

Removal and Installation

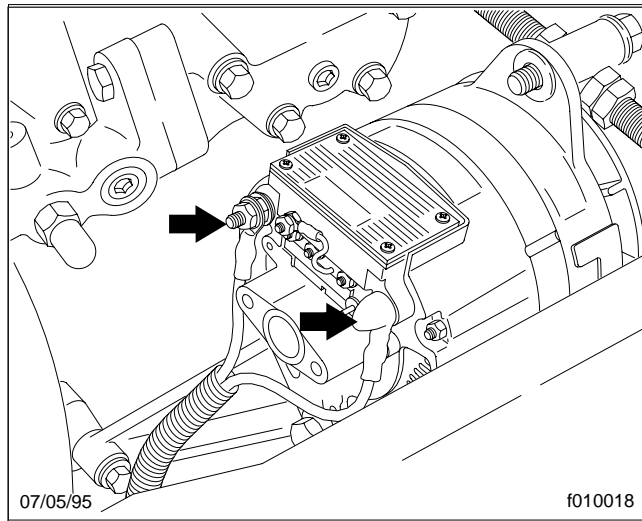


Fig. 11, Alternator Wires

33. Remove the rear engine-support upper bearing washers and upper isolators from both of the frame-mounted engine-support brackets.

Remove the front engine-support top isolators, isolator tubes, and bushings from the front crossmember.

Installation

1. Check all of the front and rear engine support components for damage and extreme wear. Replace the components as needed.
2. Install the isolator tubes and the top isolators in the engine front crossmember. Coat the rubber mounts with soapy water, and install them in the rear engine mounts.

CAUTION

Don't lubricate the components with oil, grease, or silicone lubricants, because they will soften the rubber and damage the mounts.

3. Attach the lifting device to the engine lifting eyes. Attach the A-frame or overhead crane to the lifting device.
4. Lift the engine and transmission high enough to clear the chassis. Lower the engine and transmission into position on the front and rear engine-support mounts.

5. Using a floor jack, raise the transmission high enough to allow insertion and alignment of the rear engine-support upper isolators and bearing washers. Support the transmission on a safety stand, just in front of or just behind the floor jack.

Install and align the upper isolators and bearing washers, and install the rear engine-support bolts. Remove the safety stand, lower the transmission, and remove the floor jack.

WARNING

Failure to position a safety stand under the transmission could result in personal injury if the engine and transmission assembly were to shift or drop.

6. Position the cab-mount (overslung) crossmember against the back of the frame mounted cab-support brackets. Using new bolts, install the longer attachment bolts with washers in the upper holes, and the shorter bolts with washers in the lower holes. Install new nuts, and progressively tighten them to 70 lbf-ft (95 N·m).
7. Install the lower, rear engine-support isolators, lower bearing washers, and locknuts on the bottom of the rear engine-support bolts. Tighten the locknuts 160 lbf-ft (217 N·m).
8. Position the bearing washers on the front engine-support bolts. Install the bolts upward through the front engine-support bracket and the engine front crossmember. Install the flanged locknuts; progressively tighten the locknuts to 210 lbf-ft (285 N·m).
9. Remove the lifting device.
10. If it was removed, install the relay valve and bracket on the engine front crossmember. Tighten the nuts 13 lbf-ft (18 N·m).
11. Install the clutch-release lever on the clutch-release shaft, aligning the mark on the lever with the mark on the shaft. Tighten the release-lever pinch bolt 40 lbf-ft (54 N·m).
12. Remove the cardboard cover from the opening in the transmission, and lower the shift tower into place. Install the lockwashers and capscrews. Tighten the capscrews 40 lbf-ft (54 N·m).
13. Install the transmission support spring. Tighten the bolts 125 lbf-ft (169 N·m).

Removal and Installation

14. Connect the air lines to the splitter (if so equipped), as previously marked.
15. Connect the transmission air supply line to the transmission.
16. Connect the driveline to the transmission output yoke. For instructions, refer to the driveline section in this manual.
17. Install the engine exhaust outlet pipe onto the turbocharger outlet, and tighten the V-type clamp nut 85 lbf-in (940 N-cm). Connect the wiring for the pyrometer, if equipped.
18. Install the air cleaner on the air intake duct and the mounting bracket. Using hose clamps, install the rubber connecting hose on the air cleaner inlet and the aluminum tube. Tighten the clamp screws 70 to 80 lbf-in (800 to 900 N-cm).
19. Attach the fuel return hose clamp to the fuel filter mounting plate. Connect the fuel return hose to the engine, and the fuel supply hose to the fuel filter.
20. Connect the terminal of the starter motor ground cable to the ground weld-stud in the channel of the left frame rail. Tighten the cap nut 23 lbf-ft (31 N-m). As marked earlier, connect the wiring to the starter.
21. Attach the battery cables to the standoff brackets under the engine and transmission.
22. Attach the throttle rod to the throttle pedal arm. For instructions, refer to the throttle linkage section in this manual.
23. Connect the power steering hoses to the power steering reservoir and the power steering pump.
24. Connect the air-tank air hoses to the elbow fittings on the air compressor governor. Attach the discharge line to the air compressor.
25. Connect all clamps that attach the air hoses to the engine and transmission.
26. Connect the heater hoses to the engine. Attach the radiator hoses and associated clamps to the engine. Tighten the hose clamps snug, but don't overtighten them.
27. Connect the speedometer, tachometer, and the oil level sending unit wiring connections.
28. Inspect the radiator support isolators for wear or damage, and replace them as needed. Place the radiator support lower isolators on the front crossmember.
29. Install the radiator assembly. For instructions, refer to the radiator section in this manual.
30. Connect the three radiator brace rods to the brace rod rear brackets. Tighten the brace rod fasteners 70 lbf-ft (95 N-m).
31. If equipped with an air conditioner:
 - 31.1 At all refrigerant hose fittings, install a new rubber O-ring, and lubricate the O-rings and fitting threads with refrigerant oil. Apply Loctite® 242 or 592 to the male portion of the fitting threads.
 - 31.2 Connect the refrigerant hoses to the refrigerant condenser, and compressor.
32. Tilt the hood until it is balanced over the pivots. While a coworker holds the hood in this position, connect the tilt assist cables to the brackets on top of the radiator at each side. If cable links are used, apply Loctite 242 to the threads on the cable links before screwing them closed.
33. Remove the hood supports from the front of the vehicle and tilt the hood all the way open.
34. As marked earlier, connect the wires for the PACE engine control system.
35. Connect the alternator wires.
36. Connect the positive battery cable to the batteries. Connect the negative battery cables.
37. Fill the cooling system with coolant, using the instructions in the radiator section in this manual.
38. Fill and bleed the power steering system, using the instructions in the steering section in this manual.
39. If equipped with air conditioning, evacuate and charge the system, using the instructions in the air conditioning section in this manual.
40. Install the grill. Refer to the hood section in this manual for instructions.

