SHOP NOTES - TROUBLE SHOOTING - SPECIFICATIONS - SERVICE TOOLS

SHOP NOTES

REWORKING BLOWER END PLATES FOR IN-LINE AND 6V ENGINES

On non-turbocharged engines built prior to serial numbers 2D-20911, 3D-34008, 4D-36457 and 6D-24899, when oil is detected on the blower rotors or inside surface of the housing, the blower end plate can be reworked to accommodate a new lip type oil seal or a steel insert.

NOTE: Slight phonographic grooves can actually improve sealing. Unless wear is considerable and oil leakage is evident, the end plate need not be reworked.

Rework Blower End Plate

Use tool kit J 9533 to rework the end plate.

NOTE: On some prior serviced blowers, the end plates may have been reworked to accommodate a steel insert. In such cases, proceed as follows but omit Step 10.

1. Adjust the tool holder J 9533-2 and cutting tool J 9533-3 for the proper counterbore depth as follows:

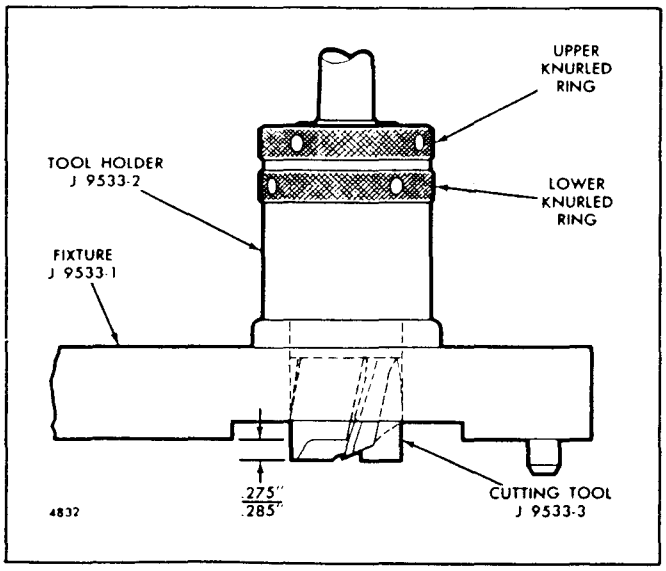

Fig. 1 - Adjustment of Tool Holder

a. Insert the rough cutting tool J 9533-3 in the tool holder as shown in Fig. 1.

b. Position the holder and the cutting tool in the fixture J 9533-1.

c. Loosen the "upper knurled ring" on the tool holder.

d. Rotate the "lower knurled ring" to raise or lower the cutting tool. Turn the "lower knurled ring" until there is a distance of .275 " - .285 " between the end of the cutting tool and the bottom of the fixture.

e. Tighten the "upper knurled ring".

2. Place fixture J 9533-1 on the blower end plate.

3. Clamp the fixture and the end plate loosely to the bed of a drill press.

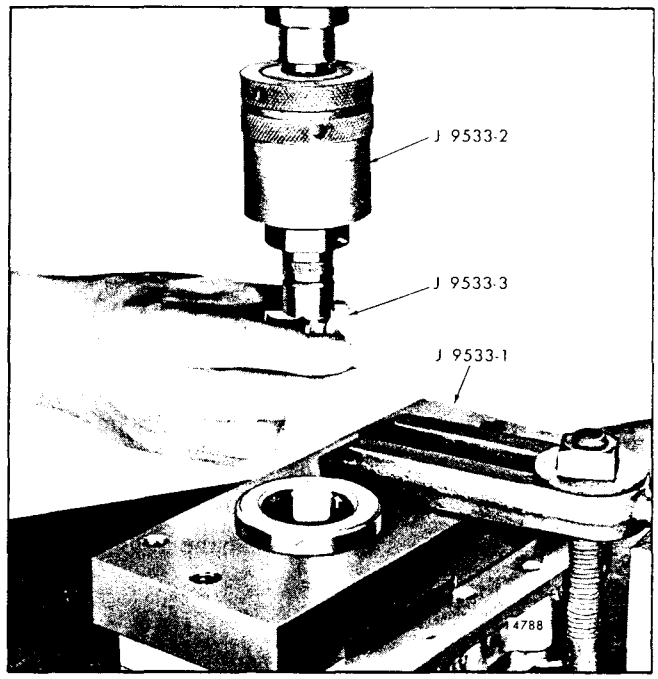

Fig. 2 - Install Cutting Tool in Holder

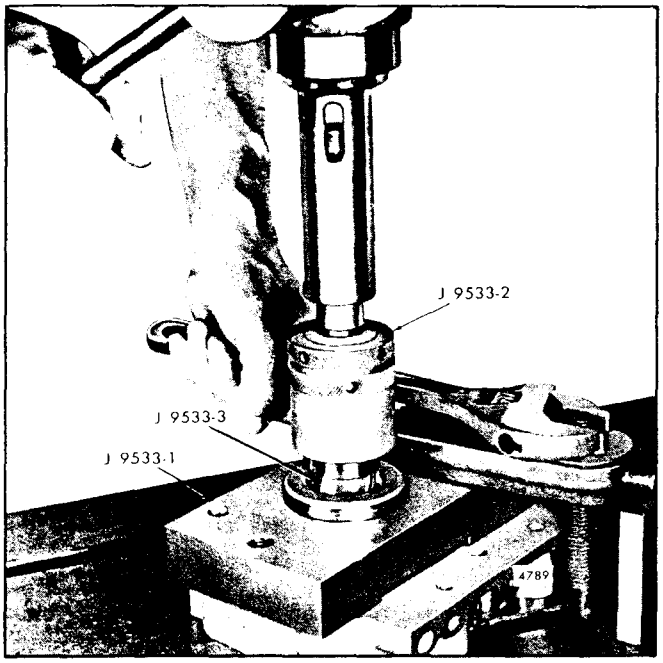

Fig. 3 - Positioning Cutting Tool in Fixture Guide

4. Install tool holder J 9533-2 in the drill press and insert the rough cutting tool J 9533-3 in the holder (Fig. 2).

5. Position the cutting tool in the fixture guide as shown in Fig. 3. Operate the drill press at 75-100 rpm so as to center the cutting tool in the rotor shaft hole. Tighten the clamp.

6. Lubricate the cutting tool and the area of the end plate that is being reworked with a lubricant (oleum or fuel oil).

7. Operate the drill press at 300-350 rpm and slowly counterbore the hole until the collar of the tool holder is approximately 1/16 " from the fixture guide. Then reduce the speed of the drill press to 75-100 rpm and continue counterboring until the collar contacts the top of the guide.

