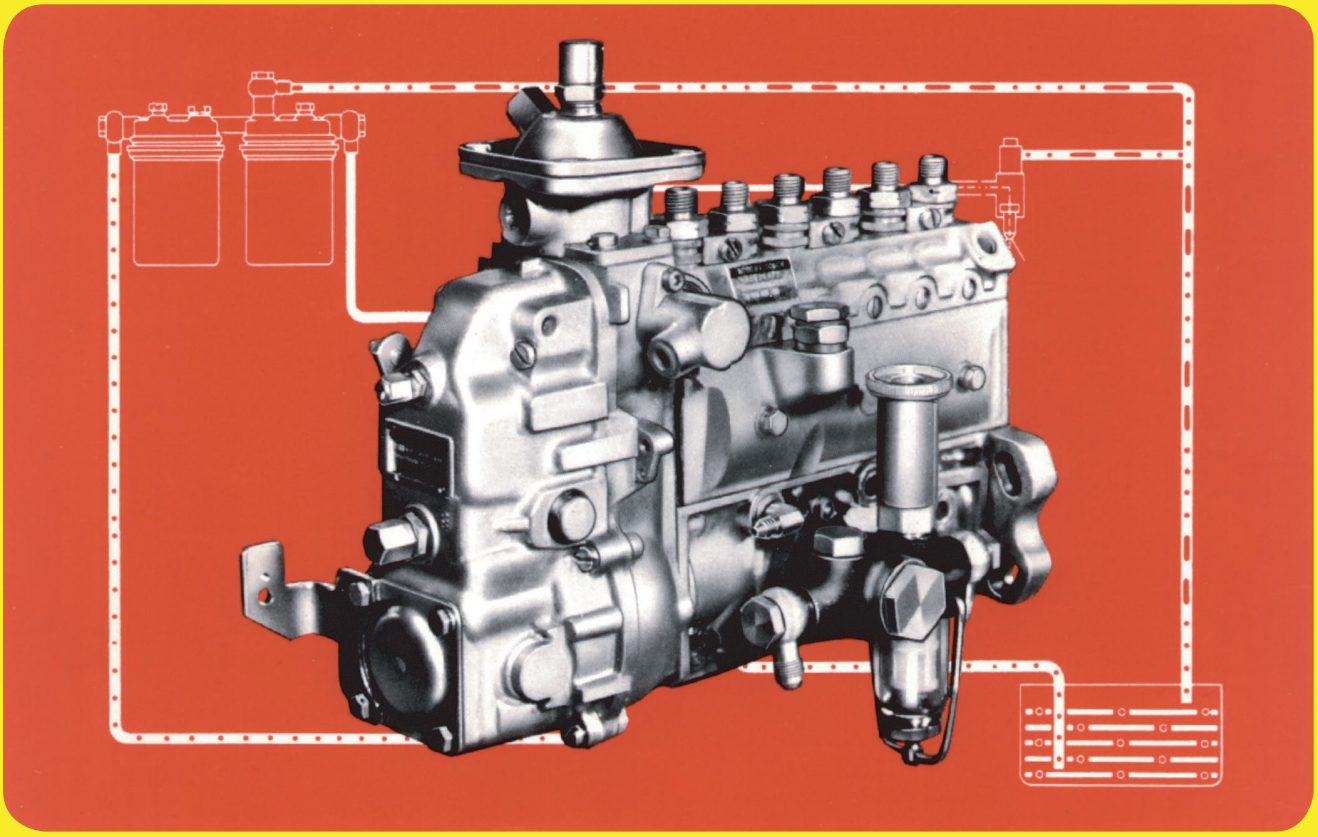
BOSCH

Module 4 (8)
RW - Governor Operation



Pre-Tech
Service Training

MODULE 4

RW-GOVERNOR OPERATION

STPR RW 1
1/84

INTRODUCTION

This audio-visual program, **RW Governor Operation** is a part of Module 4 of PRE-TECH, **Pump and Governor Operation.** You should have completed Modules 1 through 3 and the assigned Pump Operation programs before you begin this program.

This module consists of eight audio-visual programs. Each program has a separate review guide and exercise. You will be required to complete from one to all eight programs, depending on the program track that you have been assigned to by your instructor or supervisor. These audio-visual programs will introduce you to the theory of operation for several selected pumps and governors. This program introduces you to the RW governor and explains how the governor operates, the proper nomenclature of the governor parts, and how the various parts function to affect governor operation.