Engine Support Fasteners		
Description	Size	Torque lbf-ft (N·m)
Overslung Crossmember Bolts	1/2-13	70 (95)
Rear Engine-Support Locknuts	5/8-11	160 (217)
Front Engine-Support Locknuts	3/4-10	210 (285)
Engine Leg-to-Flywheel Bolts	3/4-10 x 1.75 inches	190 (258)

Table 1, Engine Support Fasteners

Removal, Installation, and Adjustment, Cummins NTC

Removal

REFRIGERANT COMPRESSOR BELT (See Fig. 1)

1. Back off the adjusting nut (Ref. E), then loosen the mounting nuts (Refs. A and F) and the adjusting link bolt (Ref. B) just enough to allow movement of the compressor.
2. Push the loosened compressor toward the accessory drive pulley until the distance between them is short enough to allow belt removal without using force.
3. Remove the belt, without prying or rolling it off of the pulleys.

FAN BELTS (See Fig. 2)

1. Remove the refrigerant compressor belt, if so equipped.
2. Loosen the nuts on the bolts (Ref. A) that secure the fan hub to the fan hub bracket.
3. Turn the fan hub adjusting bolt (Ref. B) until there is minimal distance between the pulley centers.
4. Remove both fan belts by slipping them off of the pulleys and working them over one fan blade at a time. Don't roll or pry the belts off of the pulleys; the distance between the pulley centers must be short enough to allow belt removal without using force.

WATER PUMP BELT (See Fig. 2)

1. Remove the refrigerant compressor belt (if so equipped) and both fan belts.
2. Loosen the locknut that secures the idler pulley (Ref. D) to the water pump.
3. Turn the idler pulley adjusting bolt (Ref. C) until there is minimal distance between the pulley centers.
4. Remove the belt, without prying or rolling it off of the pulleys.

ALTERNATOR BELTS (See Fig. 3)

1. Loosen the fastener (Ref. A) that attaches the adjusting rod to the engine, and loosen the fas-

teners (Refs. E and F) that attach the alternator to the adjusting link and the mounting bracket.

2. Back off the adjusting nut (Ref. B), to allow the alternator to be moved toward the drive pulley far enough to remove the drive belt without prying or twisting it.
3. Push in on the alternator, and remove the belt.

Installation

ALTERNATOR BELTS (See Fig. 3)

1. Inspect the pulleys and used alternator belts (even if new belts are being installed) as instructed in **Subject 180**.
2. Make sure the distance between the pulleys is short enough to allow belt installation without using force.
3. Install the belts on the pulleys without prying or rolling them into place.
4. Back off the jam nut (Ref. D) to the end of the adjusting rod.
5. While keeping the belts seated in the pulley grooves, turn the adjusting nut (Ref. B) against the adjusting link (Ref. C) to increase belt tension. Use your thumb to apply about 25 lbs (11 kg) of force at the center of the belt free-span to check the tension while turning the nut. When belt deflection equals one belt thickness per foot (305 mm) of pulley-center distance, proceed to "Adjustment: Alternator Belts."

WATER PUMP BELT (See Fig. 2)

1. Inspect the pulleys and used water pump belt (even if a new belt is being installed) as instructed in **Subject 180**.
2. Make sure the distance between the pulleys is short enough to allow belt installation without using force.
3. Install the belt on the pulleys without prying or rolling it into place. Be sure the ribs on the belt are seated in the grooves on each pulley.
4. While keeping the belt seated in the pulley grooves, turn the idler pulley adjusting bolt (Ref. C) to increase belt tension. Use your thumb to apply about 25 lbs (11 kg) of force at the center

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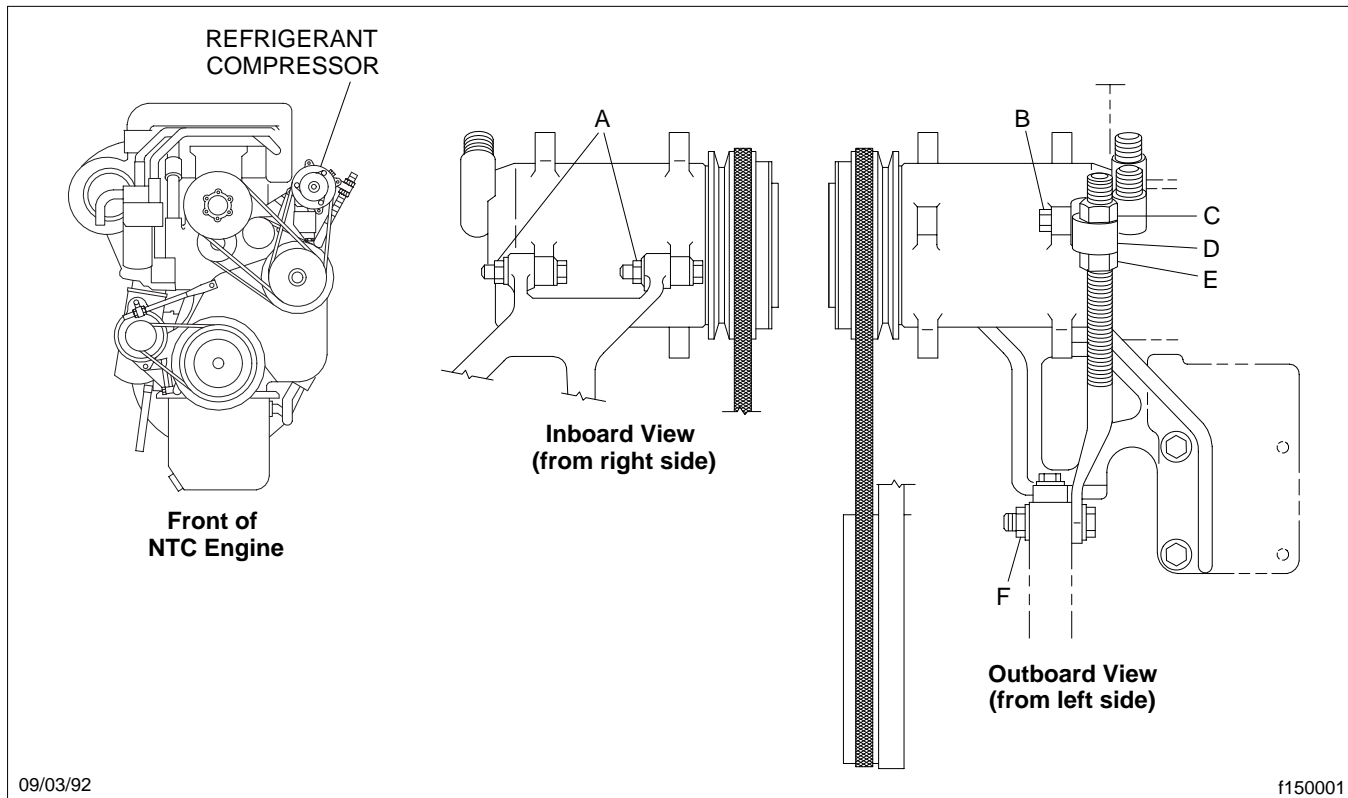