NOTE: Raise the cutting tool periodically during the drilling operation and apply additional lubricant.

8. Stop the drill press and remove the rough cutting tool.

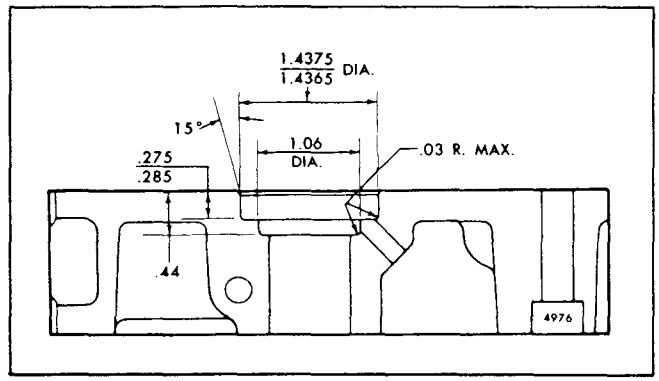

Fig. 4 - End Plate Oil Drain Back Counterbore

9. Insert the finish cutting tool J 9533-4 in the holder. Lubricate the cutting tool and the end plate. Operate the drill press at 75-100 rpm and finish-cut the counterbore. Feed the cutting tool into the work slowly.

10. Remove the finish cutting tool and install an end mill to machine the additional 1.06 " diameter counterbore. The total depth of the combined counterbores is .44 " (Fig. 4). The additional counterbore provides proper oil drain back from the oil seal area.

11. Remove the fixture from the end plate. Wipe the cuttings from the end plate and fixture and dry the plate and fixture with compressed air. Remove any burrs from the edge of the oil hole.

12. Thoroughly clean the cutting tool and the end mill flutes and repeat the procedures for the adjacent rotor shaft hole.

13. Place the blower end plate on the bed of an arbor press. Use installer J 22576 to press the seal (lip facing down) into the counterbored hole until the shoulder on the installer contacts the end plate.

NOTE: A step under the shoulder of the installer will position the oil seal below the finished face of the end plate within the .002 " to .008 " specified.

Steel Inserts

To install steel inserts in the blower end plates, follow Steps 1 through 9 and 11 and 12. Press the inserts flush to .003 " above the blower end plate surface.

REWORKING BLOWER FRONT END PLATES - 6V ENGINES

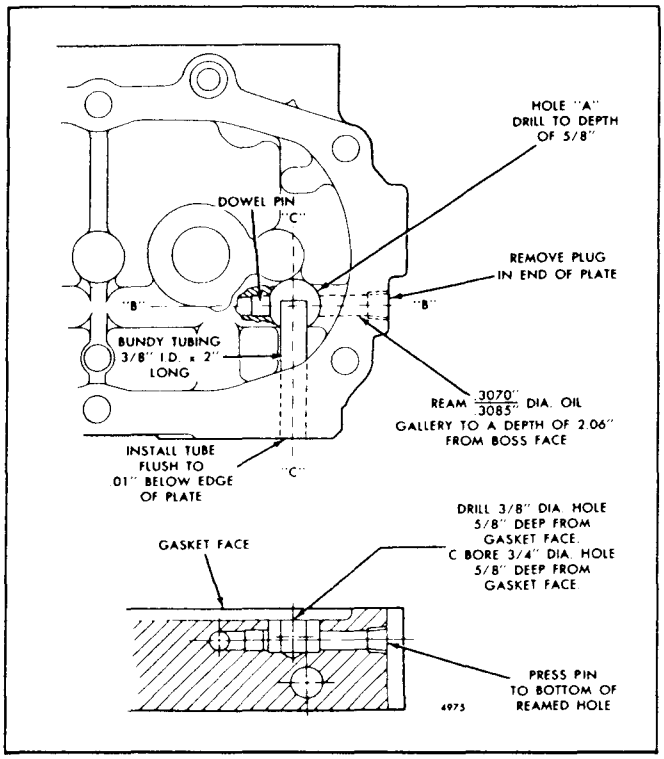

Fig. 5 - Dimensions for Reworking Front End Plate (6V Engine)

When rebuilding a 6V blower assembly in the field, the front end plate can be reworked to provide improved lubrication, when desirable, in the area of the thrust washers. The rework procedure is as follows:

1. Remove the pipe plug from the horizontal oil gallery (B-B) of the end plate. Place a reamer in the chuck of the drill press and ream a .3070 " - .3085 " diameter hole 2.06 " deep from the boss face (Fig. 5). Remove the metal cuttings from the hole.

2. Install the copper-plated dowel pin to the full depth of the reamed portion of the horizontal oil gallery.

3. Locate and mark the center of hole "A" as shown in Fig. 5. The center of hole "A" is where the center line (B-B) of the horizontal oil gallery intersects with the center line (C-C) of the drain hole. Clamp the end plate on the bed of the press and center drill at the location marked. Then drill a 3/8 " diameter hole 5/8 " deep from the gasket face of the end plate. Lubricate the drill and the area of the end plate that is being reworked with oleum or fuel oil.

4. Place either an end mill or a 3/4 " counterbore reamer (remove the pilot from the reamer) in the chuck of the drill press and counterbore a 3/4 " diameter hole 5/8 " deep from the gasket face of the end plate.

5. Wash the end plate in clean fuel oil to remove the metal cuttings and dry it with compressed air.

6. Cut a piece of 3/8 " I.D. Bundy tubing 2.00 " long. Coat the tubing with Gasola or an equivalent type sealant. Press the tubing into the oil drain hole in the end plate flush to .010 " below the edge of the plate. It is important that the area around the tube be oil tight.

7. Reinstall the pipe plug in hole (B-B).

8. When assembling the blower, apply a liberal amount of Lubriplate, or equivalent, on the surfaces of the thrust washers. This will provide lubrication of the thrust washers during initial start-up of the engine.