PROGRAM OBJECTIVES: RW GOVERNOR OPERATION

When you have completed **RW Governor Operation** you will be able to:

1. Identify governing forces.
2. Describe the function of the guide sleeve.
3. Describe adjustments which modify spring and flyweight force.
4. Describe governor linkage operation.
5. Describe low and high speed regulation.
6. Describe the full load stop.
7. Describe the operation of the torque control device.
8. Describe operation at start-up.
9. Describe operation at breakaway.

SPECIAL EQUIPMENT

To complete this program you will need the **RW Governor Operation** audio-visual program, the appropriate play-back equipment, and this review guide. The different types of audio-visual presentations (formats) and the types of required equipment to view each format are listed below. Read the operating instructions for the equipment you will be using before attempting to view the programs.

Slide/Tape Format

You will need either an automatic slide/tape player or a manual slide projector and separate tape player. Side A of the cassette tape has inaudible pulses which trigger the advance mechanism of automatic slide/tape players. Side B of the tape has tone pulses which you can hear to indicate when you should advance to the next slide. Before you begin, be sure that you are using the correct side of the cassette tape for the equipment you are using and rewind the tape completely to be sure you are at the start of the program.

Filmstrip/Cassette Tape Format

You will need either an automatic filmstrip/tape player or a manual filmstrip projector and separate tape player. Side A of the cassette tape has inaudible pulses which trigger the advance mechanism of automatic filmstrip projectors. Side B of the tape has tone pulses which you can hear to indicate when you should advance the filmstrip to the next scene. Before you begin, be sure that you are using the correct side of the cassette tape for the equipment you are using and rewind the tape completely to be sure you are at the start of the program.

Film/Tape Cartridge Format

Because of the variety of film/tape cartridge players available, we have not included instructions for this equipment. Be sure to read the operating instructions that come with the equipment you are using before viewing the audio-visual program.

If you have any questions about how to use the audio-visual equipment, see your supervisor or instructor.

SPECIAL INSTRUCTIONS

DO NOT use or refer to the review guide until you have finished viewing the audio-visual program or you are instructed to do so. The visuals in the program are produced in colors which present important information. The black and white reproductions of these visuals used in the review guide may not show the discrimination between these colors and, therefore, may not completely present the information from the color visual. In addition, the audio-visual program may have been revised with updated visuals which may not be reflected in the review guide. These changes in visuals will not alter the meaning or content of the information contained in the review guide.

Start the audio-visual program, **RW Governor Operation**, at this time. Sit back and let the colors, motion, and sound help you learn. When the program ends, turn to page 3 and continue as instructed.

NOTE

The audio-visual program will STOP from time to time when viewed using automatic playback equipment. These stops are included to provide an opportunity to review the information that has been presented to that point. When you are ready to continue, press the START button on the playback equipment.

REVIEW EXERCISE: RW GOVERNOR OPERATION

Now that you have finished viewing the audio-visual program, complete this review exercise. If you have a problem answering any of the questions, use this review guide to locate the correct answer. The numbers following each question indicate the range of scenes where the correct answer can be found.

Fill in the correct word or words to complete the following statements.

1. In calibration of the RW governor and its associated fuel pump, both _____ _____ and _____ are checked against pump RPM. (7-9)

2. Each spring in the RW governor must work to _____ _____ force. (9-11)

3. With increasing speed, the flyweights move the _____ _____ to the right causing the _____ _____ to swivel to the left. (12-14)

4. The fulcrum lever will pivot in the _____ direction to the _____ _____ . (14-16)

5. Screwing in the internal adjustment for low idle _____ the leaf spring force on the _____ _____ and flyweights. (23-24)

6. Adjusting the _____ _____ screw changes the amount the rack can travel. (38-40)

7. Turning the collapsed torque capsule against the _____ _____ will _____ delivery. (48-50)

8. When you turn in the screw for breakaway adjustment, the _____ _____ stretches the _____ _____ . (56-59)

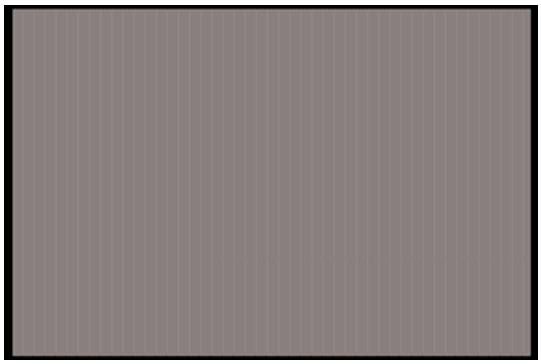
9. A _____ _____ is necessary for all internal adjustments on the RW governor. (59-61)

10. With the pump at cranking RPM, the governor should _____ the full starting rack travel, but at higher RPM's, the starting quantity cut-out must _____ rack travel above full load. (62-65)

When you have finished this exercise, review your answers. Then show the completed exercise to your instructor or supervisor. Have your instructor or supervisor record your progress on the Student Progress Sheet.

