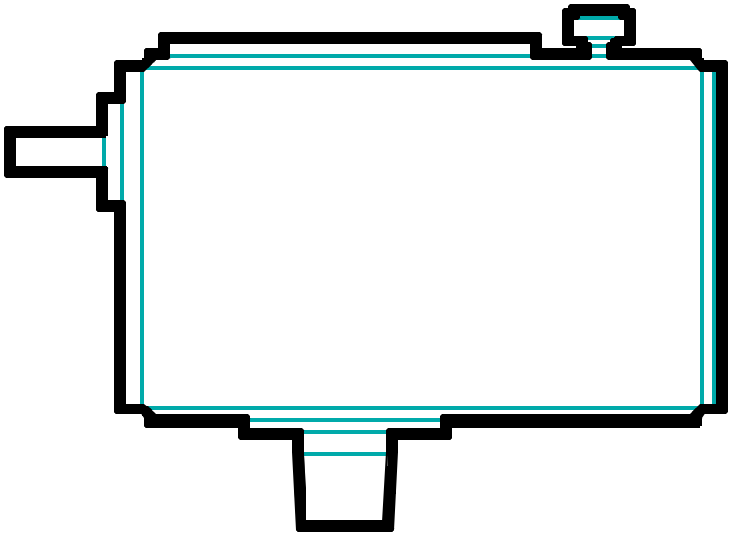
Chemineer

Manual 382

HT Gear Drive Maintenance Manual Case Sizes 7,8,9



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MAINTENANCE

GEAR DRIVE

Case Sizes 7,8,9

This manual contains instructions for HT gear drive disassembly and assembly. Refer to the agitator manual for all other information relative to the agitator.

Other than periodic lubrication as defined in the *Lubrication* section of the Agitator Manual, no routine operational gear drive maintenance is required.

To assure the longest life from your gear drive, annual shutdowns which can correspond with plant shutdowns should be planned. Gear tooth wear patterns, shaft/bearing end play, alignment, bolting and the condition of all seals should be checked. Worn parts should be replaced and any areas of general concern should be brought to the attention of your *local Chemineer office*.

GEAR DRIVE

Case Sizes 7,8,9

Disassembly

Gear Drive (*Figure 16, page 26*)

1. Remove change gear cover **[276]** and gasket **[277]**.

2. Remove pinion locknut **[217]** and change pinion washer **[216]**.

3. Remove change pinion **[215]**. All change pinions are spline mounted.

4. If the gear drive is equipped with a low speed oil wiper, remove slinger trough **[332]**. See the *Supplemental Information* section of this manual.

5. Loosen change gear bolt **[218]** two turns. Apply a gear puller to disengage the taper. Remove the gear puller and remove change gear bolt **[218]**, lockwasher **[219]** and change gear washer **[220]**. All change gears are taper hub mounted with three 5/8-11 tapped holes provided for gear puller attachment.

   CAUTION! Release of taper fit can cause the change gear to jump off the shaft if not retained.

6. Remove change gear and key **[221, 222]**.

7. Remove spiral bevel pinion cartridge assembly **[223]** *(Figure 1, page 4)* and shim set **[236]**. Keep the shim set intact for reference at assembly.

8. Remove input shaft bearing cap assembly and gasket **[201, 205]**.

9. Loosen the setscrew in locknut **[208]** two turns. Disengage keyed lockwasher **[209]** and remove locknut.

10. Press input shaft **[212]** out of bearing **[210]** cone through the change gear end of the housing. Proceed slowly when removing the input shaft through the housing to avoid damage to the input shaft.

GEAR DRIVE
Case Sizes 7,8,9

Disassembly (Cont'd)

11. Bearing **[210, 213, 226, and 228]** cups are mounted with interference fits and can be difficult to remove with a commercial bearing puller. Removal can be made easier by welding a 1/8" (3 mm) bead completely around the cup in the center of the roller race. Upon cooling, the cup will shrink allowing removal. Be sure to protect adjacent surfaces from weld spatter.

12. Remove bearing **[210, 213]** cups from the housing.

13. Remove upper bearing cap **[240]** and shim set **[243]**. Keep the shim set intact for reference at assembly.

14. Remove dowel pins **[266]**. Remove bolts **[264]** and housing cover **[263]**.

15. Remove bearing **[241]** cup from housing cover **[263]**.

16. Install a 1/2-13 eyebolt in the end of output shaft **[247]**. Lift the output shaft assembly *(Figure 2, page 5*) out of the housing.

17. Remove lower bearing cap assembly **[256]** and shim set **[259]**. Keep the shim set intact for reference at assembly.

18. Remove bearing **[255]** cup from the housing.

The gear drive is now disassembled into major subassemblies; input shaft, spiral bevel pinion cartridge, output shaft and bearing caps.

NOTE: When the gear drive is fully disassembled, all bearings, lip seals, o-rings, shims and gaskets should be replaced with new parts. When replacing bearings, always replace both cup and cone. Replace gears in sets. Spiral bevel gears must always be replaced in matched sets.

GEAR DRIVE

Case Sizes 7,8,9

Disassembly (Cont'd)

Spiral Bevel Pinion Cartridge

1. Remove the setscrew from locknut **[224]**. Remove the locknut and keyed lockwasher **[225]** from the spiral bevel pinion shaft.

2. Press spiral bevel pinion shaft **[230]** out of bearing **[226]** cone. Press bearing **[228]** cone off the spiral bevel pinion shaft.

3. Remove bearing **[226, 228]** cups from the cartridge housing.

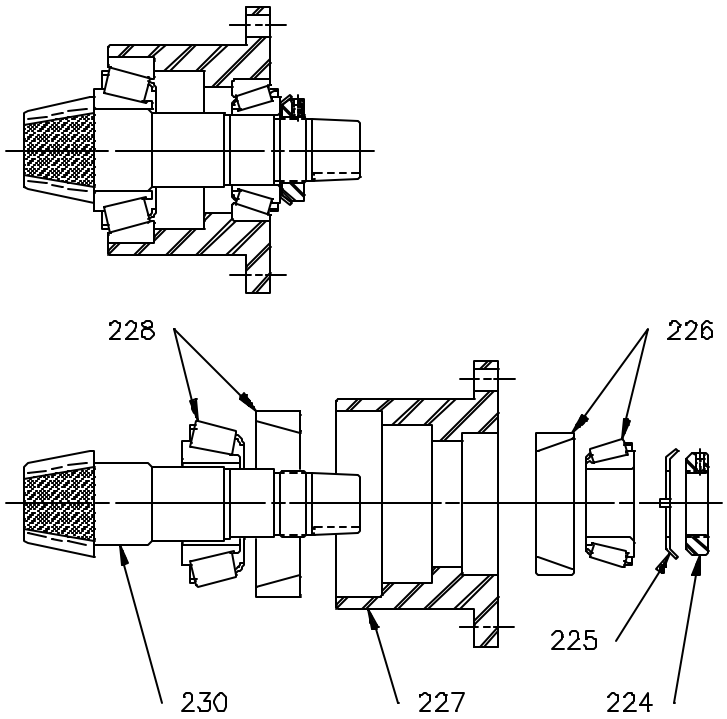

Figure 1: Spiral Bevel Pinion Cartridge Assembly [223]

