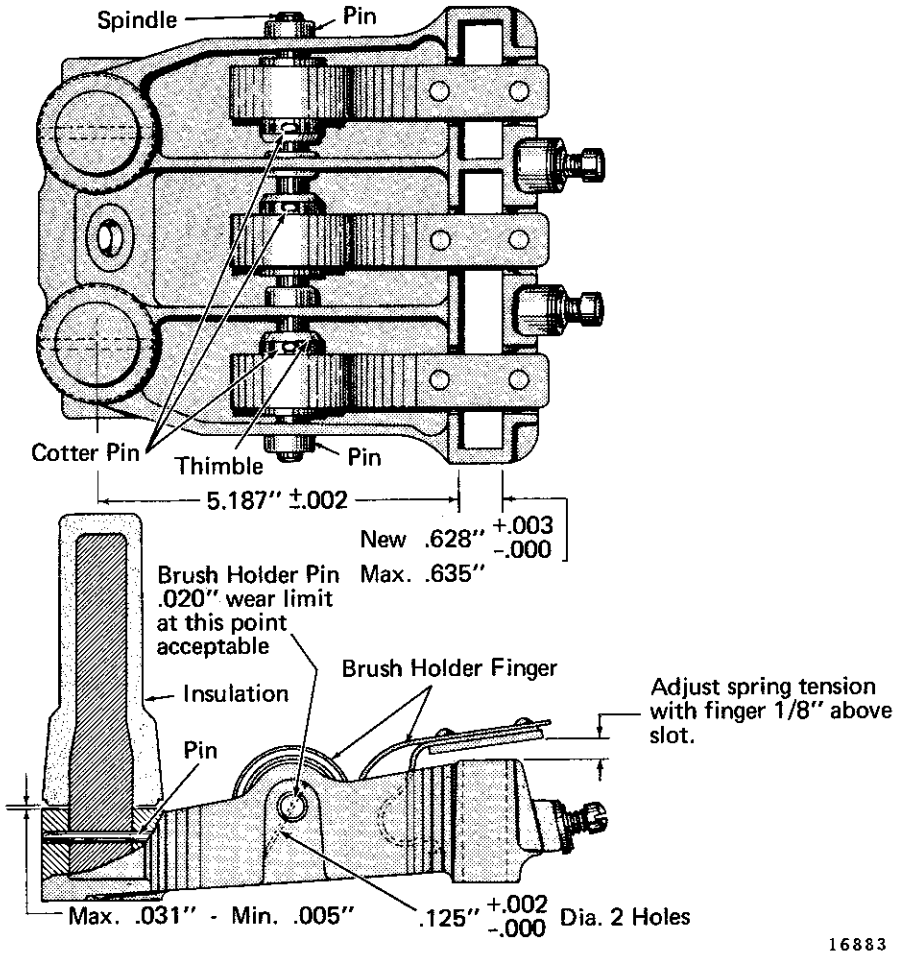


Fig. 5 – Coil Spring Type Brush Holder Assembly

Before a new stud is pressed into the brush holder body, the hole must be checked to make certain there will be a .001" to .003" tight fit between the stud and holder. It is believed that the standard size stud 8159003 can be used in most cases, however in the event the holes are slightly oversize, a .002" oversize