Go on to the next audio-visual program or module assigned to your program track.

1. FOCUS



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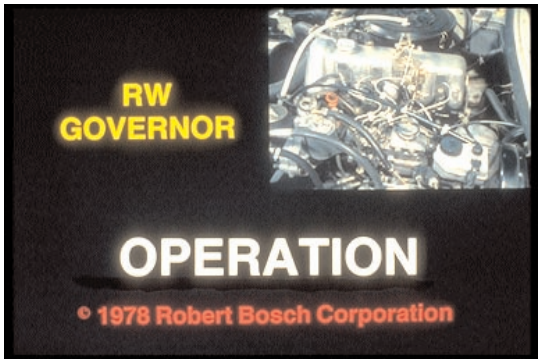

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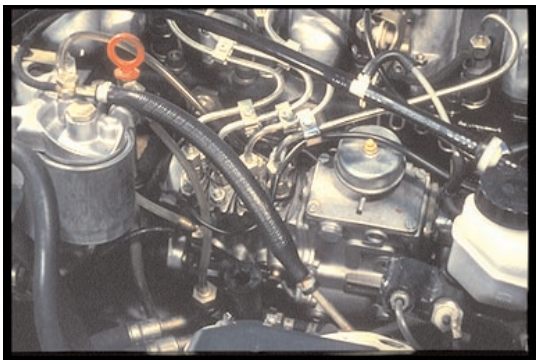
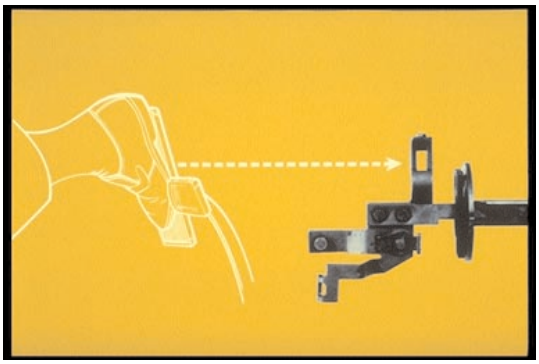
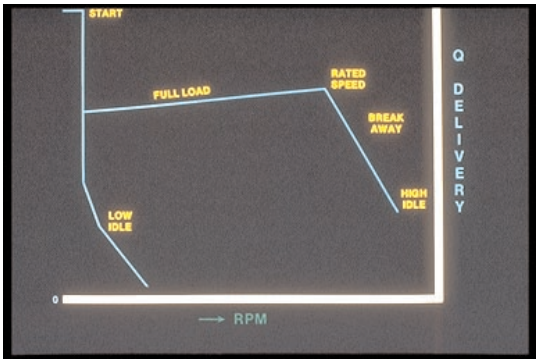


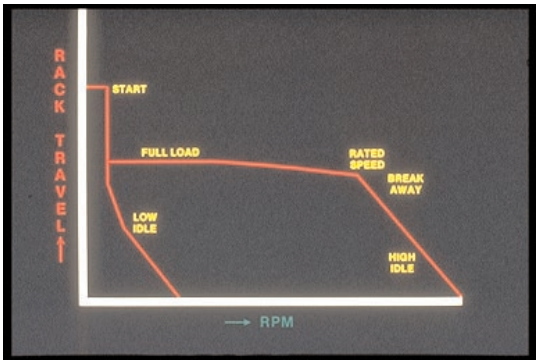
5. We all know that at starting, running flat out and idling, this is what controls the engine.



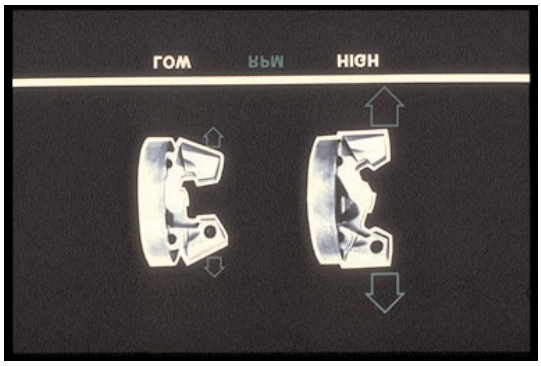
6. We know that, at part loads, the acclerator controls the engine — controls the rack through the RW governor linkage.