GEAR DRIVE

Case Sizes 7,8,9

Disassembly (Cont'd)

Output Shaft

1. Remove gear mounting bolts **[249]** and spiral bevel gear **[248]**.
2. Press bearing **[255]** cone off output shaft **[247]**.
3. Press grease retainer **[253]** and bearing **[241]** cone off the output shaft.
4. Remove o-ring **[254]** from the grease retainer.

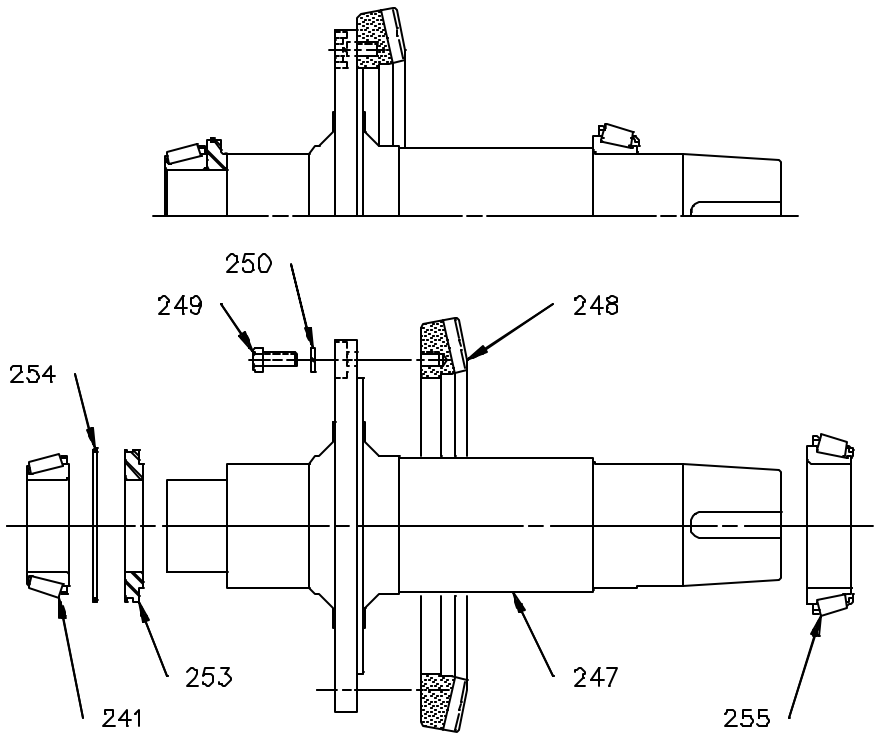

Figure 2: Output Shaft Assembly [246]

GEAR DRIVE

Case Sizes 7,8,9

Disassembly (Cont'd)

Lower Bearing Cap

1. Press lip seal **[258]** out of lower bearing cap **[257]**.

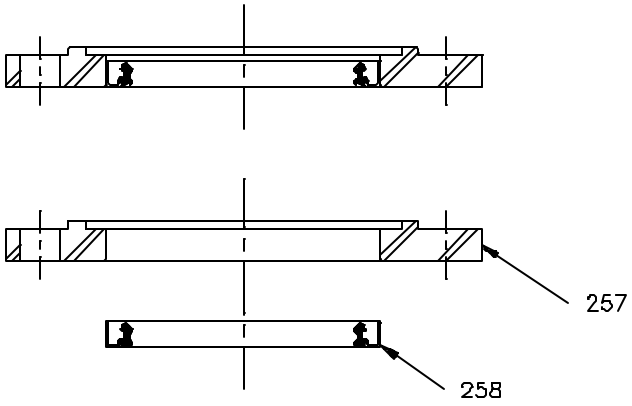

Figure 3: Lower Bearing Cap Assembly [256]

GEAR DRIVE
Case Sizes 7,8,9

Disassembly (Cont'd)

Input Shaft

1. Press bearing **[213]** cone off input shaft **[212]**.

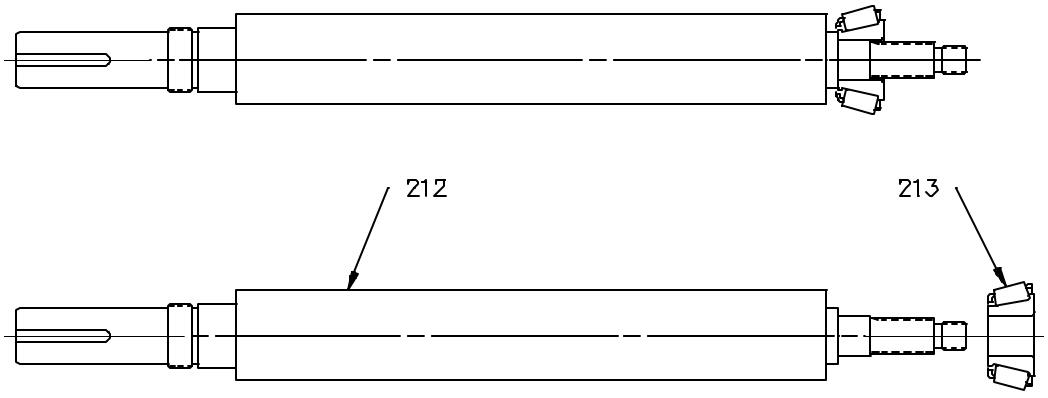

Figure 4: Input Shaft Assembly [211]

GEAR DRIVE

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Disassembly (Cont'd)