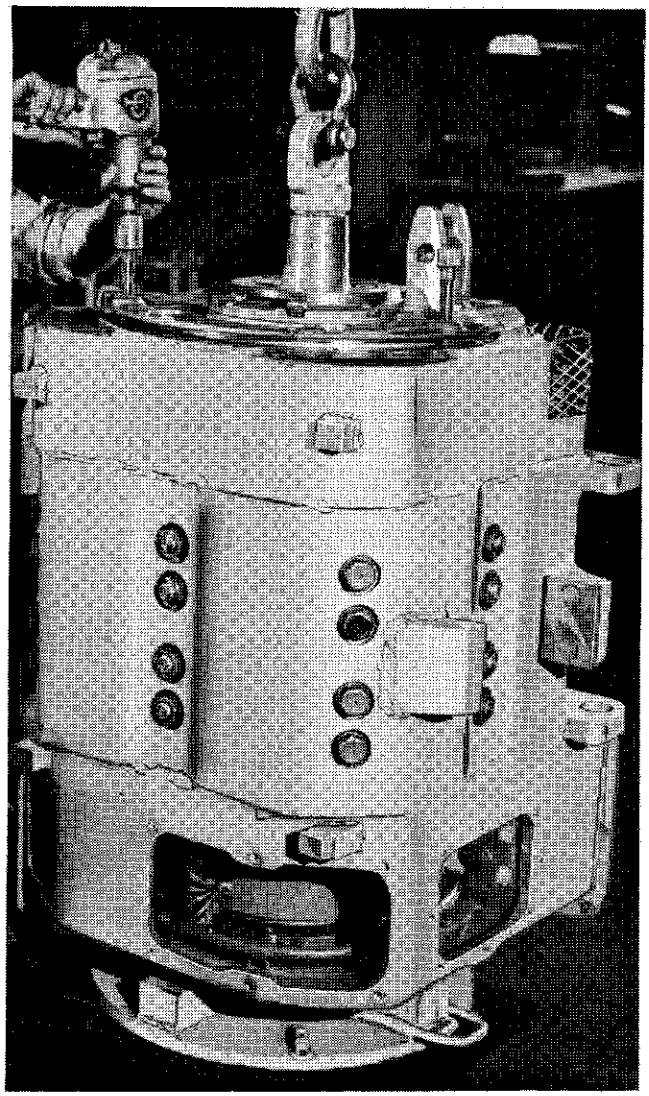

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Fig. 3 — Preparing For Armature Removal

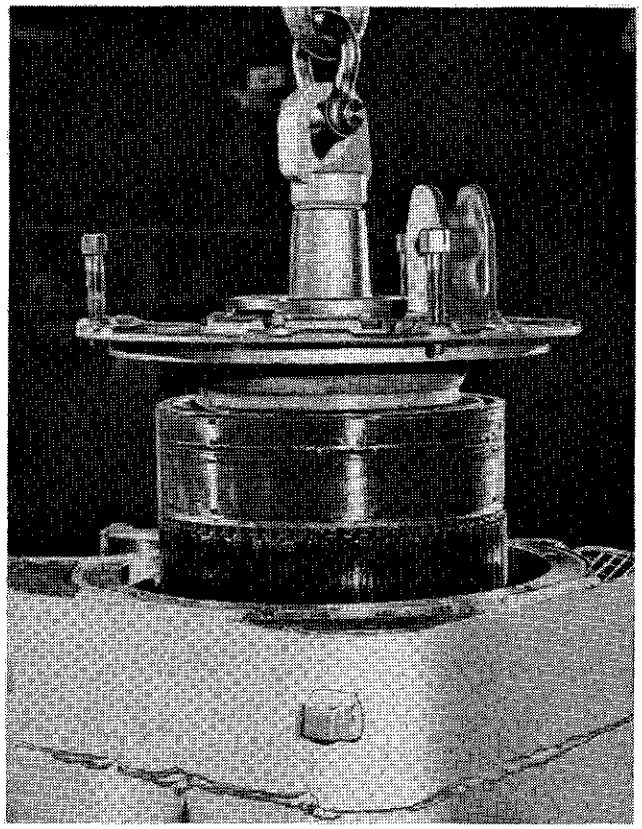

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Fig. 4 — Removing Armature Assembly