TROUBLE SHOOTING

TURBOCHARGER

CONDITION	PROBABLE CAUSE	SUGGESTED REMEDY
NOISY OPERATION OR VIBRATION	WHEEL SHAFT BEARINGS ARE NOT BEING LUBRICATED	Supply required oil pressure. Clean or replace oil line. If trouble persists, overhaul turbocharger.
	IMPROPER CLEARANCE BETWEEN TURBINE WHEEL AND HOUSING	Remove, disassemble, and inspect turbocharger.
	LEAK IN ENGINE AIR INTAKE OR EXHAUST MANIFOLD	Tighten all loose connections or replace exhaust manifold gaskets as necessary.
ENGINE WILL NOT DELIVER RATED POWER	CLOGGED AIR INTAKE SYSTEM	Check air cleaner and clean air intake ducts.
	FOREIGN MATERIAL LODGED IN COMPRESSOR OR TURBINE WHEELS	Remove, disassemble and clean turbocharger.
	EXCESSIVE DIRT BUILD-UP IN COMPRESSOR	Thoroughly clean compressor assembly. Clean air cleaner and check for leaks.
	LEAK IN ENGINE AIR INTAKE OR EXHAUST MANIFOLD	Tighten all loose connections or replace exhaust manifold gaskets as necessary.
	ROTATING ASSEMBLY BEARING SEIZURE	Remove and overhaul turbocharger.

SPECIFICATIONS

TABLE OF SPECIFICATIONS, NEW CLEARANCES AND WEAR LIMITS

These limits also apply to oversize and undersize parts.

ENGINE PART (Standard Size, New)	MINIMUM	MAXIMUM	LIMITS
Blower			
Backlash--rotor gears (all)	.0005 "	.0025 "	.0035 "
Backlash between upper rotor and camshaft or balance shaft gear (2,3-53)	.0030 "	.0070 "	
Backlash between blower drive gear and camshaft gear	.0030 "	.0070 "	
Oil seal (below end plate surface) (8V)	flush	.0100 "	
Oil strainer (below end plate surface) (8V)	flush	.0150 "	
Pin--dowel (projection beyond inside face of front or rear end plate) (8V)	.3800 "		
Clearances:			
Thrust plate and thrust washer (in-line, 6V)	.0010 "	.0030 "	
Rotor to air outlet side of housing:			
In-line and 6V	.0040 "		
8V	.0050 "		
Rotor to air inlet side of housing:			
In-line	.0075 "		
6V	.0100 "		
8V	.0170 "		
Rotor to front end plate:			
In-line	.0060 "		
6V	.0080 "		
+8V (former)	.0070 "		
†8V (current)	.0170 "		
Rotor to rear (gear) end plate:			
2-53	.0060 "		
3-53	.0080 "		
4-53	.0090 "		
6V	.0120 "		
+8V (former)	.0140 "		
†8V (current)	.0070 "		
Trailing edge of R.H. helix rotor to leading edge of L.H. helix rotor (8V)	.0080 "		
Leading edge of R.H. helix rotor to trailing edge of L.H. helix rotor (8V)	.0180 "		
Turbocharger (TE0675)			
Rotating shaft axial end play	.0040 "	.0070 "	
Rotating shaft radial movement	.0030 "	.0070 "	
Turbine wheel rotor shaft journal bearing:			
Inside diameter	.6268 "	.6272 "	
Outside diameter	.9780 "	.9785 "	
Turbine wheel shaft journal diameter	.6251 "	.6254 "	
Bearing bore diameter in center housing	.9827 "	.9832 "	

+ This clearance applies to former blowers with the ball bearings in the front end plate and roller bearings in the rear end plate.

†This clearance applies to current blowers with the roller bearings in the front end plate and ball bearings in the rear end plate.

STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

THREAD SIZE	TORQUE (lb-ft)	THREAD SIZE	TORQUE (lb-ft)
1/4 -20	7-9	9/16-12	90-100
1/4 -28	8-10	9/16-18	107-117
5/16-18	13-17	5/8 -11	137-147
5/16-24	15-19	5/8 -18	168-178
3/8 -16	30-35	3/4 -10	240-250
3/8 -24	35-39	3/4 -16	290-300
7/16-14	46-50	7/8 - 9	410-420
7/16-20	57-61	7/8 -14	475-485
1/2 -13	71-75	1 - 8	580-590
1/2 -20	83-93	1 -14	685-695

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

APPLICATION	THREAD SIZE	TORQUE (lb-ft)
Blower drive coupling to rotor gear bolt (in-line and 6V)	1/4 "-28	14-18
Blower drive gear pilot bolt (in-line and 6V)	5/16 "-24	25-30
Blower timing gear-to-rotor shaft bolts (in-line and 6V)	5/16 "-24	25-30
Blower thrust washer retaining bolt (in-line and 6V)	5/16 "-24	25-30
Front end plate cover bolts (4-53 and 6V-53)	3/8 " -16	20-25
Air inlet adaptor-to-blower bolts	3/8 " -16	16-20
Air inlet housing-to-adaptor or blower housing bolts	3/8 " -16	16-20
Governor-to-blower front end plate bolts	3/8 " -16	20-24
Blower drive support-to-blower rear end plate bolts	3/8 " -16	20-24
Flywheel housing-to-blower drive support bolts	3/8 " -16	20-24
Blower drive gear cover bolt	3/8 " -16	20-24
Blower-to-engine rear end plate and flywheel housing bolts (2-53 and 3-53)	3/8 " -16	20-25
	3/8 " -24	20-25
Blower thrust washer retaining bolt (in-line and 6V)	3/8 " -24	54-59
Blower timing gear-to-rotor shaft bolts (8V)	3/8 " -24	50-55
Rotor shaft ball bearing retaining bolt (8V)	3/8 " -24	50-55
Blower end plate-to-block bolts	7/16 "-14	55-60
Rotor shaft ball bearing retaining nut (8V)	.781 "-32	60-65

SERVICE TOOLS

TOOL NAME	TOOL NO.
BLOWER	
Blower clearance feeler gage set	J 1698-02
Universal puller (4-53 and 6V-53)	J 4794-01
Blower drive cam installer	J 5209
Gear puller (2 and 3-53)	J 5825-01
Handle	J 7079-2
Blower end plate counterbore set:	J 9533
Fixture	J 9533-1
Cutting tool - holder	J 9533-2
Cutting tool - roughing	J 9533-3
Cutting tool - finishing	J 9533-4
Blower service tool set:	J 21672
Gear pullers	J 21672-7
Rotor shaft ball bearing installer	J 21672-10
Oil seal and bearing remover	J 21672-11
Oil seal and roller bearing installer	J 21672-12
Oil seal sleeve and roller bearing inner race installer	J 21672-16
Spanner wrench	J 21672-17
Oil seal sleeve and roller bearing inner race remover	J 21672-20
Oil seal installer	J 22576
Oil seal sleeve installer (in-line and 6V)	J 23679-1
Oil seal sleeve remover (in-line and 6V)	J 23679-2
TURBOCHARGER	
Magnetic base indicator set	J 7872
Magnetic clamp	J 7872-2
Swivel adaptor	J 7872-3
Dial indicator	J 8001-3