Input Shaft Bearing Cap

1. Press lip seal **[204]** out of bearing cap **[203]**.

2. Remove gasket **[205]**.

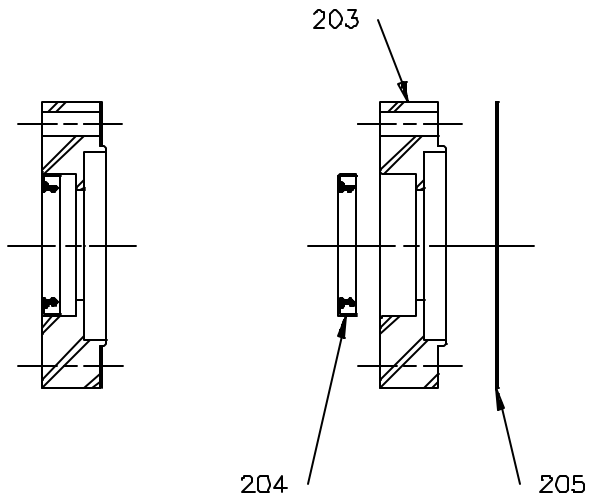

Figure 5: Input Shaft Bearing Cap Assembly [201]

The gear drive is now fully disassembled. Clean all parts and inspect for wear. Replace worn parts as required.

GEAR DRIVE

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Assembly

Inspect all bolts and setscrews for damage after cleaning (threads, shank and head). If replacement is required, replace with the equivalent type and strength grade.

Inspect and clean all tapped holes. If threads are damaged, chase with an appropriate tap.

NOTE: The following assembly procedures require the use of a torque wrench. The values listed in Table 1, page 10 are proper tightening torques as a function of thread size.

All bearing cones are mounted with interference fits. Heat the cones and press onto the shaft. Heat bearings in oven or oil bath.

NOTE: Do not heat parts in excess of 275°F (135°C). Do not apply direct flame. Do not allow parts to touch the bottom or sides of the oven or oil bath.

Bearing **[210, 213, 226 and 228]** cups are mounted with interference fits. Press bearing cups into their housings cold. *Placing the cups in dry ice will cause them to shrink and ease installation.*

Before installing lip seals, clean the cap bore and apply Permatex #2 or equal to the outside of the lip seal. Install lip seal with the seal lip toward the bearing. Before installation on a shaft, coat the shaft and seal lip with bearing grease.

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TABLE 1: BOLT TIGHTENING TORQUE(1),(2)

Bolt Size	CARBON STEEL(3)			
	Grade 2		Grade 5	
	ft lb	Nm	ft lb	Nm
8-32	1.2	1.6	1.9	2.5
10-24	1.7	2.3	2.7	3.6
10-32	1.9	2.6	3.1	4.1
1/4-20	4.1	5.6	6	8.1
5/16-18	8.3	11	13	17
5/16-24	-	-	14	19
3/8-16	15	20	23	31
3/8-24	-	-	26	36
1/2-13	38	51	56	76
1/2-20	-	-	68	92
5/8-11	68	92	113	153
5/8-18	-	-	135	161
3/4-10	120	163	200	271
3/4-16	-	-	225	305
7/8-9	105	143	296	401
1-8	165	224	443	601
1 1/8-7	225	305	596	808
1 1/4-7	315	428	840	1139
1 3/8-6	417	566	1103	1495
1 1/2-6	555	752	1463	1983

(1) Tighten all fasteners to values shown in the table unless specifically instructed to do otherwise.

(2) Lubricate all fasteners at assembly with grease, oil or an anti-seize material. Bolt threads and contact surfaces of bolt heads and nuts should be lubricated.

(3) If fasteners cannot be lubricated, multiply table values by 1.33.

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Case Sizes 7,8,9

Assembly (Cont'd)

Most gear drive bolt patterns are circular with four, six, eight, twelve or sixteen hole spacings. Install all bolts finger tight, then tighten in sequential order (see below) to 50% of the prescribed torque values. Repeat the sequence, tightening the bolts to full torque values.

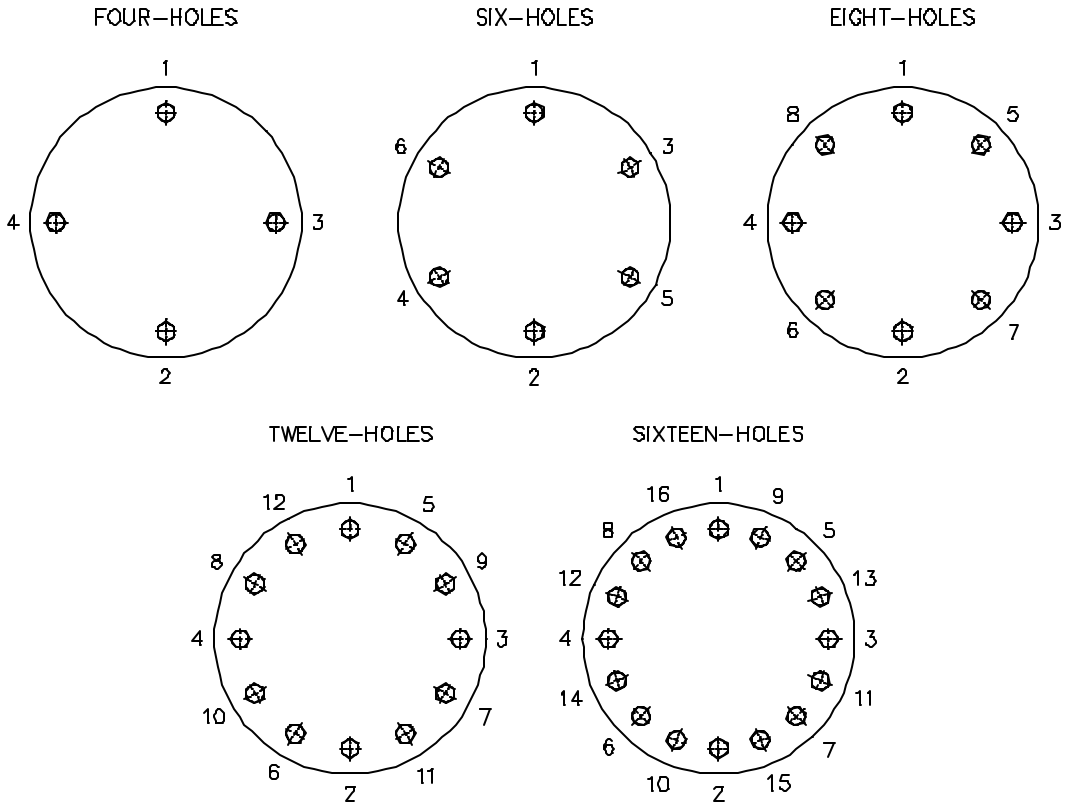

Figure 6: Sequential Tightening

When tightening two or more setscrews which retain a collar, flange, or sleeve to a shaft, tighten alternately, working back and forth or around the shaft. Tighten in several steps to full torque values.