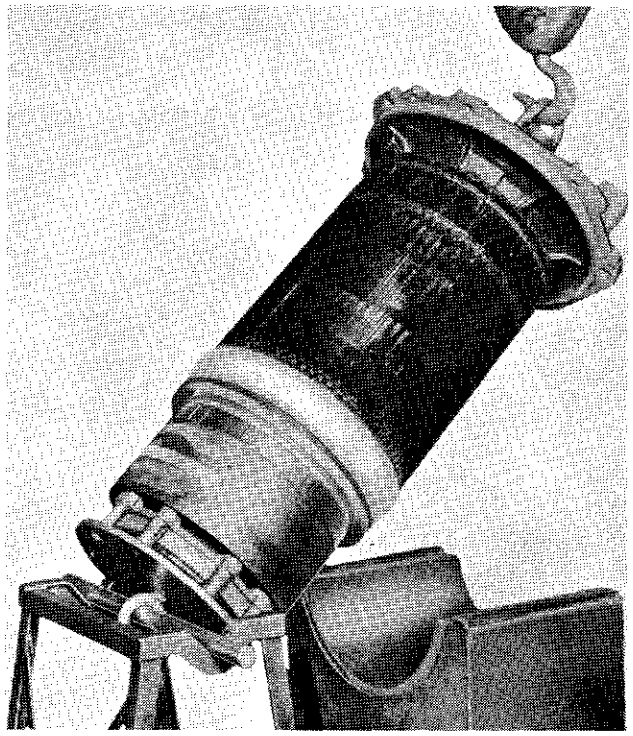

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Fig. 5 — Lowering Armature Into Saddle

stud 8209068 is available. A 1/32" oversize stud 8209069 is also available on those holders where the bore is scored and will require cleaning up before a stud can be pressed in. The holes will have to be reamed or machined to 1.0248" ± .0005" to give a .001"—.003" press fit with the 1/32" oversize stud.

After the correct stud and hole size have been determined press new stud into brush holder. Reasonable care must be exercised when pressing in the preinsulated stud; there must be clearance from .005"—.031" between the base of the insulation on the stud and the brush holder, Fig. 5. It is suggested a fixture slightly larger on the inner diameter than the outside diameter of the insulated stud and closed on one end, be used to press in the stud in order to prevent damage to the insulator.

If the holes of previous dowel pins are damaged, a new pin hole can be located and drilled in such a manner as not to interfere with the old dowel pin and/or hole. Drive in a new dowel pin, and peen over both ends of the hole.

Later model brush holder assemblies have a rubber insulating sleeve over the base of the brush holder studs. When replacing or reconditioning older brush holder studs be sure to install the insulating sleeves.

When brush holder is completely rebuilt, apply a high potential ground test to brush holder at 5400 volts for 10 seconds.

If brush holder is to be stored before using, it should be stored in such a manner that the brush slots or insulated stud will not be damaged.

## COIL SPRING TYPE BRUSH HOLDER

### Spindle And Thimble Removal

When inspection indicates it is necessary to remove the spindle to replace thimble or brush holder finger, the groove pin at either end of the spindle will have to be removed. This can be accomplished by slightly bending back the portion of the pin protruding into the hole directly below the spindle hole, Fig. 5, or by using a drift and hammer to drive the pin down and out of its hole. It may be necessary to alternately bend the pin back and then down to accomplish its removal.

NOTE: Care should be used in driving the pin out so as not to damage the reamed holes. A drift smaller than the hole should be used.

It will then be necessary to remove the cotter pins holding the thimbles. This can be done by inserting a small drift into one of the adjusting holes in the thimble and holding the thimble to prevent it from turning while the cotter pin is removed.

NOTE: The drift will have to be held firmly as the finger spring is under tension.

Release the spring tension on the thimble by removing the drift pin after the cotter pin is removed. The spindle can then be driven out of the brush holder body. To remove the spring, shunt and thimble assembly from the brush holder body, it will be necessary to free the soldered end of the shunt by heating with a soldering iron.

With the shunt assembly removed, component parts can be inspected for wear or damage. Any defective parts should be replaced with new parts.

When the spindle shows excessive wear (maximum .010") or cracks, remove and replace defective spindle. Use new cotter pins when reassembling. New brush holder spindle measures .3725"—.375" in diameter.

When the .377" spindle holes show excessive wear or the acceptable service clearance between spindle and brush holder is exceeded, the following procedure is recommended:

1. Ream or drill worn spindle holes to .503"—.507" diameter.

2. Clean and flux both the drilled holes and plugs 8166383.

3. Insert plug in drilled hole and silver braze in place.

NOTE: Do not overheat when brazing in the plug as holder will warp.

4. Clean in hot water.

5. Redrill the three holes to .368" maintaining the 1-5/16" and 2-7/16" dimensions.

6. Ream the .368" holes to .377"—.380".

### Spring Shunts

Inspect brush holder spring shunts for wear and for condition of soldered joint at brush holder.