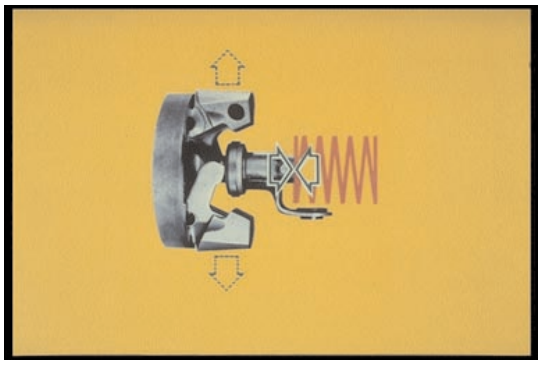
7. As far as the engine is concerned, the governor controls the pump "Q" quantity or delivery at start, low idle, full load, rated speed, breakaway, high idle — all those points you're already familiar with. But instead of looking at how pump delivery changes with RPM . . .



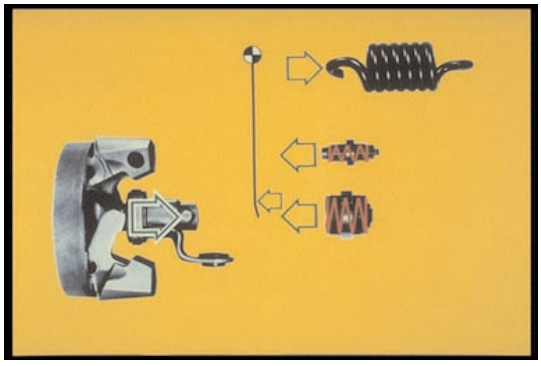
8. . . . let's look at a similar graph of these governing points showing how rack travel changes with RPM. In the calibration of governor and pump, both rack travel and delivery are checked against pump RPM.



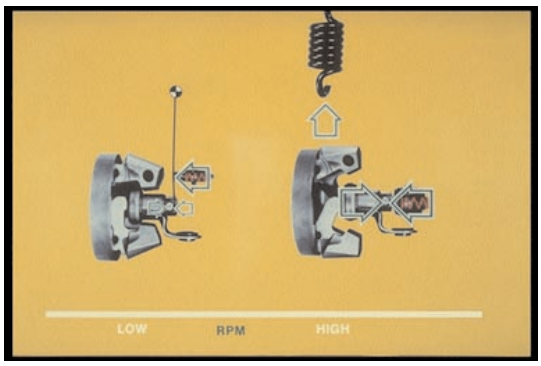
9. At low RPM, small forces are developed by governor flyweights. As the RPM gets higher, flyweight forces are greater.



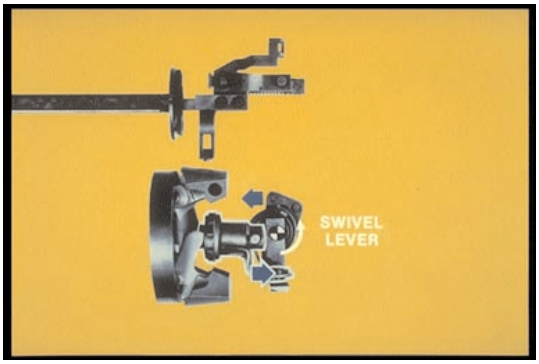
10. The flyweight forces work to push the guide sleeve to the right. Spring force tends to push the guide sleeve the other way.



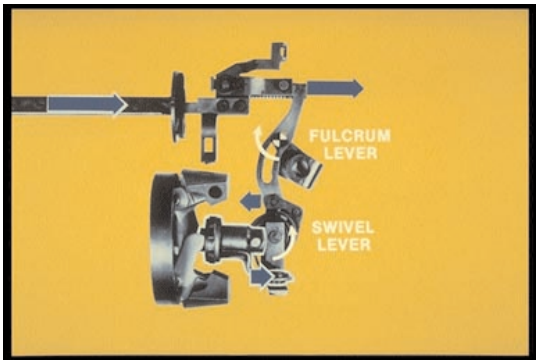
11. There are several spring forces in the RW governor. Each spring has a job to do, balancing flyweight force.



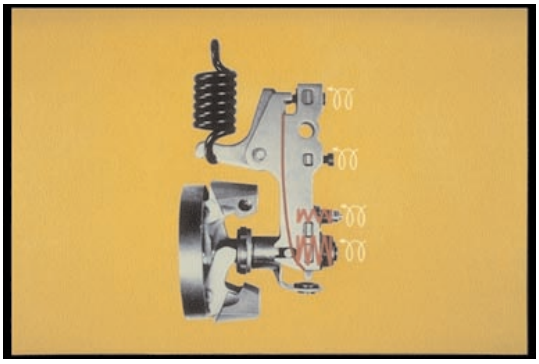
12. At low RPM, flyweight force is small; it can be countered by small springs, ones you can easily compress with your fingers. At higher RPM, greater flyweight force is countered by heavier springs. In either case, when flyweight force overcomes spring force, how does that move the rack?