GEAR DRIVE

Case Sizes 7,8,9

Assembly (Cont'd)

Input Shaft Bearing Cap

1. Press lip seal **[204]** into input shaft bearing cap **[203]**.

2. Coat the gasket surface of the input shaft bearing cap with Permatex #2 or equal. Apply gasket **[205]** and align with all the holes in the cap.

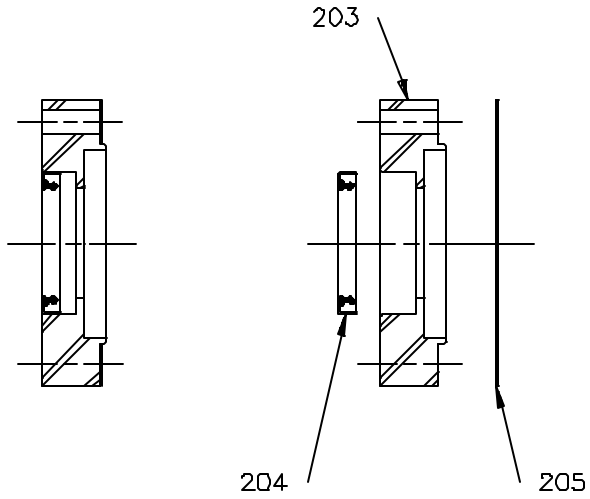

Figure 7: Input Shaft Bearing Cap Assembly [201]

GEAR DRIVE
Case Sizes 7,8,9

Assembly (Cont'd)

Input Shaft

1. Heat bearing **[213]** cone and press onto the spline end of input shaft **[212]**.

2. Assemble change pinion **[215]**, change pinion washer **[216]**, and pinion locknut **[217]**. Tighten the pinion locknut to retain the bearing cone. The bearing cone must be firmly seated against the shaft shoulder. Check with a feeler gage.

   NOTE: Counter-bored side of the change pinion goes against the bearing face.

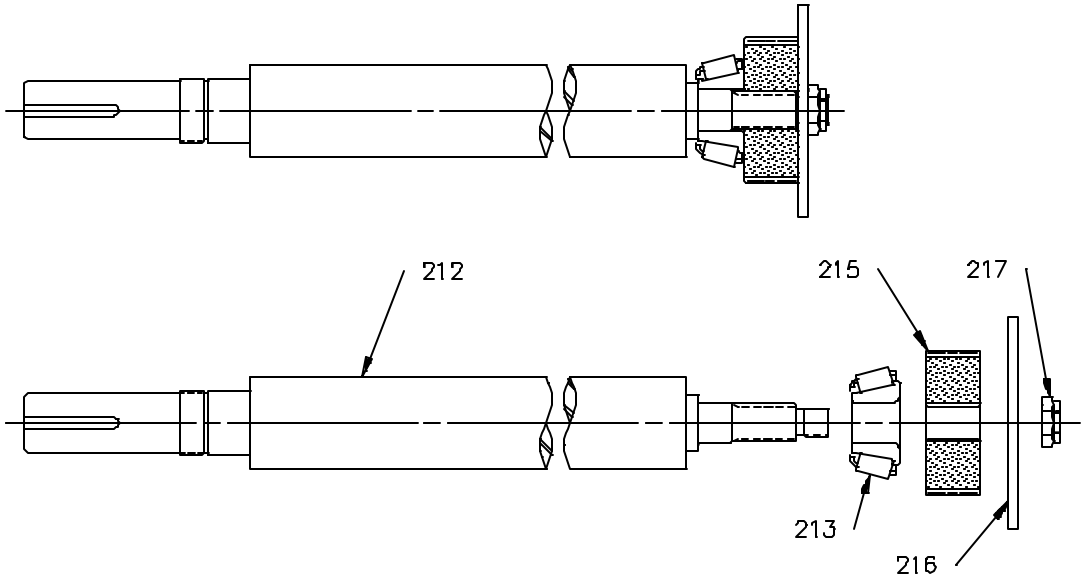

Figure 8: Input Shaft Assembly [211]

GEAR DRIVE

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Assembly (Cont'd)

Lower Bearing Cap

1. Press lip seal **[258]** into lower bearing cap **[257].**

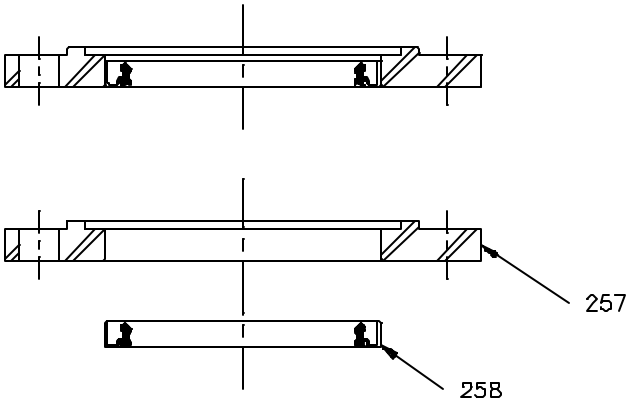

Figure 9: Lower Bearing Cap Assembly [256]

GEAR DRIVE

Case Sizes 7,8,9

Assembly (Cont'd)

Output Shaft

1. Heat grease retainer **[253]** and bearing **[241]** cone and press onto output shaft **[247]**.

2. Heat bearing **[255]** cone and press onto the output shaft. The grease retainer and bearing cones must be firmly seated against the shaft shoulders. Check a with a feeler gage.