When shunt and/or tip shows excessive wear, replace shunt and tip assembly. If only slight wear on tip is found, shunt surface may be cleaned by filing.

Resolder shunt connection at brush holder with 63-37 solder 8004403 or with pure tin solder 8107868.

After the shunts have been soldered in place, reassemble the thimble and spindle assembly to the brush holder. Install two 142488 1/8" x 1" type "A" groove pins at both ends of the spindle to anchor spindle to brush holder. Stake upper ends of the pin holes.

NOTE: When the groove pin holes are oversize so that the pin is loose in the hole, rework the hole by filling the hole with silfos brazing alloy (do not overheat holder) and redrill to drawing size, Fig. 5.

### Spring Tension

Check spring tension with a brush spring tension scale. When the spring finger is 1/8" above top inside edge of brush box, the tension should be from 9—11 pounds.

Spring tension can be regulated by removing the cotter pin locking the thimble to spindle and turning the thimble and the spindle. The adjusting collar on the thimble can be set every half notch by using alternately two cotter pin holes in the spindle. This will give a variation of tension from 1-1/4 to 1-1/2 pounds for each half notch.

## CONSTANT PRESSURE BRUSH HOLDERS

### Spring Cell Removal

When inspection indicates that it will be necessary to remove the spring cell assemblies from the holder, the following procedure should be used:

1. Place the pressure fingers in the "cocked" position.

2. The lower end of each pin, visible in the holes directly below and at each end of the spindle should be pried upward slightly until it protrudes from the top of the holder and then be pulled out of the pin hole.

3. After the pins are removed, the spindle can be driven out of the holder to free the spring cell assemblies.

### Spring Cell Replacement

1. Before installing spring cells, the holder should be checked and the necessary repairs made as previously outlined in this bulletin.

2. Insert the spindle in the spindle hole with the spindle pushed up against the top of the hole. Check the distance from the bottom of the spindle to the inside surface of the bottom web of the brush holder casting as shown in Fig. 6. If this dimension is more than .775" or if the hole is more than .020" oversize the hole must be plugged and relocated.

3. Check spring cell to make certain that offset of rear tab is 3/8" as shown in Fig. 6 and adjust as necessary. Place pressure spring in "cocked" position.

4. Place cell assembly in brush holder spring pocket with fingers centered in slot "A", Fig. 7, and spindle holes aligned. Note quantity of spacers needed at "B" and "C".