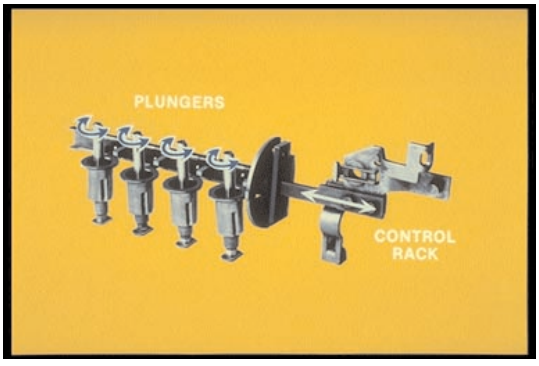
13. With increasing speed, the flyweights move the guide sleeve with its arm to the right, causing the swivel lever to swivel to the left.



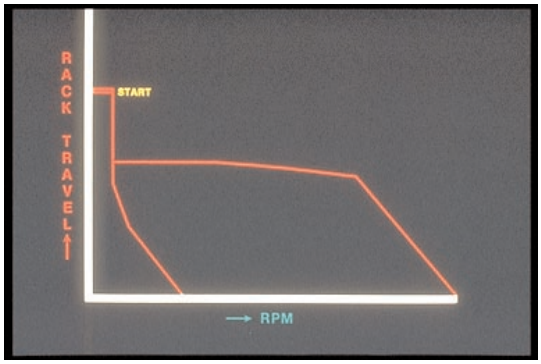
14. This movement causes the fulcrum lever to pivot in the opposite direction, moving the rack. It's easy to remember — when the sleeve moves right, the rack moves to the right. Sleeve left, rack left. From now on, we'll simplify our flyweight rack story without this linkage.



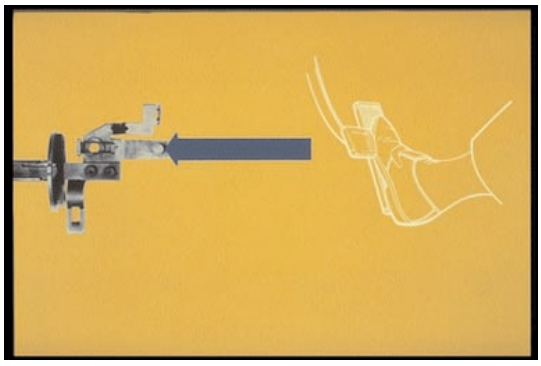
15. You'll see how each adjustment you make to one of these screws changes the way the various spring forces counter the flyweight force.



16. Just remember, flyweight force tends to pull the rack for less delivery; governor spring forces tend to push the rack into the pump.

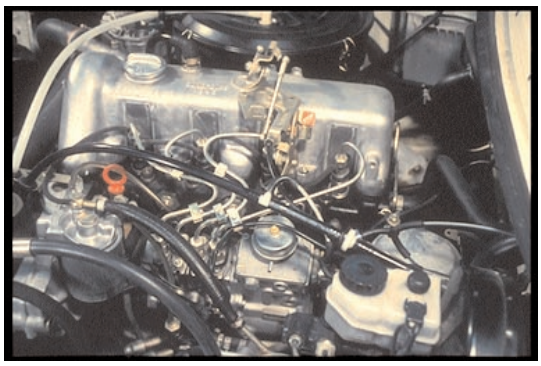


17. What do we need for start-up? That's right, pushing the rack full in for greatest fuel delivery.



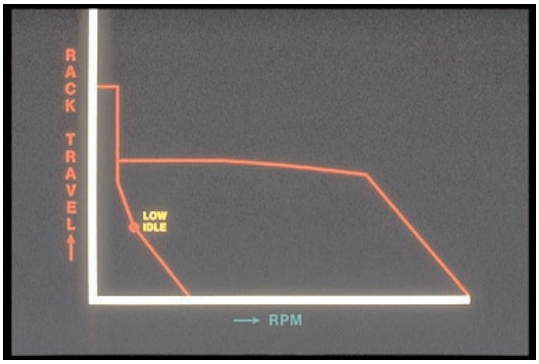
18. At start, the control rack is pushed full in for max. fuel delivery.

19.