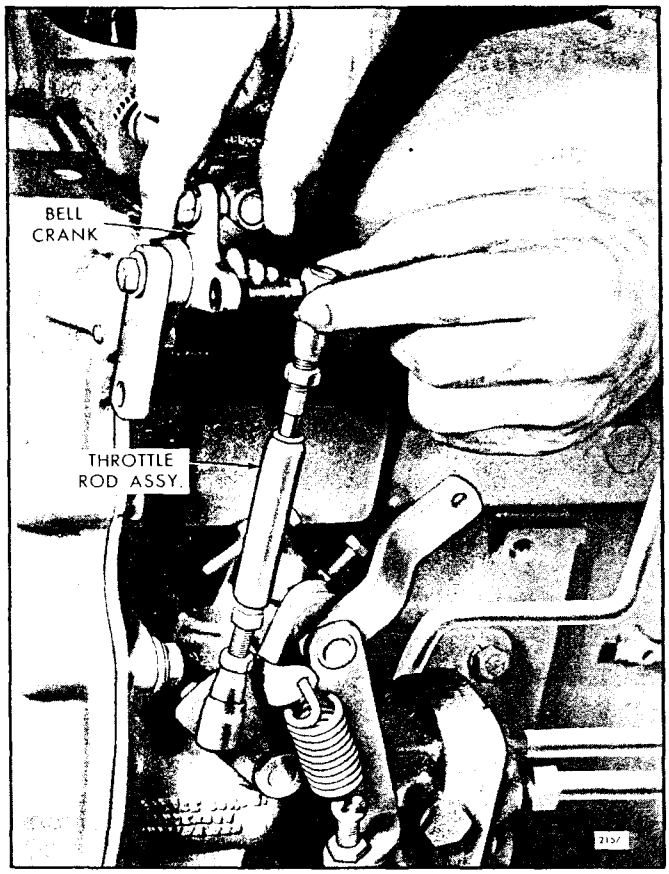

Fig. 3 - Adjusting the Throttle Rod Assembly

an equal distance on either side of center when moving the fuel injector racks from the full-fuel to the no-fuel positions. Position the bell crank by loosening the fuel rod lock nut and remove the ball joint from the bell crank. Turn the ball joint to adjust the length of the fuel rod to give the bell crank the correct travel. Reinstall the ball joint on the bell crank and tighten the lock nuts to retain the adjustment.

2. Advance the governor rocker shaft lever to the maximum fuel position and retain it in this position by advancing the governor speed control lever to its maximum speed position (Fig. 5) or by turning the idle speed adjusting screw down until the rocker shaft lever is held at the end of its travel.

NOTE: Back out the maximum speed adjusting screw only as far as necessary to permit the idle speed adjusting screw to move the rocker shaft lever to the end of its travel.

3. Hold the injector control racks in the full-fuel position, then adjust the length of the throttle rod assembly, by turning the ball and socket on the throttle rod, until it can be connected to the bell crank as shown in Fig. 3, without compressing the spring within the rod more than 1/32".

4. Check the injector racks to be sure the governor holds the racks in the full-fuel position.

5. Back out the idle speed adjusting screw (Fig. 6).

6. Place the speed control lever in the minimum speed position and move the injector racks to the no-fuel position. Then check for interference between the rocker shaft lever and the throttle rod assembly; no interference should occur.

NOTE: If the spring in the throttle rod assembly is compressed more than 1/32", interference may occur with the rocker shaft lever.

7. Adjust the speed adjusting spring eye bolt until one-half of the threads extend through the speed control lever. Secure the adjustment by tightening the lock nuts on the eyebolt.

8. Back out the buffer screw until it is within 1/16" to 1/8" of the governor speed control shaft.

Adjust Maximum No-Load Speed

1. Start the engine and move the speed control lever to the full-speed position.

NOTE: Do not overspeed the engine.

2. Loosen the lock nut and adjust the maximum speed adjusting screw (Fig. 4) until the desired no-load speed is obtained.

3. Tighten the maximum speed adjusting screw lock nut to retain the adjustment.

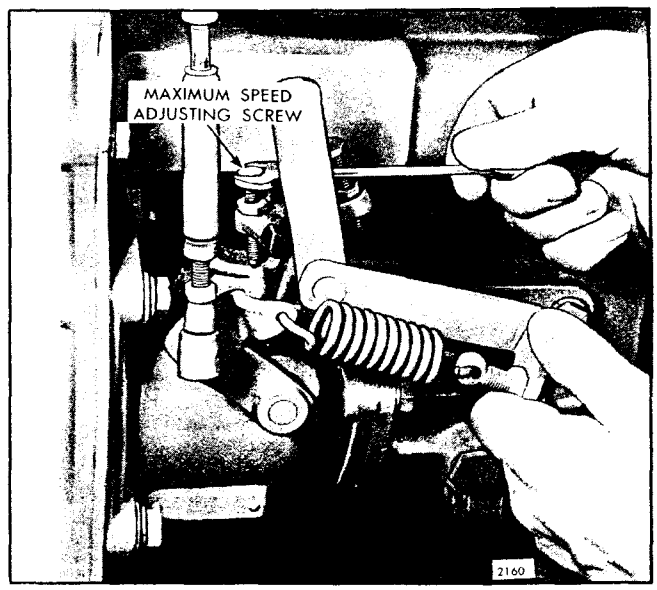

Fig. 4 - Adjusting Maximum Speed

Adjust Engine Speed Droop

With the engine operating at maximum speed, depress the linkage to the injector control tube to cause a speed decrease of several hundred rpm. Release the linkage and check for hunting when the governor returns the engine to the maximum speed setting. If the engine stabilizes in less than three surges, the droop may be excessive. If the engine does not stabilize in five surges, the droop may be insufficient. The speed droop may be set as follows:

1. If the speed droop is excessive, increase the tension of the speed adjusting spring (Fig. 5). If the speed droop is insufficient, decrease the tension of the speed adjusting spring.

NOTE: Make sure the eye of the eye bolt is in a vertical position to avoid twisting the spring.

2. Reset the maximum engine no-load speed if necessary.

3. Check the speed droop. The engine speed should be stable when the governor speed droop is 7 1/2% to 10% of the full-load speed. Thus, if the engine is operating at 2000 rpm full load, the speed droop should be 150 to 200 rpm. Therefore, the engine no-load speed would be set between 2150 to 2200 rpm.