3. Install spiral bevel gear **[248]**.

4. Install bolts and lockwashers **[249, 250]** and torque to the value shown in *Table 1, page 10*.

5. Install o-ring **[254]**.

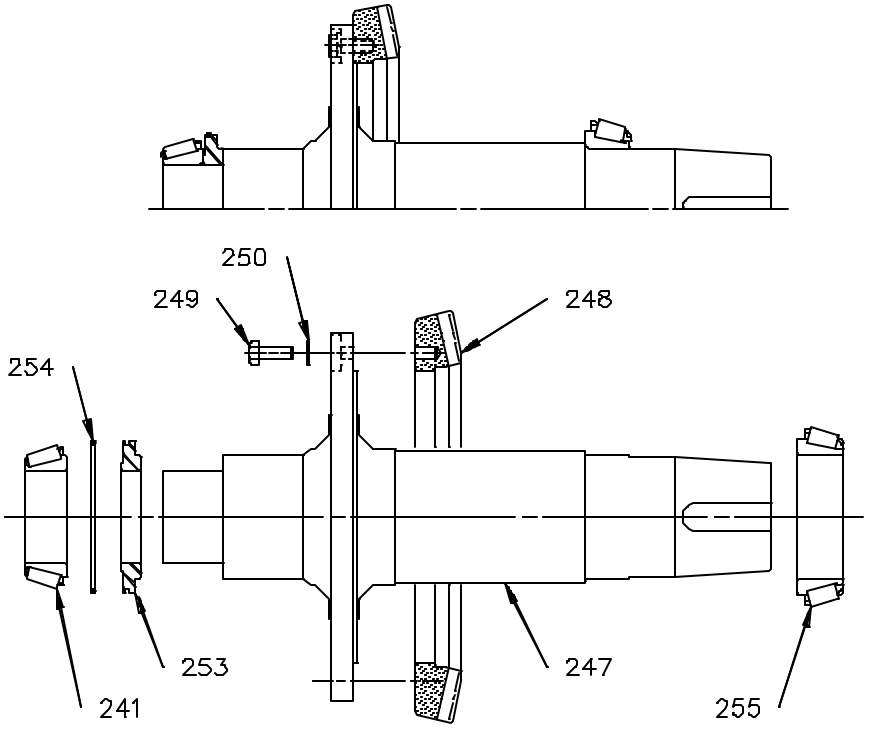

Figure 10: Output Shaft Assembly [246]

GEAR DRIVE

Case Sizes 7,8,9

Assembly (Cont'd)

Spiral Bevel Pinion Cartridge

1. Press bearing **[226, 228]** cups into cartridge housing **[227]**. The bearing cups must be firmly seated against the housing shoulders. Check with a feeler gage.

2. Heat and press bearing **[228]** cone onto spiral bevel pinion shaft **[230]**. Allow the bearing to cool. The cone must be firmly seated against the shaft shoulder. Check with a feeler gage.

3. Insert the spiral bevel pinion shaft into the cartridge housing.

4. Heat bearing **[226]** cone and press it onto the spiral bevel pinion shaft while turning the cartridge housing by hand. The cartridge housing should show slight resistance to turning. Maintain this pressure while the bearing cone cools.

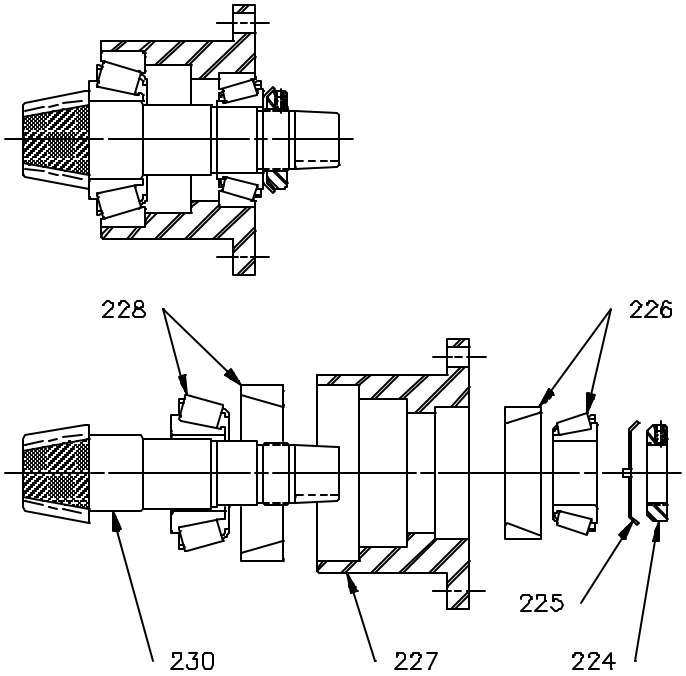

Figure 11: Spiral Bevel Pinion Cartridge Assembly [223]

GEAR DRIVE
Case Sizes 7,8,9

Assembly (Cont'd)

5. Clamp the housing flange of the cartridge assembly in a soft jawed bench vise.

6. Spray the bearings and shaft threads with light machine oil and install locknut and keyed lockwasher **[224, 225]** finger tight.

7. Install bolt **[218]** and tighten securely.

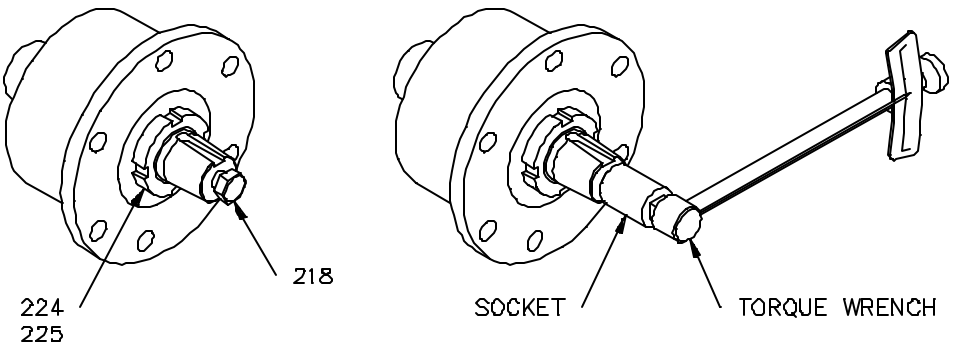

Figure 12: Torque Reading

8. Apply a torque wrench and measure the shaft turning torque. The torque reading is to be taken while rotating the pinion shaft at about 3 rpm. Increase turning torque by tightening locknut **[224]**. Turn shaft one complete revolution between adjustments. Adjust to:

Case Size 7: 25 in lb (2.8 Nm)
Case Size 8: 30 in lb (3.4 Nm)
Case Size 9: 40 in lb (4.5 Nm)

GEAR DRIVE

Case Sizes 7,8,9

Assembly (Cont'd)

9. Engage keyed lockwasher **[225]** and torque locknut **[224]** setscrew to the value shown in *Table 1, page 10*. Precision measure and record the assembled height "A" of the spiral bevel pinion cartridge assembly. This measurement will be required to set the mounting distance of the spiral bevel pinion. Delete the original dimension stamped on the cartridge housing.