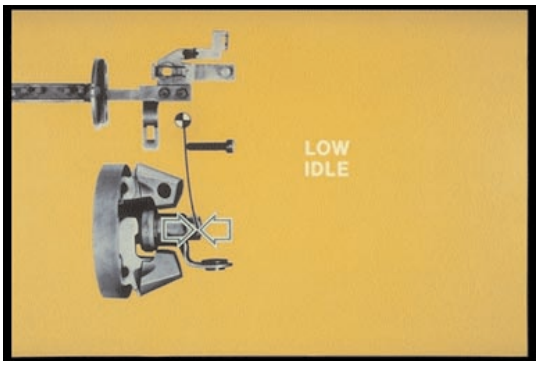


20. At low idle, the fuel flow must be just enough to keep the engine running.

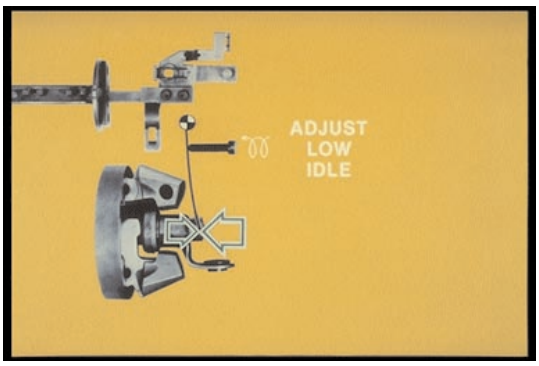
21. With accelerator released, the governor is controlling at low idle.



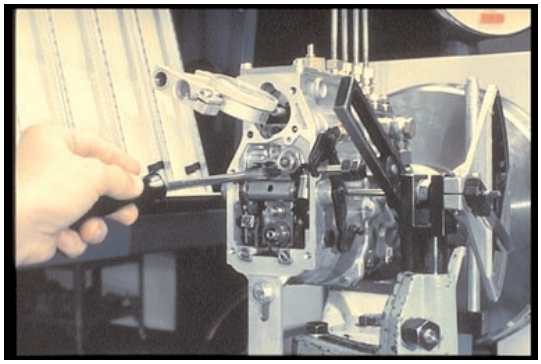
22. At the specified low idle RPM, this rack travel should deliver the proper quantity of fuel.



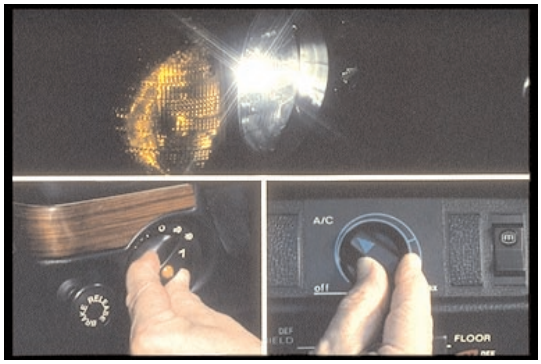
23. The rack is positioned at low idle as the leaf spring force counters the flyweight force.



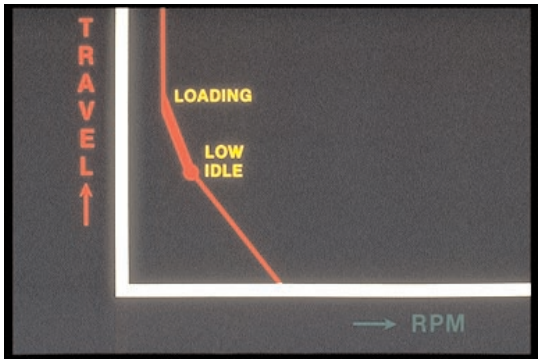
24. When you screw in the internal adjustment for low idle, what happens? You increase the leaf spring force on the guide sleeve and the flyweights.



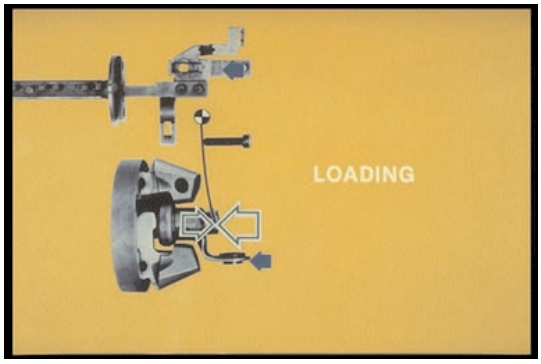
25. On the test bench, this adjustment changes low idle fuel delivery.