Adjust Engine Idle Speed

1. Start the engine and adjust the idle speed adjusting screw, as shown in Fig. 6, to obtain the desired idle speed.

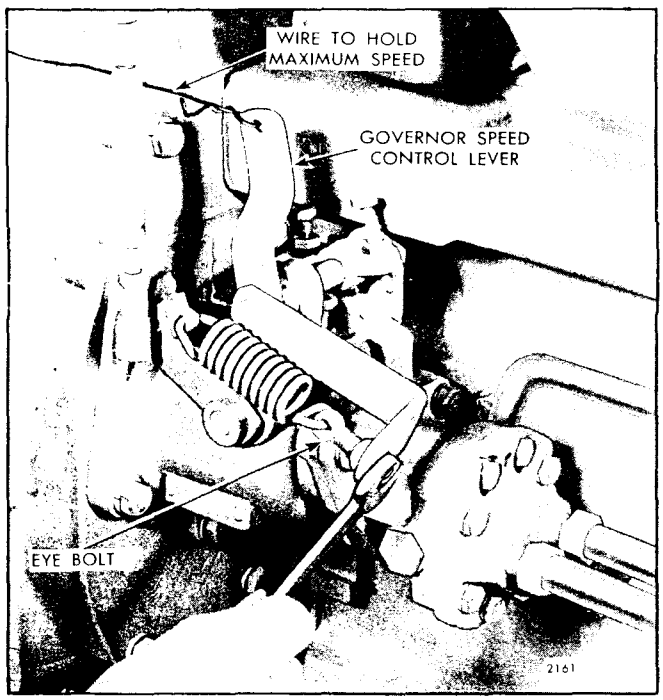

Fig. 5 - Adjusting Engine Droop

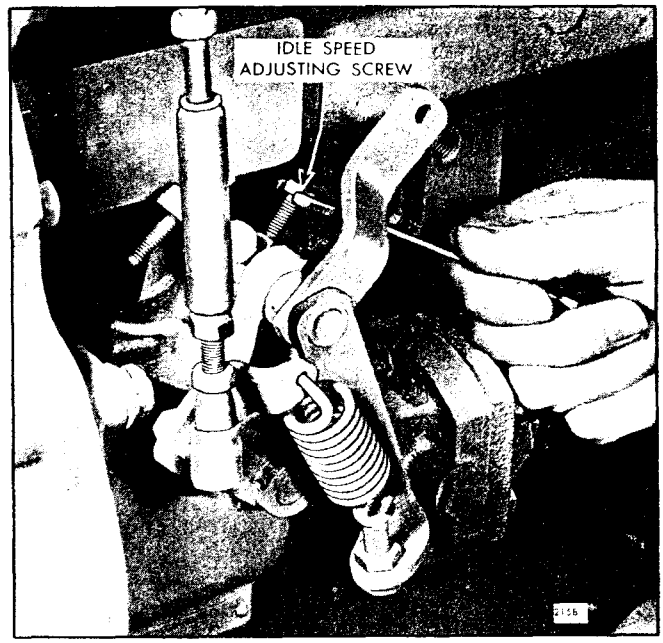

Fig. 6 - Adjusting Engine Idle Speed

NOTE: The idle speed must be set in excess of 575 rpm or engine operation at idle will be erratic.

Adjust Buffer Screw

1. Loosen the buffer screw lock nut and, with the engine operating at idle speed, turn the buffer screw in (Fig. 7) until engine roll is eliminated.

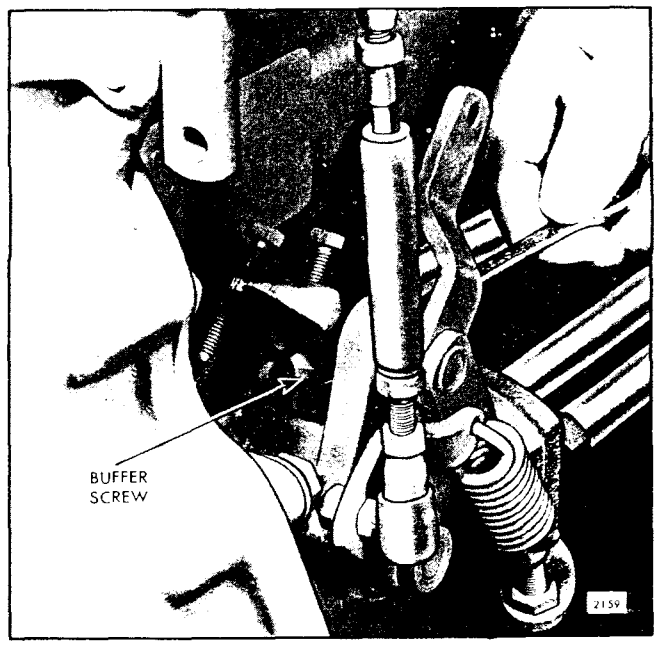

Fig. 7 - Adjusting Buffer Screw

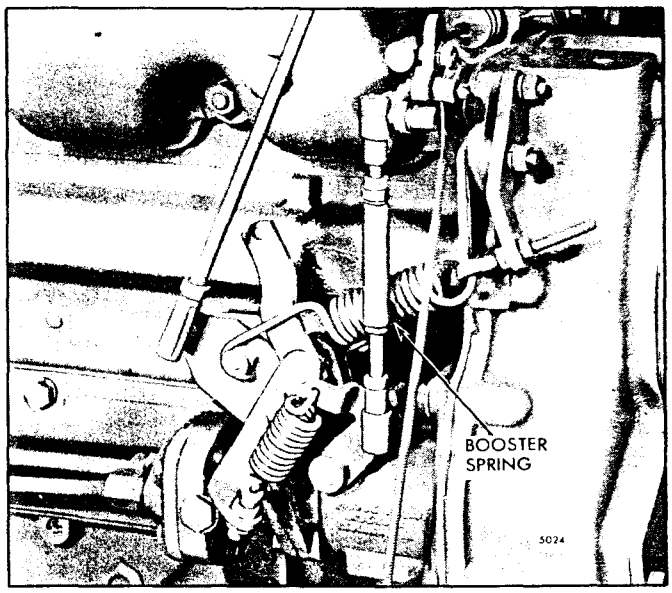

Fig. 8 - Governor Booster Spring

NOTE: Do not raise the engine speed more than 20 rpm with the buffer screw.