Fig. 1

of the belt free-span to check the tension while turning the bolt. When belt deflection equals one belt thickness per foot (305 mm) of pulley-center distance, proceed to "Adjustment: Water Pump Belt."

FAN BELTS (See Fig. 2)

1. If the water pump belt was removed, install and adjust it first.
2. Inspect the pulleys and used fan belts (even if new belts are being installed) as instructed in [Subject 180](#).
3. Make sure the distance between the pulleys is short enough to allow belt installation without using force.
4. Work the belts over the fan blades, one blade at a time. Install the belts on the pulleys without prying or rolling them into place.
5. While keeping the belts seated in the pulley grooves, turn the fan hub adjusting bolt (Ref. B)

to increase belt tension. Use your thumb to apply about 25 lbs (11 kg) of force at the center of the belt free-span to check the tension while turning the bolt. When belt deflection equals one belt thickness per foot (305 mm) of pulley-center distance, proceed to "Adjustment: Fan Belts."

REFRIGERANT COMPRESSOR BELT (See Fig. 1)

1. If the water pump belt or fan belts were removed, install and adjust them first.
2. Inspect the pulleys and used refrigerant compressor belt (even if a new belt is being installed) as instructed in [Subject 180](#).
3. Make sure the distance between the pulleys is short enough to allow belt installation without using force.
4. Install the belt on the pulleys without prying or rolling it into place.

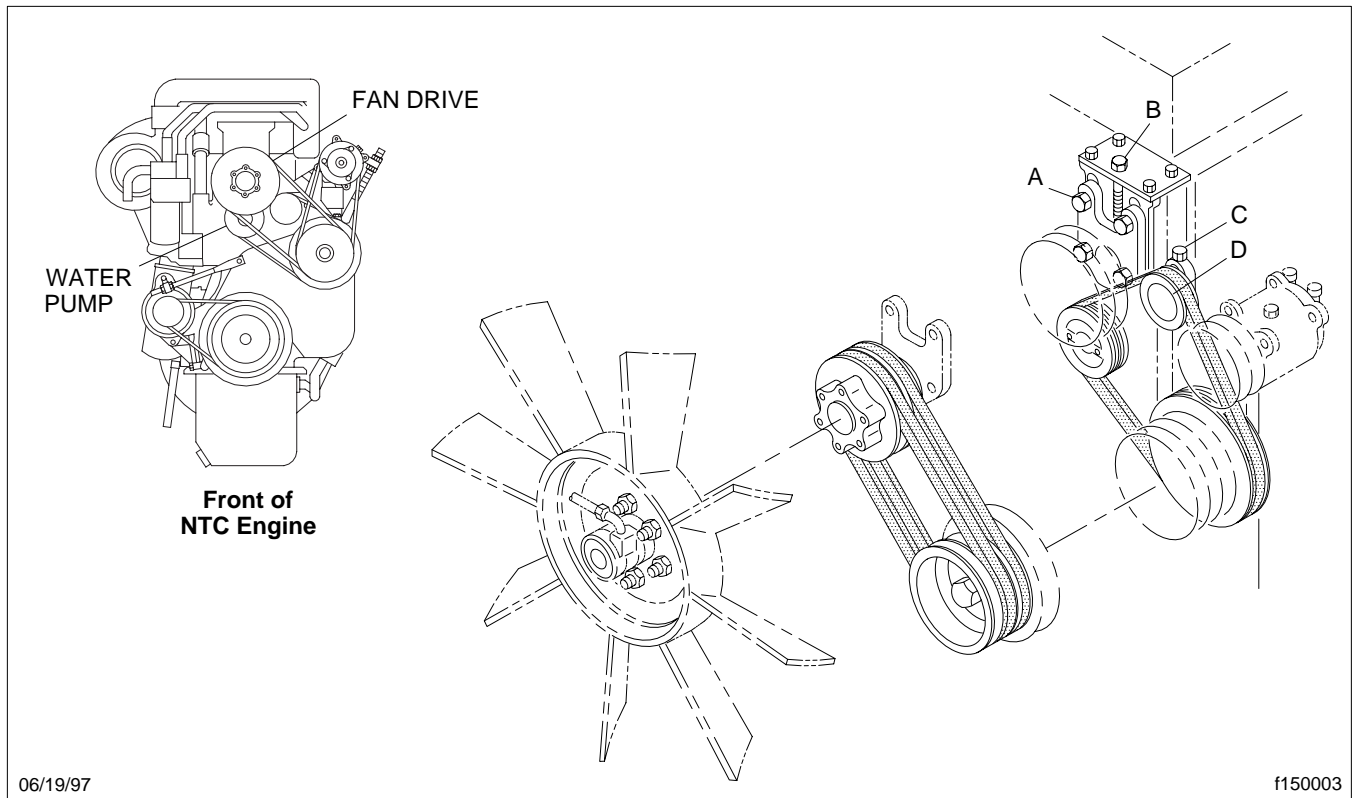
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Fig. 2

5. Back off the jam nut (Ref. C) to the end of the adjusting rod.
6. While keeping the belt seated in the pulley grooves, turn the adjusting nut (Ref. E) against the adjusting link (Ref. D) to increase belt tension. Use your thumb to apply about 25 lbs (11 kg) of force at the center of the belt free-span to check the tension while turning the nut. When belt deflection equals one belt thickness per foot (305 mm) of pulley-center distance, proceed to "Adjustment: Refrigerant Compressor Belt."
2. Install a belt tension gauge at the center of the free-span of one of the belts.
3. Turn the adjusting nut (Ref. B) to adjust the tension to a reading of 130 to 150 lbs (59 to 68 kg) for new belts, or 80 to 120 lbs (36 to 55 kg) for used belts. A used belt is any belt that has been in operation more than ten minutes.