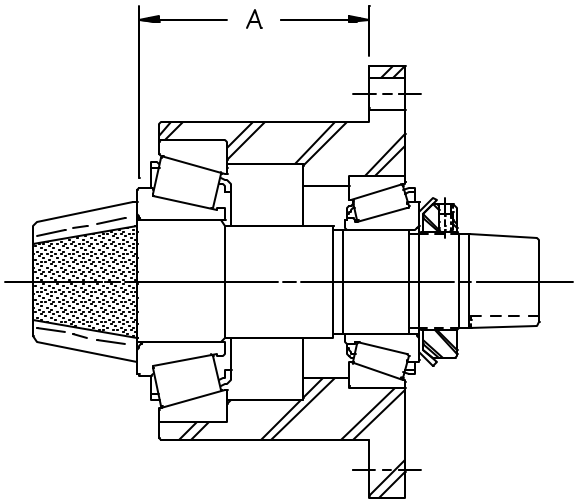

Figure 13: Cartridge Measurement

GEAR DRIVE
Case Sizes 7,8,9

Assembly (Cont'd)

Gear Drive

1. Calculate required pinion cartridge shim set **[236]** thickness as follows:

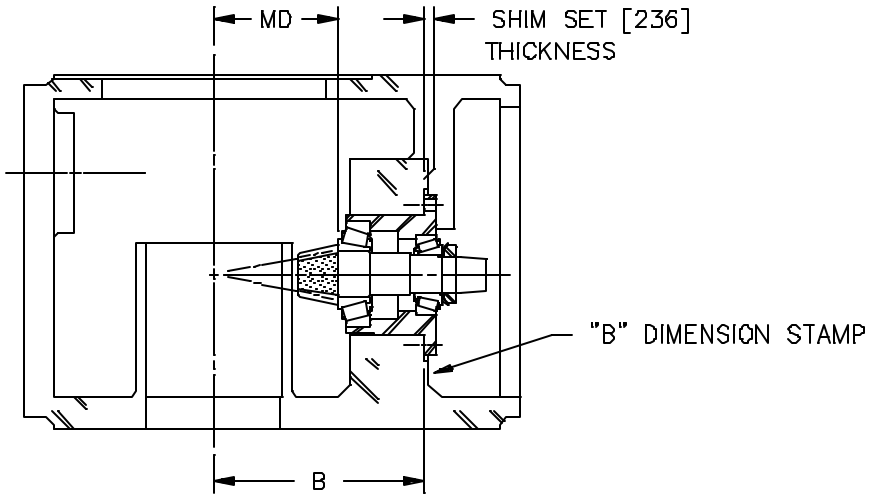

Figure 14: Shim Calculation

A+MD ! B = Shim set **[236]** thickness

MD = Pinion mounting distance (MD X.XXX) etched on the small end of the pinion.

B = Dimensional value marked on the housing.

A = Assembled cartridge height measurement *(Figure 13, page 18.)*

2. Using a paint stick, highlight the top edge of the tooth marked with an "X" on the spiral bevel pinion.

3. Install spiral bevel pinion cartridge assembly **[223]** and shim set **[236]** into the housing.

4. Install bolts and lockwashers **[237, 238]** and torque to the value shown in *Table 1, page 10*.

GEAR DRIVE
Case Sizes 7,8,9

Assembly (Cont'd)

5. Measure with a micrometer the thickness of original shim set **[259]** for the lower bearing cap and duplicate the thickness with new shims.

Example:

If the thickness of the old shim set was .062", use (12) blue shims and (1) red shim to equal .062" when compressed.

Red = .002" (.051 mm) thick
Blue = .005" (.127 mm) thick

6. Install bearing **[255]** cup, lower bearing cap assembly **[256]** and new shim set **[259]** into housing **[262]**. Install bolts and lockwashers **[260, 261]**. Torque to the value shown in *Table 1, page 10*.

7. Position the housing so that the lower bearing cap is down. Rotate the spiral bevel pinion shaft until the tooth marked "X" is on top center.

8. Using a paint stick, highlight the "X" match marks on the outside of spiral bevel gear **[248]**.

9. Spray bearings **[241, 255]** with light machine oil and lower output shaft assembly **[246]** into the housing. *CAUTION! Make sure the spiral bevel gear teeth marked "X" straddle the pinion shaft tooth marked "X".*

10. Coat the housing/housing cover mating surfaces with Permatex #2 or equal. Install housing cover **[263]**, dowel pins **[266]**, bolts and lockwashers **[264, 265]**. Torque bolts to the value shown in *Table 1*.

11. Install bearing **[241]** cup into housing cover.

12. Install upper bearing cap **[240]**. Bolt in place using four equally spaced bolts **[244]**. Alternately tighten bolts until the upper bearing cap is seated on the bearing. *Do not torque the bolts; snug-up only.*