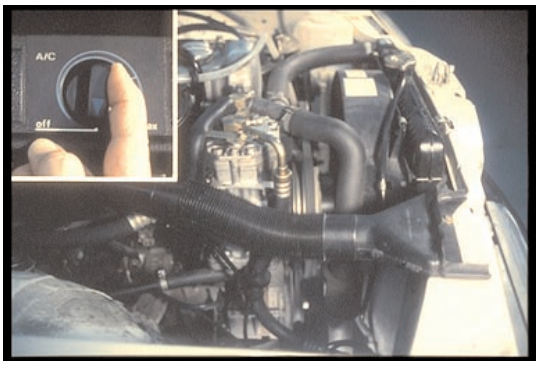
26. Of course in the car, the alternator load, compressor and other loads may be added to the engine. Idle governoring must handle this loading.



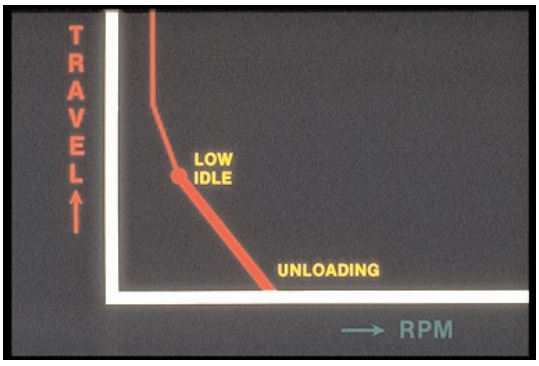
27. When loading causes a loss of RPM, how does the governor increase rack travel for greater fuel delivery?



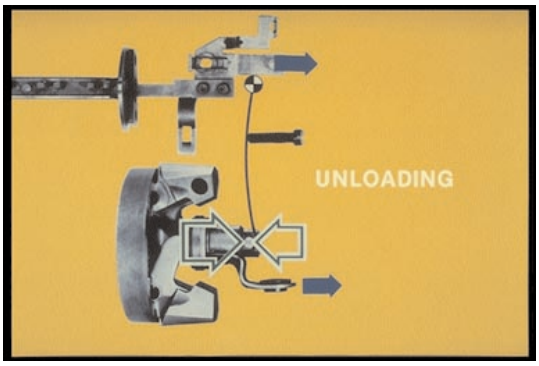
28. As the engine slows, there is less flyweight force. So the spring force can push the sleeve; and through levers, push the rack in the same direction. If this is loading, what's unloading?



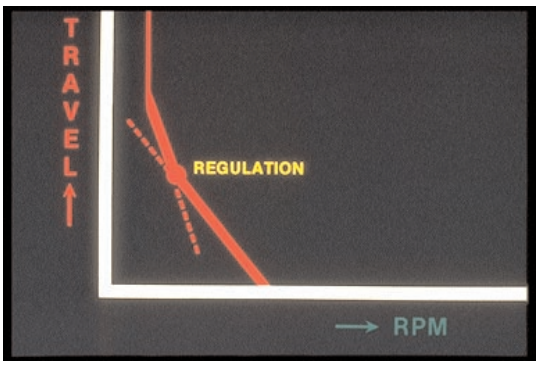
29. Unloading could be turning off an accessory or any way of reducing load on the idling engine.



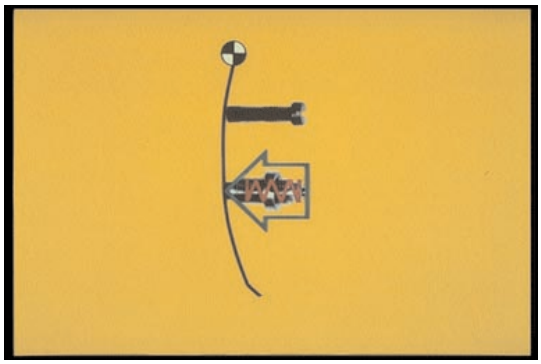
30. If unloading increases RPM, the governor will have to pull the rack to reduce fuel delivery.



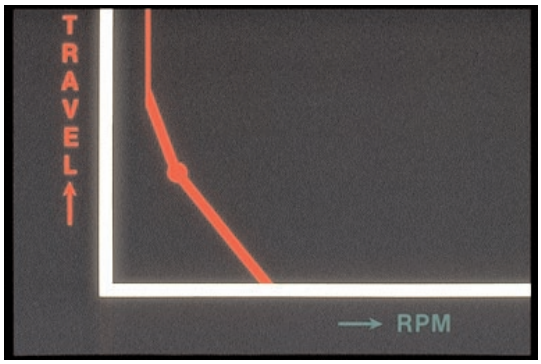
31. The rack will be pulled by the greater flyweight force. That's what will slow the engine toward low idle.