2. Tighten the lock nut to retain the adjustment.

Adjust Governor Booster Spring

The governor booster spring is used on some engines to reduce the force necessary to move the governor speed control lever from the idle speed position to the maximum speed position. Adjust the booster spring as follows:

1. Reduce the tension on the booster spring (Fig. 8) to the minimum by backing off the outer nut.

2. Adjust the eye bolt so an imaginary center line drawn through the booster spring will align with an imaginary outer line drawn through the speed adjusting shaft. Secure the lock nuts on the eye bolt to retain the adjustment.

3. Move the governor speed control lever from the idle speed position to the maximum speed position, noting the force required.

4. To reduce the force required to move the governor speed control lever, back off on the inner eye bolt nut and tighten the outer nut, increasing the booster spring tension.

NOTE: Before tightening the eye bolt nuts, reposition the booster spring as in Step 2.

The setting is correct when the governor speed control lever can be moved from the idle speed to the maximum speed position, while the engine is operating, with a fairly constant force and, when released, will return to the idle speed position.

VARIABLE SPEED MECHANICAL GOVERNOR (OPEN LINKAGE) AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE ENGINES

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor (Fig. 1) and the injector rack control levers.

Preliminary Governor Adjustments

1. Clean the governor linkage and lubricate the ball joints and bearing surfaces with clean engine oil.

2. Back out the buffer screw until it projects 9/16 " from the boss on the control housing.

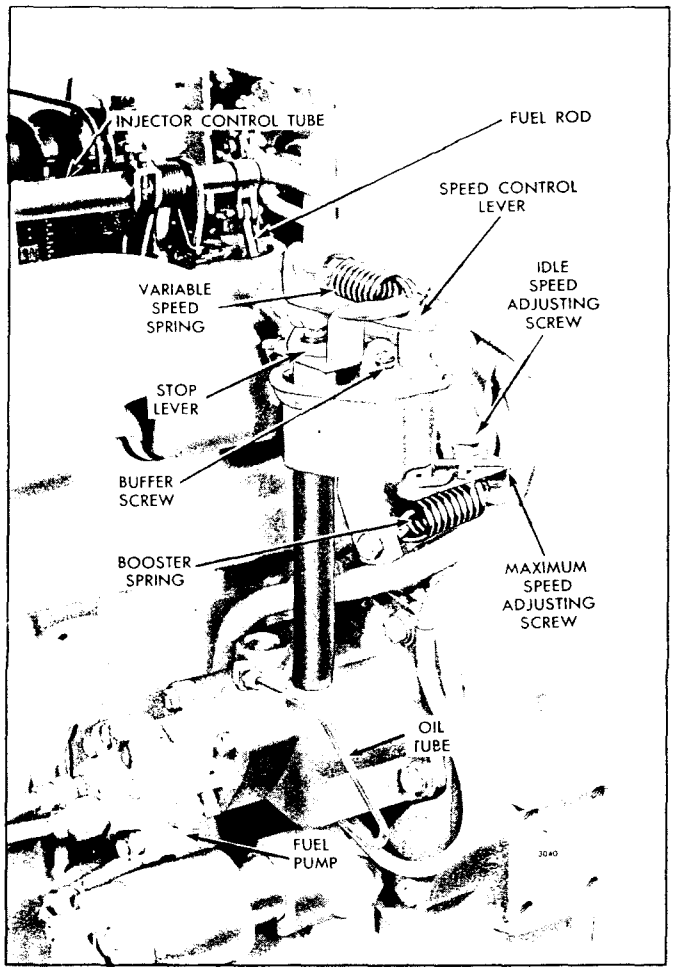

Fig. 1 - Variable Speed Open Linkage Governor Mounted on Engine

3. Back out the booster spring eye bolt until it is flush with the outer lock nut.

Adjust Variable Speed Spring Tension

1. Adjust the variable speed spring eye bolt until 1/8 " of the threads project from the outer lock nut (Fig. 2).

2. Tighten both lock nuts to retain the adjustment.

NOTE: This setting of the eye bolt will produce approximately 7% droop in engine speed from no-load to full-load.

Position Injector Rack Control Levers

The position of the injector control racks must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each

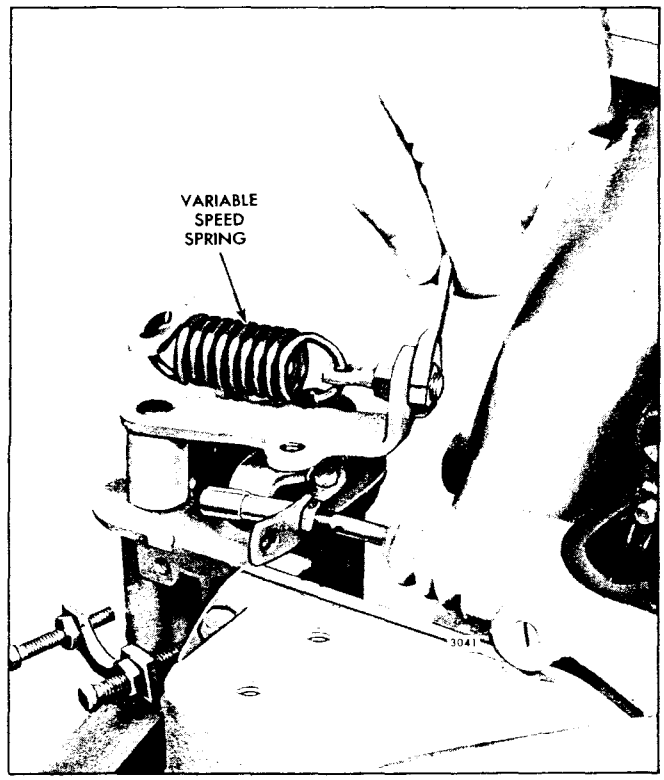

Fig. 2 - Adjusting Governor Spring Eye Bolt

cylinder and ensures equal distribution of the load. Adjust the rear injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Remove the valve rocker cover.

2. Disconnect the fuel rod at the stop lever.

3. Loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all of the injector rack control levers are free on the injector control tube.

4. Move the speed control lever to the maximum speed position.

5. Adjust the rear cylinder injector rack control lever adjusting screws (Fig. 3) until both screws are equal in height and tight on the injector control tube.

6. Move the rear injector control rack into the full-fuel position and note the clearance between the fuel rod and the cylinder head bolt. The clearance should be 1/32 " or more. If necessary, readjust the injector rack adjusting screws until a clearance of at least 1/32 " to 1/16 " exists. Tighten the adjustment screws.