IMPORTANT: Do not overtighten the belts; too much tension shortens belt life and bearing life.

Adjustment

ALTERNATOR BELTS (See Fig. 3)

1. If not already done, back off the adjusting link jam nut (Ref. D). Loosen the mounting fasteners (Refs. E and F) just enough to allow movement of the alternator, and loosen the fastener (Ref. A) that attaches the adjusting rod to the engine.
4. Tighten the adjusting link jam nut (Ref. D) 155 lbf-ft (210 N·m).
5. Tighten the alternator mounting fasteners (Refs. E and F) and the adjusting-rod bolt (Ref. A) 70 lbf-ft (95 N·m).
6. Check the belt tension, and adjust it if needed.
7. If new alternator belts were installed, operate the engine for about 20 minutes, then check the belt tension. All new belts will lose tension after 20 minutes of operation.

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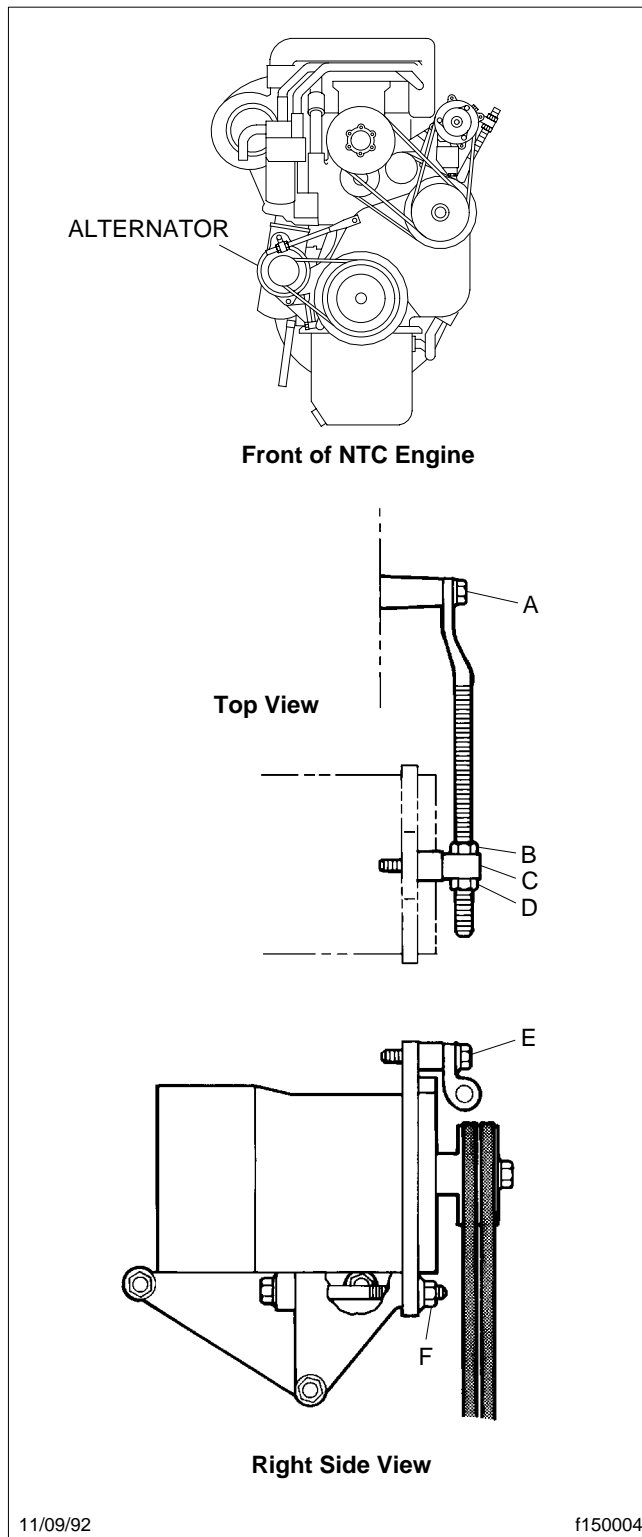


Fig. 3

If the alternator belt tension is not between 80 and 120 lbs (36 to 55 kg), adjust the tension to 120 lbs (55 kg).

WATER PUMP BELT (See Fig. 2)

1. If not already done, loosen the locknut that secures the idler pulley (Ref. D) to the water pump.
2. Install a belt tension gauge at the center of the belt's longest free-span.
3. Turn the idler pulley adjusting bolt (Ref. C) to increase or decrease the belt tension, but do not adjust the tension to the full value with the adjusting bolt; belt tension can increase when the idler pulley shaft locknut is tightened. Final tension must be 140 to 160 lbs (64 to 73 kg) for a new belt, or 90 to 120 lbs (41 to 55 kg) for a used belt. A used belt is any belt that has been in operation more than ten minutes.

IMPORTANT: Do not overtighten the belt; too much tension shortens belt life and bearing life.

4. Tighten the idler pulley shaft locknut 50 lbf-ft (70 N·m).
5. Loosen the idler pulley adjusting bolt one-half turn to prevent breakage.
6. Check the belt tension, and adjust it if needed.
7. Install and adjust both fan belts and the refrigerant compressor belt (if so equipped).
8. If any new belts were installed, operate the engine for about 20 minutes, then check the belt tension. All new belts will lose tension after 20 minutes of operation.

If the water pump belt tension is not between 90 and 120 lbs (41 to 55 kg), adjust the tension to 120 lbs (55 kg).

FAN BELTS (See Fig. 2)

1. If not already done, loosen the nuts on the bolts (Ref. A) that secure the fan hub to the fan hub bracket.
2. Install a belt tension gauge at the center of the free-span of one of the belts.
3. Turn the fan hub adjusting bolt (Ref. B) to increase or decrease belt tension, but do not adjust the tension to the full value with the adjusting bolt; belt tension can increase when the fan

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hub bracket nuts are tightened. Final tension must be 130 to 150 lbs (59 to 68 kg) for new belts, or 80 to 120 lbs (36 to 55 kg) for used belts. A used belt is any belt that has been in operation more than ten minutes.