GEAR DRIVE
Case Sizes 7,8,9

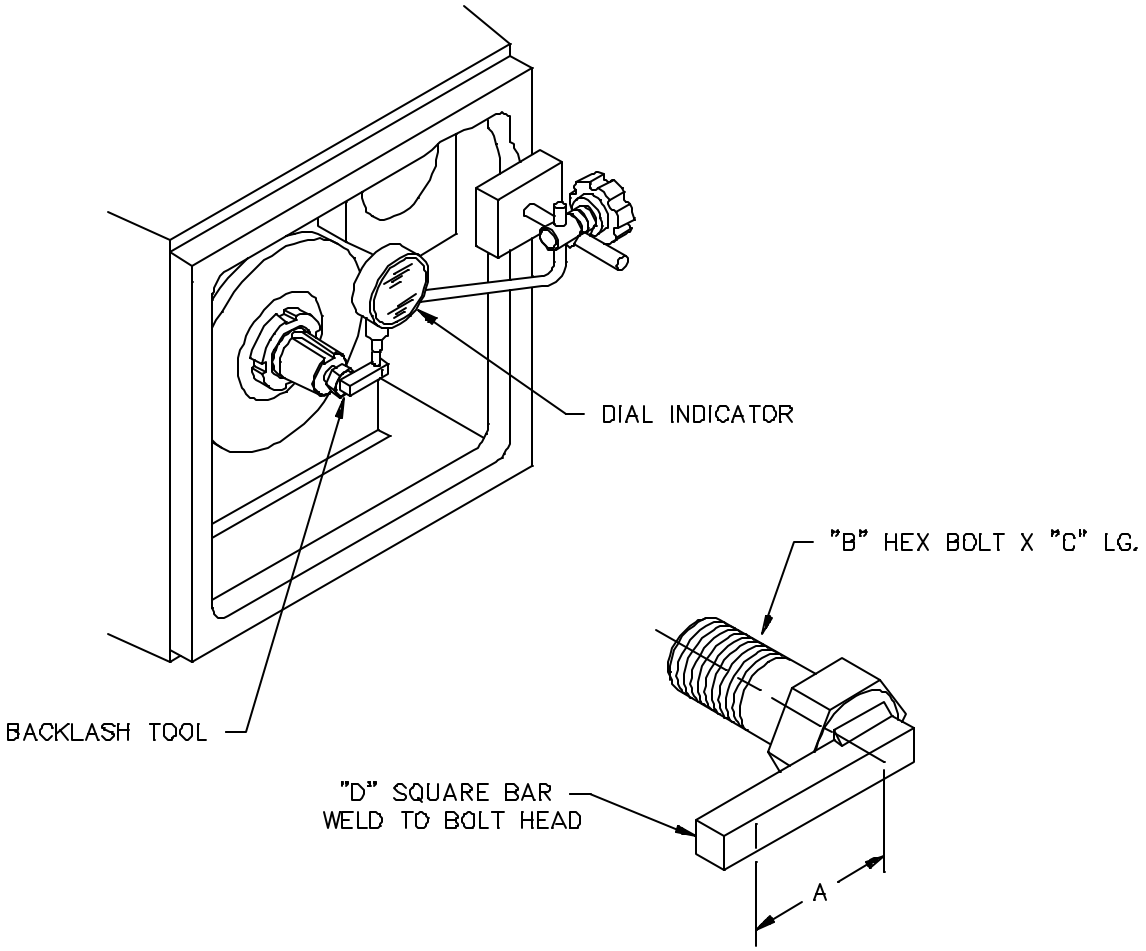

Figure 15: Backlash Setting

TABLE 2: BACKLASH SETTING

Case Size	A	B	C	D
7	1!1/2" (38.1 mm)	7/8-9	1!1/2" (38.1 mm)	3/8" (9.5 mm)
8	1!5/8" (41.3 mm)	7/8-9	1!1/2" (38.1 mm)	3/8" (9.5 mm)
9	1!13/16" (46.0 mm)	7/8-9	1!1/2" (38.1 mm)	3/8" (9.5 mm)

GEAR DRIVE
Case Sizes 7,8,9

Assembly (Cont'd)

13. Install a backlash tool (supplied by others) *(Figure 15, page 21)* in the spiral bevel pinion shaft and measure the backlash by placing a dial indicator against the backlash tool at a right angle to the rotation. Restrain the output shaft from turning and rotate the spiral bevel pinion shaft back and forth to measure the free movement.

    The Backlash Setting (Full Indicator Movement) is etched on the spiral bevel gear.

14. Take five (case size 7) or six (case sizes 8 and 9) consecutive backlash readings. Rotate the spiral bevel pinion shaft one revolution counterclockwise after each reading. Turn the pinion shaft back to the position of the lowest backlash reading.

15. Add shims **[259]** to lower bearing cap assembly **[256]** to decrease backlash; remove shims to increase backlash.

    NOTE: Before each shim adjustment, the bolts on the upper bearing cap should be loosened. After changing the shims, the bolts on the lower bearing cap should be torqued to the value shown in Table 1, page 10 and then the bolts on the upper bearing cap should be snugged-up.

16. Measure the gap between upper bearing cap **[240]** and the housing cover. Count out new shims equal to the gap plus .003" to .004" to provide a bearing setting of .003" to .004" (.076 mm to .102 mm) endplay.

17. Install upper bearing cap **[240]** with new shim set **[243]**. Install bolts and lockwashers **[244, 245]** and torque to the value shown in *Table 1*.

18. Check the output shaft endplay. If adjustment is required, add or subtract from shim set **[243]** to obtain .003" to .004" (.076 mm to .102 mm) endplay.

19. Press bearing **[210, 213]** cups into the housing. The bearing cups must be firmly seated against the housing shoulders. Check with a feeler gage.

20. Install input shaft assembly **[211]** into the housing through the change gear end.

GEAR DRIVE

Case Sizes 7,8,9

Assembly (Cont'd)

21. Heat bearing **[210]** cone and press onto the input shaft.

22. Spray locknut **[208]** threads and face, and bearings **[210, 213]** with light machine oil. Install and tighten the locknut against the bearing cone face.

23. Apply torque wrench to pinion locknut **[217]** and measure the turning torque while rotating the input shaft at approximately 3 rpm.

24. Increase turning torque by tightening locknut **[208]**. To decrease torque, loosen the locknut and drive the input shaft axially (using a rawhide mallet). Turn the input shaft one complete revolution between adjustments. Adjust to:

    Case Size 7: 10 in lb (1.13 Nm)
    Case Size 8: 15 in lb (1.69 Nm)
    Case Size 9: 25 in lb (2.82 Nm)

25. Remove the bearing locknut and install keyed lockwasher **[209]**. Reinstall the bearing locknut and tighten against the bearing. Check the turning torque.

26. Torque locknut **[208]** setscrew to the value shown in *Table 1, page 10*. Engage the keyed lockwasher.

27. Place input shaft bearing cap assembly **[201]** over the end of the input shaft. Align the four cap bolt holes with the four housing bolt holes. The fifth hole orients at the 6 o'clock position.

28. Assemble the input shaft bearing cap assembly to the housing with bolts and lockwashers **[206, 207]**. Torque the bolts to the value shown in *Table 1*.

29. Remove pinion locknut **[217]**, change pinion washer **[216]** and change pinion **[215]**.

30. Slide change gear **[221]** (taper bore) into place on spiral bevel pinion shaft **[230]**. The change gear bore and spiral bevel pinion shaft must be clean and dry prior to assembly.

31. Install key, bolt, lockwasher and change gear washer **[222, 218, 219 and 220]**. Torque the bolt to the value shown in *Table 1*.

GEAR DRIVE

Case Sizes 7,8,9

Assembly (Cont'd)

32. If the gear drive is equipped with a low speed oil slinger, install slinger trough **[332]**. See the *Supplemental Information* section of this manual.

33. Reinstall the change pinion, change pinion washer and pinion locknut. *NOTE: Counter-bored side of the change pinion goes against the bearing face.* Torque the locknut to the value shown below:

    Case Sizes 7, 8, 9: 600 ft lb (813 Nm)

34. Coat the gasket surface of change gear cover **[276]** with Permatex #2 or equal. Align holes and apply a new gasket **[277]** to the change gear cover.