7. Loosen the nut which locks the ball joint on the fuel rod. Hold the fuel rod in the full-fuel position and adjust the ball joint until it is aligned and will slide on the ball stud on the stop lever (Fig. 4). Position the shutdown cable clip and tighten the fuel rod lock nut to retain the adjustment.

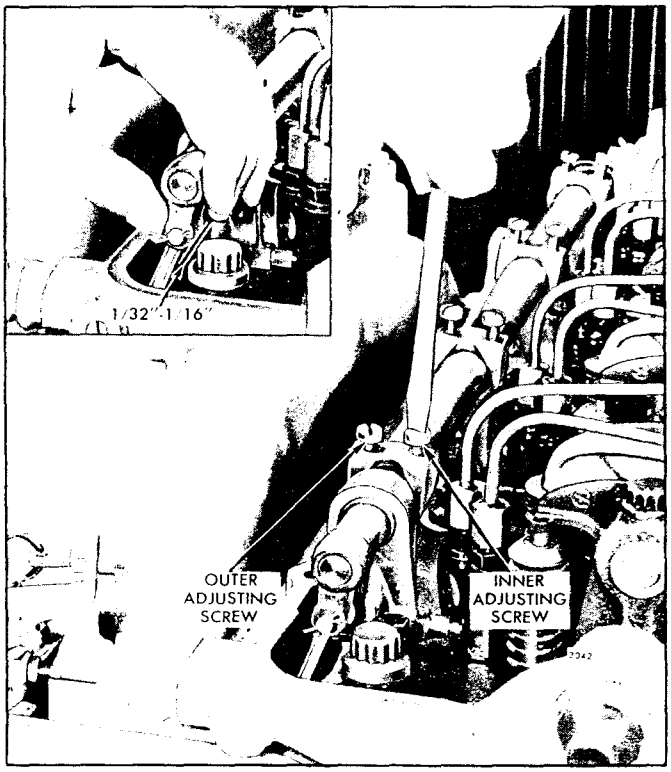

Fig. 3 - Adjusting Injector Rack Control Lever Adjusting Screws

8. Check the adjustment by pushing the fuel rod toward the engine and make sure the injector control rack is in the full-fuel position. If necessary, readjust the fuel rod.

9. Manually hold the rear injector rack in the full-fuel position, with the lever on the injector control tube, and turn the inner adjusting screw of the adjacent injector rack control lever down until the injector rack moves into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

> **NOTE:** Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lb.**

10. Recheck the rear injector rack to be sure that it has remained snug on the ball end of the rack control lever while adjusting the adjacent injector rack. If the rack of the rear injector has become loose, back off the inner adjusting screw slightly on the adjacent injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective control levers.

11. Position the remaining injector rack control levers as outlined in Steps 9 and 10.

Adjust Engine Idle Speed

1. Make sure the stop lever is in the run position and place the speed control lever in the idle position.

2. With the engine operating, loosen the lock nut and turn the idle speed adjusting screw (Fig. 5) in or out until the engine idles at the recommended speed. The recommended idle speed is 550 rpm. However, the idle speed may vary with special engine applications.

3. Hold the idle speed adjusting screw and tighten the lock nut.

Adjust Maximum No-Load Speed

1. With the engine running, move the speed control lever to the maximum speed position. Use an accurate tachometer to determine the no-load speed of the engine.

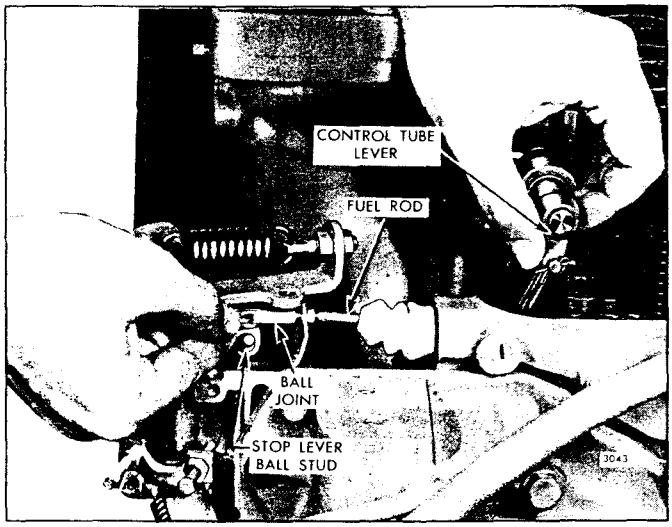

Fig. 4 - Adjusting Fuel Rod Length

NOTE: Do not overspeed the engine.

2. Loosen the lock nut and adjust the maximum speed adjusting screw (Fig. 6) until the required no-load speed is obtained.