IMPORTANT: Do not overtighten the belts; too much tension shortens belt life and bearing life.

4. Tighten the fan hub bracket nuts 80 lbf-ft (110 N·m).
5. Loosen the fan hub adjusting bolt one-half turn to prevent breakage.
6. Check the belt tension, and adjust it if needed.
7. Install and adjust the refrigerant compressor belt, if so equipped.
8. If any new belts were installed, operate the engine for about 20 minutes, then check the belt tension. All new belts will lose tension after 20 minutes of operation.

If the fan belt tension is not between 80 and 120 lbs (36 to 55 kg), adjust the tension to 120 lbs (55 kg).

6. Check the belt tension, and adjust it if needed.
7. If a new refrigerant compressor belt was installed, operate the engine for about 20 minutes, then check the belt tension. All new belts will lose tension after 20 minutes of operation.

If the refrigerant compressor belt tension is not between 80 and 100 lbs (36 to 45 kg), adjust the tension to 100 lbs (45 kg).

**REFRIGERANT COMPRESSOR
BELT (See Fig. 1)**

1. If not already done, back off the adjusting link jam nut (Ref. C) to the end of the adjusting rod, and loosen the mounting nuts (Refs. A and F) and adjusting link bolt (Ref. B) just enough to allow movement of the compressor.
2. Install a belt tension gauge at the center of the belt free-span.
3. Turn the adjusting nut (Ref. E) to adjust the tension to a reading of 130 lbs (59 kg) for a new belt, or 80 to 100 lbs (36 to 45 kg) for a used belt. A used belt is any belt that has been in operation more than ten minutes.

IMPORTANT: Do not overtighten the belt; too much tension shortens belt life and bearing life.

4. Tighten the adjusting link jam nut (Ref. C) 155 lbf-ft (210 N·m).
5. Tighten the compressor mounting nuts (Ref. A) and the adjusting link bolt (Ref. B) 33 lbf-ft (45 N·m). Tighten the adjusting rod nut (Ref. F) 70 lbf-ft (95 N·m).

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Removal

REFRIGERANT COMPRESSOR BELT (See Fig. 1 or Fig. 2)

FAN BELT (See Fig. 3)

1. Loosen the locknut that secures the idler pulley to the fan bracket.

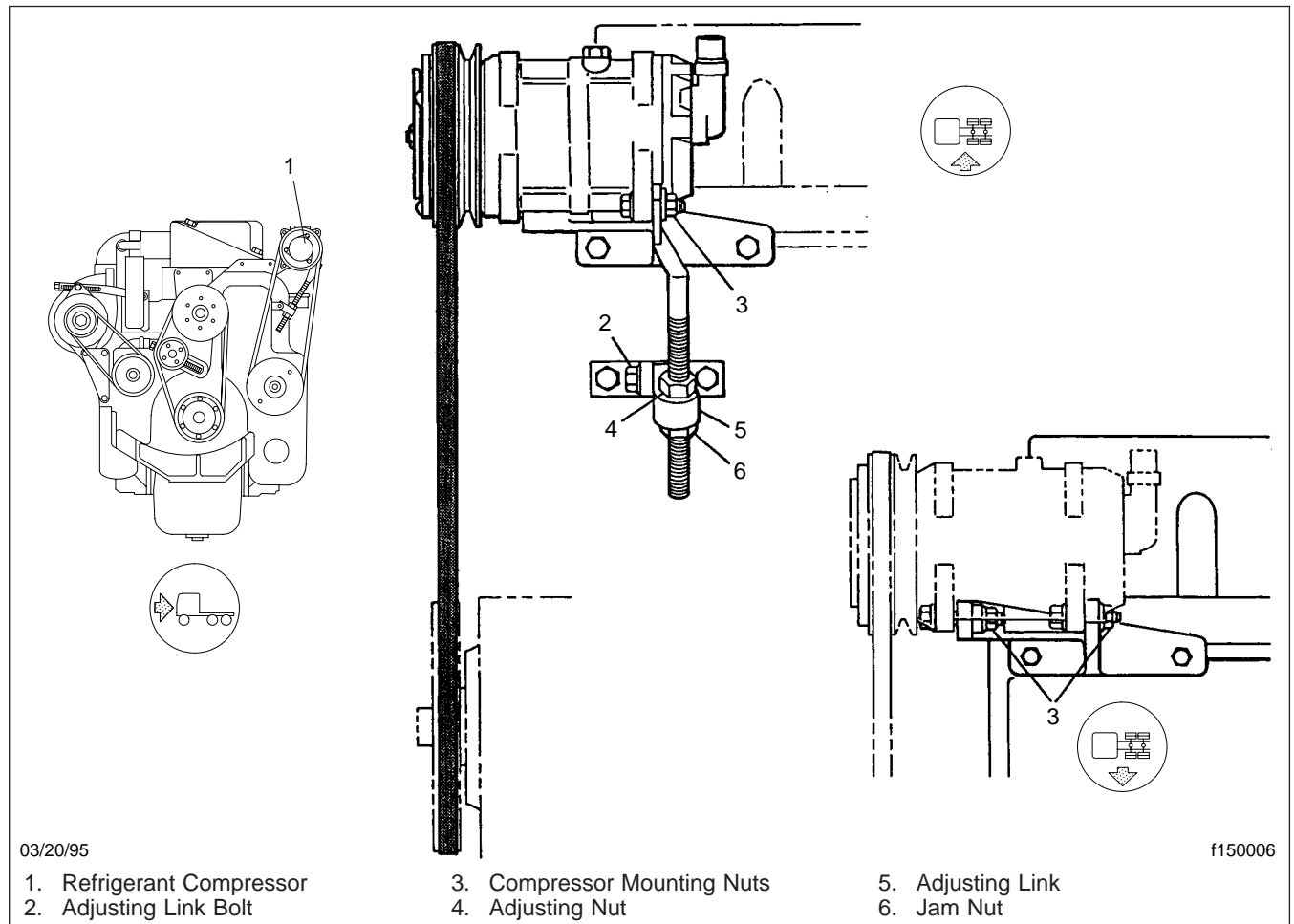


Fig. 1, Refrigerant Compressor Installation, Rotary Type

1. Back off the adjusting nut. Loosen the mounting nuts and the adjusting link bolt just enough to allow movement of the compressor.
2. Push the loosened compressor toward the accessory drive pulley until the distance between them is short enough to allow belt removal without using force.
3. Remove the belt, without prying or rolling it off of the pulleys.
2. Turn the idler pulley adjustment capscrew until there is minimal distance between the pulley centers.
3. Remove the fan belt by slipping it off of the pulleys and working it over one fan blade at a time. Don't roll or pry the belt off of the pulleys; the distance between the pulley centers must be short enough to allow belt removal without using force.