35. Install the change gear cover with bolts and lockwashers **[278, 279]**. Torque the bolts to the value shown in *Table 1, page 10.*

36. Rotate the input shaft by hand until the output shaft makes at least one turn. Check for any binding.

37. Add grease to bearings **[241, 255]** and fill the gear housing with oil. See *Agitator IOM Manual, Lubrication, Gear Drive.*

38. Reinstall gear drive coupling half **[351]**. See *Agitator IOM Manual, Installation, Rigid Shaft Coupling.*

39. Reinstall motor bracket **[131]** and motor **[100]**. See *Agitator IOM Manual, Installation.*

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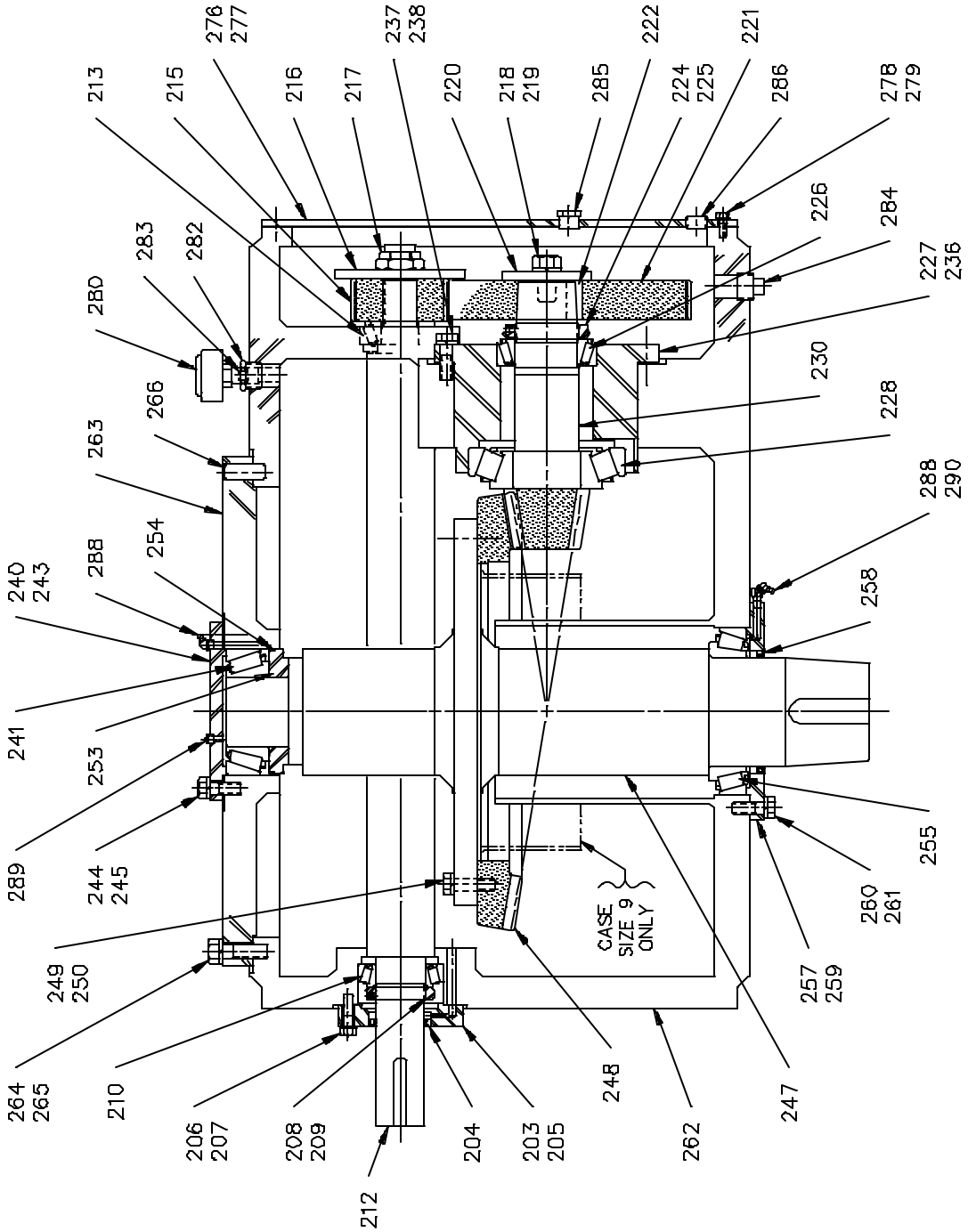

Figure 16: HT Gear Drive: Sizes 7,8,9

GEAR DRIVE ITEM LIST
Case Sizes 7,8,9

Item #	Description	Qty.
200	**gear drive assembly**	**1**
201	**input shaft bearing cap assembly**	**1**
203	bearing cap	1
204-002	lip seal	1
205	gasket	1
206	bolt	4
207	lockwasher	4
208-002	locknut with setscrew	1
209	keyed lockwasher	1
210-001	bearing	1
211	**input shaft assembly**	**1**
212	input shaft	1
213-001	bearing	1
215	change pinion	1
216	change pinion washer	1
217-001	pinion locknut	1
218	bolt	1
219	lockwasher	1
220	change gear washer	1
221	change gear	1
222	key	1

Item #	Description	Qty.
223	**spiral bevel pinion cartridge assembly**	**1**
224-001	locknut with setscrew	1
225	keyed lockwasher	1
226	bearing	1
227	cartridge housing	1
228	bearing	1
230	spiral bevel pinion shaft	1
236	shim set	1
237	bolt	
238	lockwasher	
240	upper bearing cap	1
241	bearing	1
243	shim set	1
244	bolt	8
245	lockwasher	8
246	**output shaft assembly**	**1**
247	output shaft	1
248-001	spiral bevel gear	1
249	bolt	12
250	lockwasher	12
253	grease retainer	1
254	o-ring	1
255	bearing	1

Item #	Description	Qty.
256	**lower bearing cap assembly**	**1**
257	lower bearing cap	1
258-002	lip seal	1
259	shim set	1
260	bolt	8
261	lockwasher	8
262	housing	1
263	housing cover	1
264	bolt	8
265	lockwasher	8
266	dowel pin	2
276	change gear cover	1
277	gasket	1
278	bolt	18
279	lockwasher	18
280-001	breather	1
282	hex bushing	1
283	pipe plug, NPT	1
284	magnetic drain plug, NPT	1
285	oil level sight glass	1
286	pipe plug, NPT	1
288	grease fitting	2
289	relief fitting	1
290	elbow fitting	1