3. Hold the adjusting screw and tighten the lock nut.

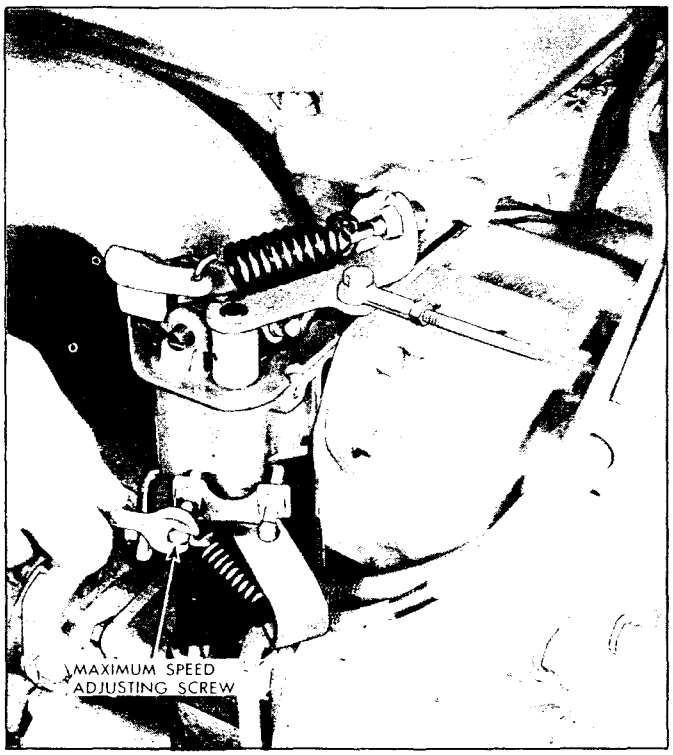

Fig. 6 - Adjusting Maximum No-Load Engine Speed

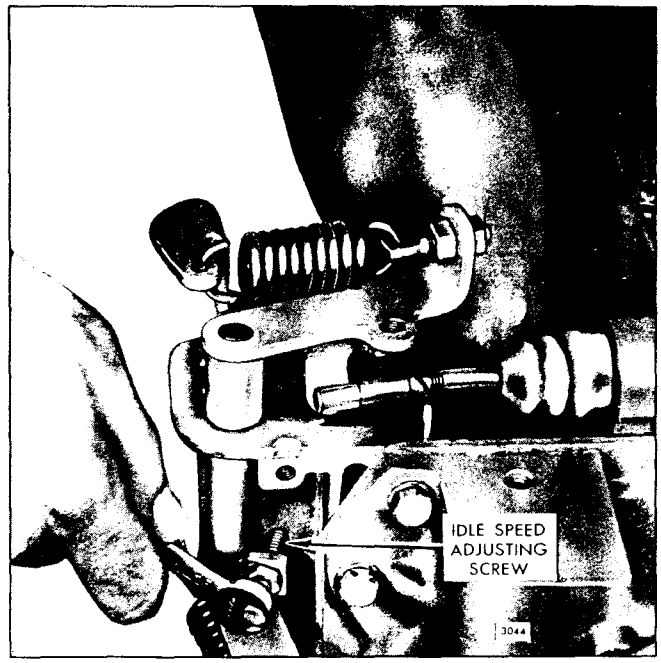

Fig. 5 - Adjusting Idle Speed

Adjust Buffer Screw

1. With the engine running at idle speed, turn the buffer screw in (Fig. 7) so that it contacts the stop lever as lightly as possible and still eliminates engine roll.

NOTE: Do not raise the engine idle speed more than 20 rpm with the buffer screw. Check the maximum no-load speed to make sure it has not

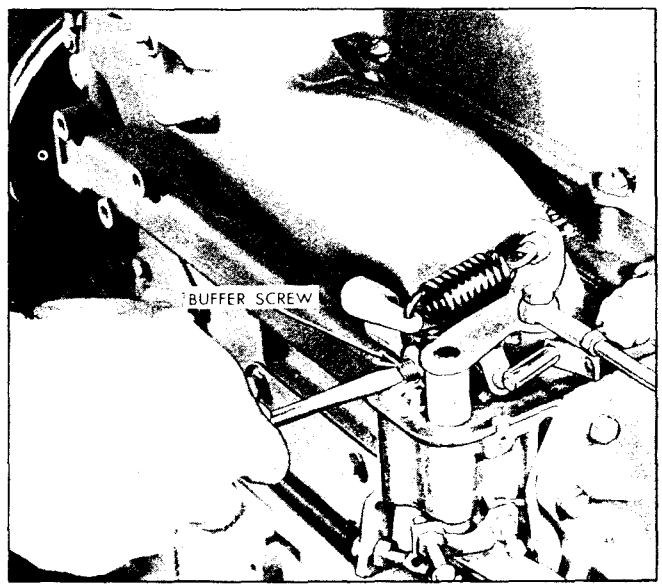

Fig. 7 - Adjusting Buffer Screw

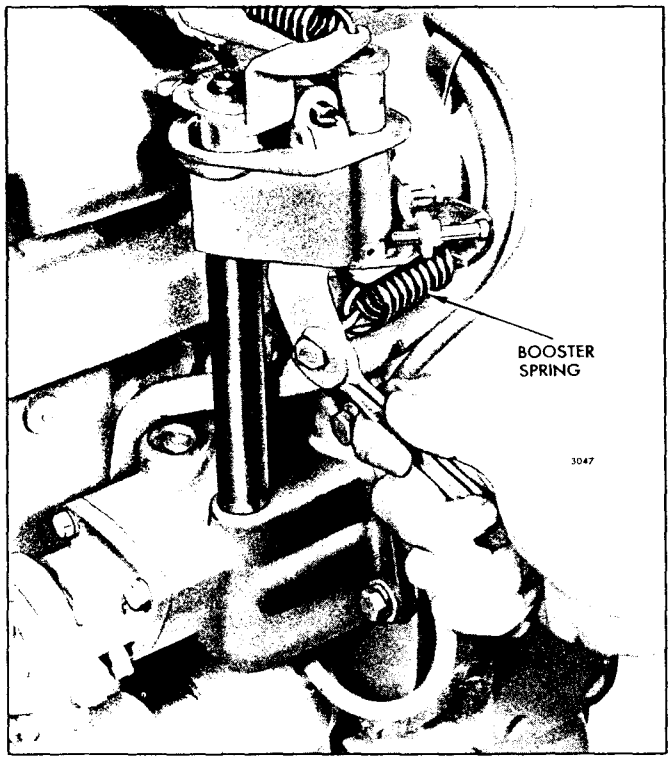

Fig. 8 - Adjusting Booster Spring

increased over 25 rpm by the buffer screw setting.

Adjust Governor Booster Spring

The governor booster spring is used on some engines to reduce the force necessary to move the speed control lever from the idle speed position to the maximum speed position. Adjust the booster spring as follows:

1. Move the speed control lever to the idle speed position.

2. Reduce the tension on the booster spring, if not previously performed, to the minimum by backing off the outer lock nut (Fig. 8) until the end of the booster spring eye bolt is flush with the end of the nut.

3. Adjust the eye bolt in the slot in the bracket so that an imaginary line through the booster spring will align with an imaginary center line through the speed control shaft. Secure the lock nuts on the eye bolt to retain the adjustment.

4. Move the speed control lever to the maximum speed position and note the force required. To reduce the force, back off the inner lock nut and tighten the outer lock nut to increase the tension on the booster spring.

NOTE: Before tightening the lock nuts, reposition the booster spring as in Step 3.

The setting is correct when the speed control lever can be moved from the idle speed position to the maximum speed position with a constant force, while the engine is running, and when released it will return to the idle speed position.

Adjust Engine Speed Droop

The adjustment of the spring tension as outlined under *Adjust Variable Speed Spring Tension* will result in approximately 7% droop from the maximum no-load speed to the full-load speed. This is the optimum droop setting for most applications. However, the droop may be changed as necessary for a particular engine application.

1. Lower the speed droop by increasing the spring tension.

2. Raise the speed droop by decreasing the spring tension.

NOTE: A change in the variable speed spring tension will change the engine idle speed and maximum no-load speed, which must also be readjusted.