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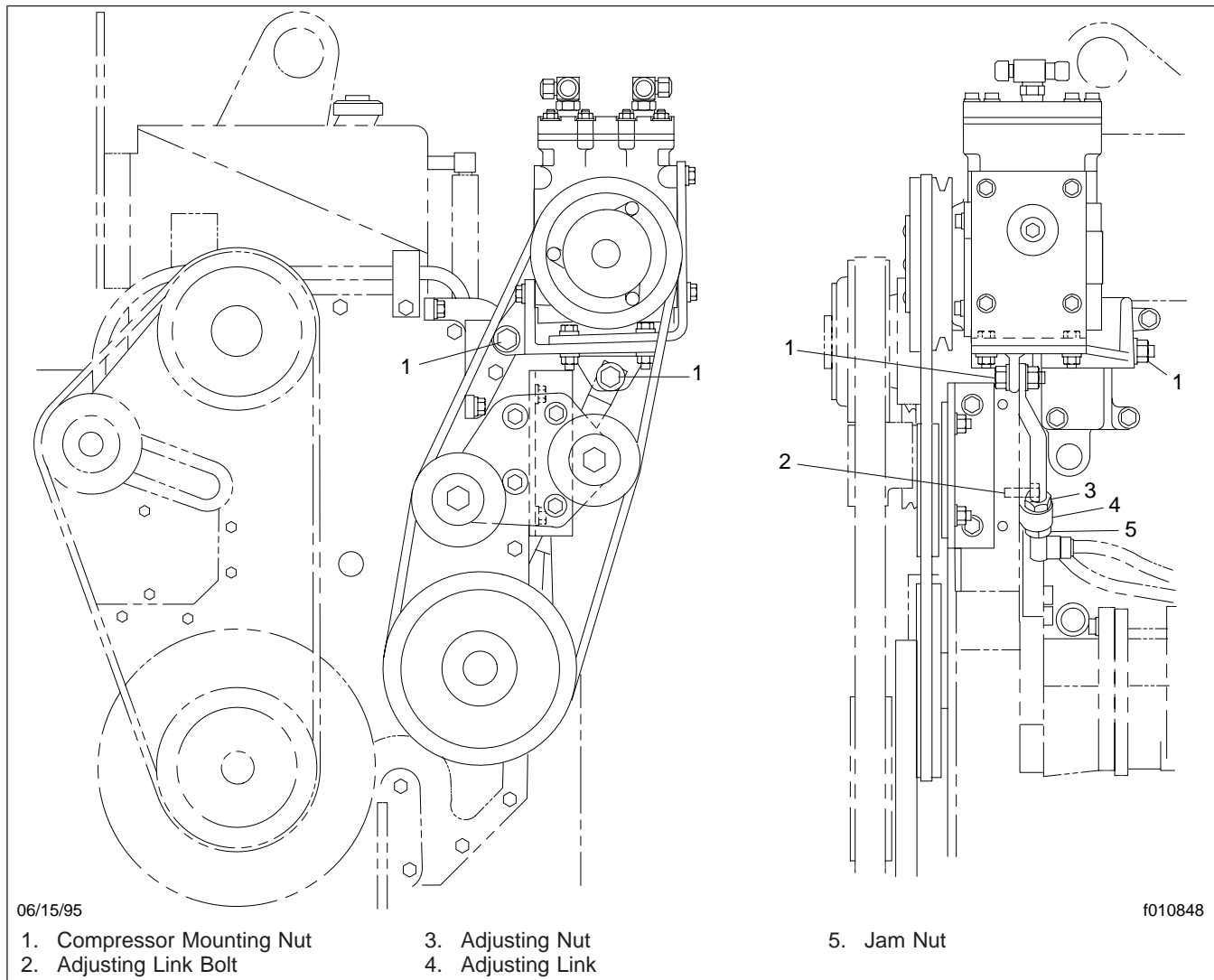


Fig. 2, Refrigerant Compressor Installation, Piston Type

ALTERNATOR BELT (See Fig. 3)

1. Loosen the three mounting fasteners just enough to allow movement of the alternator.
2. Loosen the adjusting screw locknut.
3. Turn the adjusting screw counterclockwise, backing off the alternator toward the drive pulley far enough to allow belt removal without using force.
4. Remove the belt, without prying or rolling it off of the pulleys.

Installation

REFRIGERANT COMPRESSOR BELT (See Fig. 1 or Fig. 2)

1. Inspect the pulleys and used refrigerant compressor belt (even if a new belt is being installed) as instructed under [Subject 180](#).
2. Make sure the distance between the pulleys is short enough to allow belt installation without using force.