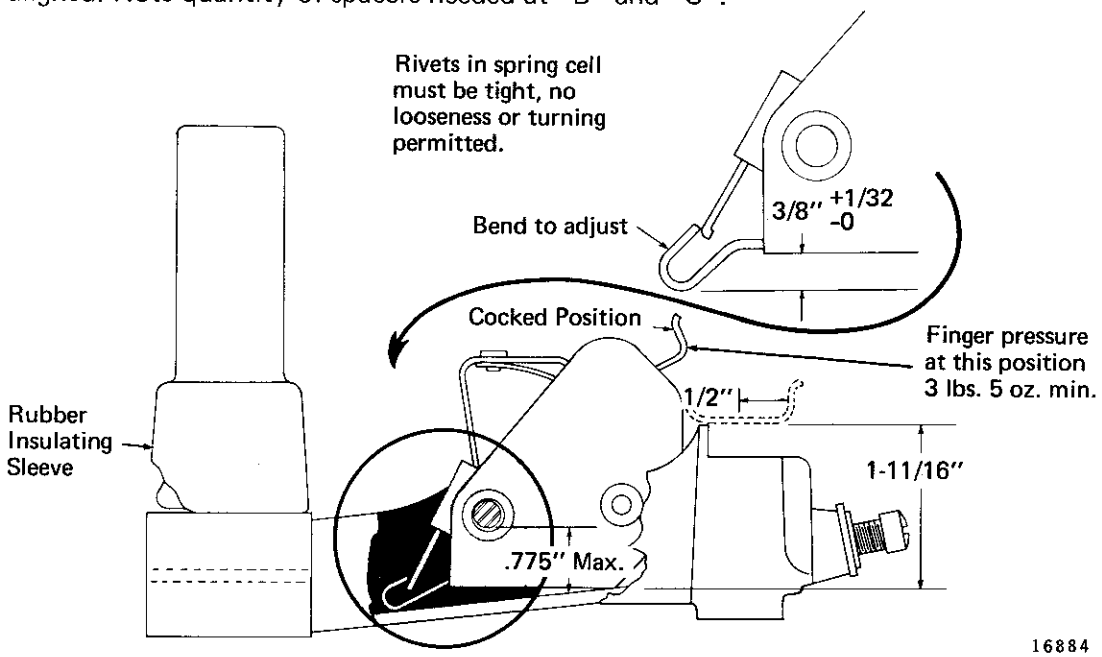



Fig. 6 – Constant Pressure Brush Holder And Cell Tolerances

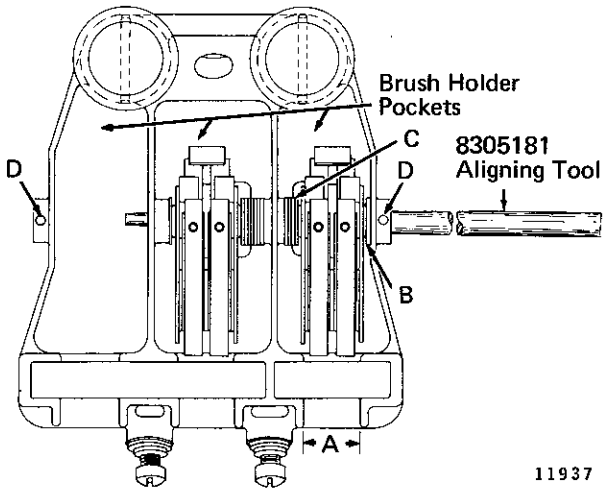



Fig. 7 – Installing Constant Pressure Cell In Brush Holder

5. Start aligning tool 8305181 through one side of the brush holder adding necessary spacers at "B" and "C".

6. Recheck alignment of cell pressure fingers at slot "A" and readjust cell position if necessary.

7. Repeat procedure for the other cell assembly as aligning tool is advanced through brush holder.

8. Check each cell assembly for correct alignment.

NOTE: When replacing spring cell assemblies, the cell MUST be tight in the holder, and the pressure fingers MUST be centered in the brush box slot.

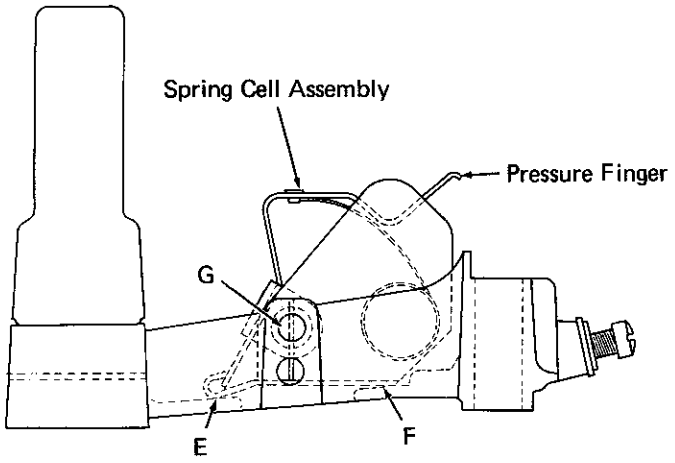
9. Press aligning tool into holder until large end is flush with the side of holder.

10. Using brush holder spindle, drive aligning tool out of holder. Do not pull aligning tool out of holder.

11. Center spindle in holder. If the old spindle is reused, the two .125" diameter holes in the ends ("D" Fig. 7) should be aligned with their matching holes in the brush holder. If a new spindle is used, two .125" diameter holes should be drilled through the spindle after it is installed.

12. Drive grooved pins 142488 in each hole at "D" and peen casting lightly into each hole to lock the pins.

The cell assembly, if properly installed, will be held in firm contact at points "E" and "F" Fig. 8.




Adjust this tab so that the spring cell is anchored tightly in assembly at points "E" & "F" when spindle "G" is driven in place. Points "E" & "F" must have definite contact with holder.

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Fig. 8 — Position Of Cell Assembly In Holder



Litho in U.S.A.