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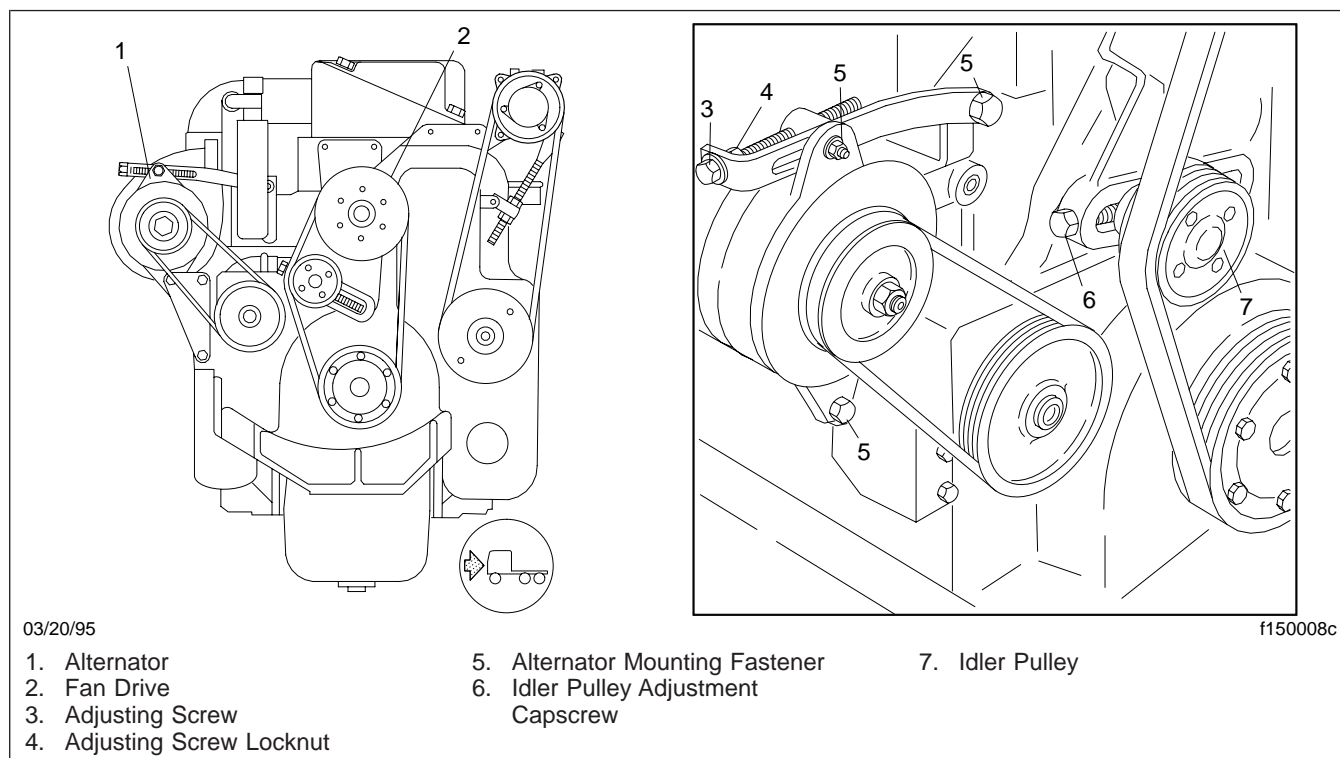


Fig. 3, Alternator and Fan Drive

3. Install the belt on the pulleys without prying or rolling it into place.
 4. Back off the jam nut to the end of the adjusting rod.
 5. While keeping the belt seated in the pulley grooves, turn the adjusting nut against the adjusting link to increase belt tension. Use your thumb to apply about 25 lbs (11 kg) of force at the center of the belt free-span to check the tension while turning the nut. When belt deflection equals one belt thickness per foot (305 mm) of pulley-center distance, proceed to "Adjustment: Refrigerant Compressor Belt."
3. Work the belt over the fan blades, one blade at a time. Install the belt on the pulleys without prying or rolling it into place. Be sure the ribs on the belt are seated in the grooves on each pulley.
 4. While keeping the belt seated in the pulley grooves, turn the idler pulley adjustment capscrew to increase the belt tension. Use your thumb to apply about 25 lbs (11 kg) of force at the center of the belt free-span to check the tension while turning the capscrew. When belt deflection equals one belt thickness per foot (305 mm) of pulley-center distance, proceed to "Adjustment: Fan Belt."

FAN BELT (See Fig. 3)

1. Inspect the pulleys and used fan belt (even if a new belt is being installed) as instructed under **Subject 180**.
2. Make sure the distance between the pulleys is short enough to allow belt installation without using force.

ALTERNATOR BELT (See Fig. 3)

1. Inspect the pulleys and used alternator belt (even if a new belt is being installed) as instructed under **Subject 180**.
2. Make sure the distance between the pulleys is short enough to allow belt installation without using force.

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3. Install the belt on the pulleys without prying or rolling it into place. Be sure the ribs on the belt are seated in the grooves on each pulley.
4. While keeping the belt seated in the pulley grooves, turn the adjusting screw clockwise to increase the belt tension. Use your thumb to apply about 25 lbs (11 kg) of force at the center of the belt free-span to check the tension while turning the adjusting screw. When belt deflection equals one belt thickness per foot (305 mm) of pulley-center distance, proceed to "Adjustment: Alternator Belt."

Adjustment

REFRIGERANT COMPRESSOR BELT (See Fig. 1 or Fig. 2)

1. If not already done, back off the adjusting link jam nut to the end of the adjusting rod, and loosen the mounting nuts and adjusting link bolt just enough to allow movement of the compressor.
2. Install a belt tension gauge at the center of the belt free-span.
3. Turn the adjusting nut to adjust the tension to a reading of 130 lbs (59 kg) for a new belt, or 80 to 100 lbs (36 to 45 kg) for a used belt. A used belt is any belt that has been in operation more than ten minutes.

IMPORTANT: Do not overtighten the belt; too much tension shortens belt life and bearing life.

4. Tighten the adjusting link jam nut 155 lbf-ft (210 N·m).
5. Tighten the compressor mounting nuts 30 lbf-ft (40 N·m), and the adjusting link bolt 40 lbf-ft (55 N·m).
6. Check the belt tension, and adjust it if needed.
7. If a new refrigerant compressor belt was installed, operate the engine for about 20 minutes, then check the belt tension. All new belts will lose tension after 20 minutes of operation.

If the refrigerant compressor belt tension is not between 80 and 100 lbs (36 to 45 kg), adjust the tension to 100 lbs (45 kg).

FAN BELT (See Fig. 3)

1. If not already done, loosen the locknut that secures the idler pulley to the fan bracket.
2. Install a belt tension gauge at the center of the belt's longest free-span.
3. Turn the idler pulley adjustment capscrew to increase or decrease belt tension, but do not adjust the tension to the full value with the idler pulley adjustment capscrew; belt tension can increase when the idler pulley locknut is tightened. Final tension must be 190 to 210 lbs (86 to 95 kg) for a new belt, or 155 to 165 lbs (70 to 75 kg) for a used belt. A used belt is any belt that has been in operation more than ten minutes.

IMPORTANT: Do not overtighten the belt; too much tension shortens belt life and bearing life.

4. Tighten the idler pulley locknut 120 to 140 lbf-ft (165 to 190 N·m).
5. Loosen the idler pulley adjustment capscrew one-half turn, to prevent breakage.
6. Check the belt tension, and adjust it if needed.
7. If a new fan belt was installed, operate the engine for about 20 minutes, then check the belt tension. All new belts will lose tension after 20 minutes of operation.

If the fan belt tension is not between 155 and 165 lbs (70 to 75 kg), adjust the tension to 165 lbs (75 kg).

ALTERNATOR BELT (See Fig. 3)

1. If not already done, loosen the adjusting screw locknut, and loosen the three mounting fasteners just enough to allow movement of the alternator.
2. Install a belt tension gauge at the center of the belt free-span.
3. Turn the adjusting screw to adjust the tension to a reading of 140 to 160 lbs (64 to 73 kg) for a new belt, or 90 to 120 lbs (41 to 55 kg) for a used belt. A used belt is any belt that has been in operation more than ten minutes.

IMPORTANT: Do not overtighten the belt; too much tension shortens belt life and bearing life.

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4. Tighten the adjusting screw locknut 95 lbf·ft (130 N·m).
5. Tighten the alternator mounting fastener 60 lbf·ft (80 N·m), the adjusting block nut 35 lbf·ft (50 N·m), and the adjusting arm bolt 55 lbf·ft (75 N·m).
6. Check the belt tension, and adjust it if needed.
7. If a new alternator belt was installed, operate the engine for about 20 minutes, then check the belt tension. All new belts will lose tension after 20 minutes of operation.

If the alternator belt tension is not between 90 and 120 lbs (41 to 55 kg), adjust the tension to 120 lbs (55 kg).

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Removal

ALTERNATOR AND REFRIGERANT COMPRESSOR BELTS (See Fig. 1)

1. Back off the adjusting nut (Ref. D), then loosen the alternator mounting fasteners (Refs. A and E) just enough to allow movement of the alternator.

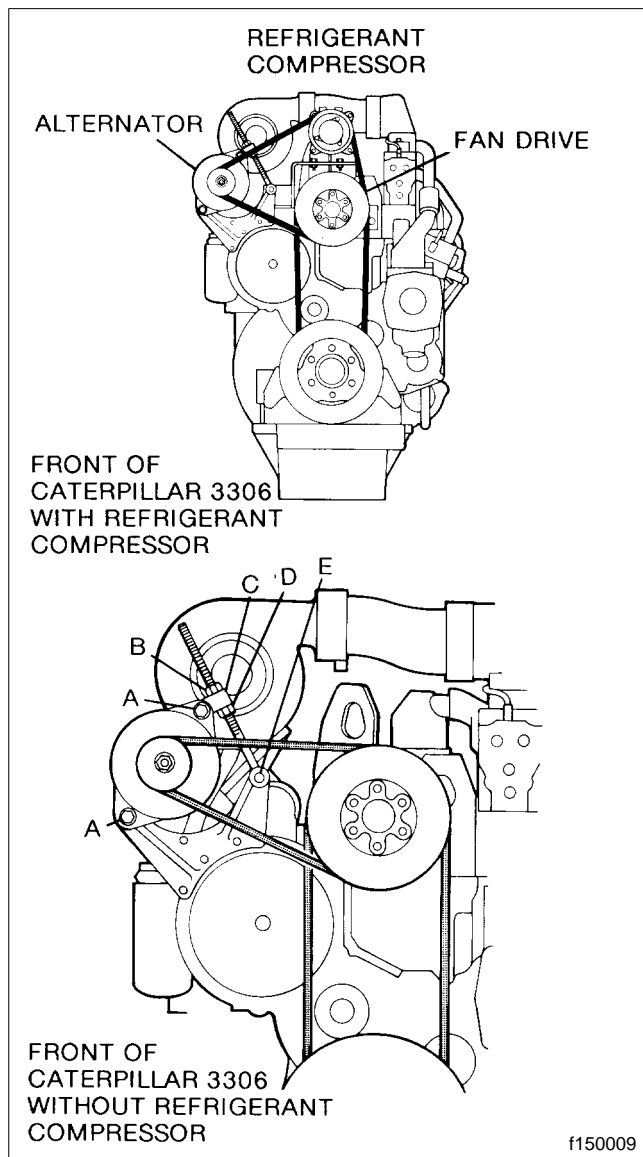


Fig. 1, Alternator and Refrigerant Compressor

2. Push the loosened alternator toward the fan drive pulley until the distance between them is short enough to allow belt removal without using force.
3. Remove both belts by slipping them off of the pulleys and working them over one fan blade at a time.

FAN BELTS (See Fig. 2)

1. Remove both alternator belts.
2. Loosen the bolts (Ref. B) that secure the fan hub to the fan hub bracket.
3. Turn the fan hub adjusting bolt (Ref. A) until there is minimal distance between the pulley centers.
4. Remove both fan belts by slipping them off of the pulleys and working them over one fan blade at a time. Don't roll or pry the belts off; the distance between the pulley centers must be short enough to allow belt removal without using force.

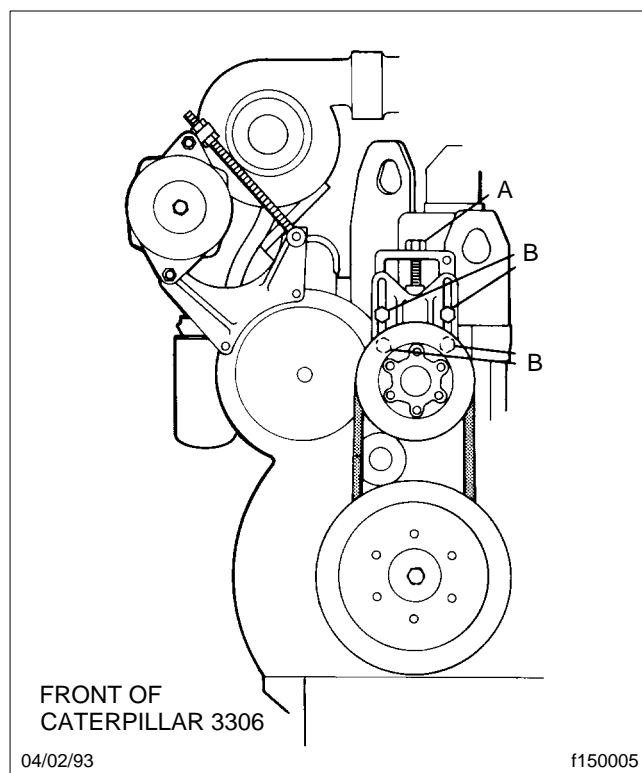


Fig. 2, Fan Drive