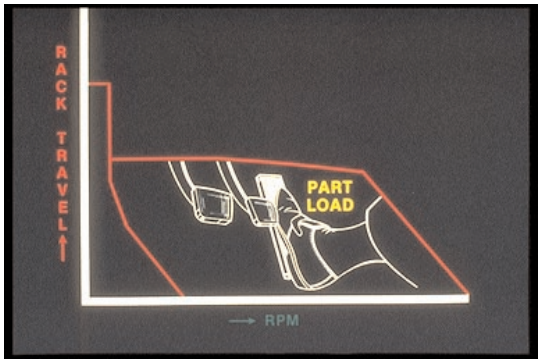
32. Stable RPM comes from regulation — that is, how much rack travel for a certain RPM change. In this RW, loading has a different regulation, or slope, than unloading.



33. Idle regulation is changed by the bumper spring. It just touches the leaf spring at normal idle. So, during unloading, it adds to the spring forces against the flyweights.

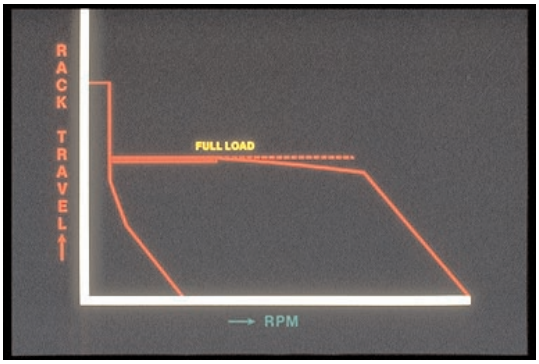


34. You have seen how low speed governor settings control rack travel at low idle. Above low idle . . .

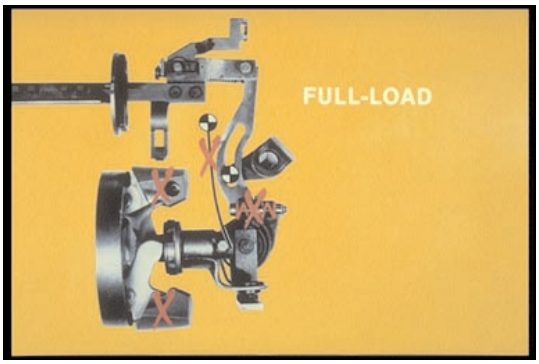


35. . . . at part load operation, the driver controls rack travel. But, when part load . . .

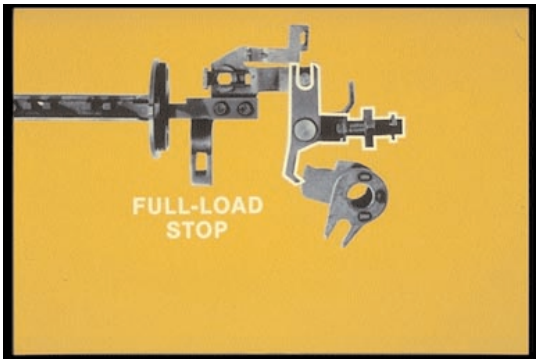
36. . . . becomes full load (as with the pedal full down), the governor . . .



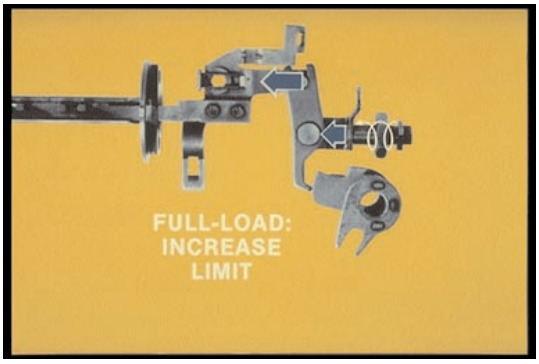
37. . . . must limit full load rack travel to this heavy red line to avoid too much fuel. This could overstress the engine; it could also cause smoke. At these RPM's . . .



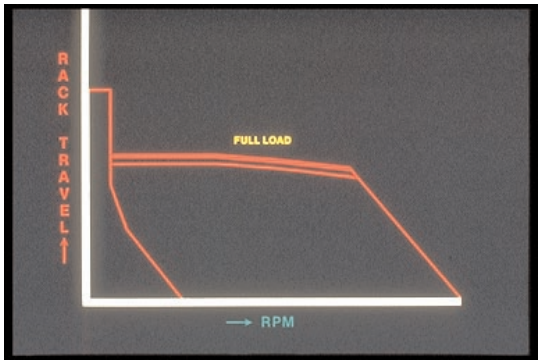
38. . . . full load limitation is not a balance of forces; the flyweights are not controlling — the springs are not controlling.



39. In the RW, the full load stop limits rack travel.

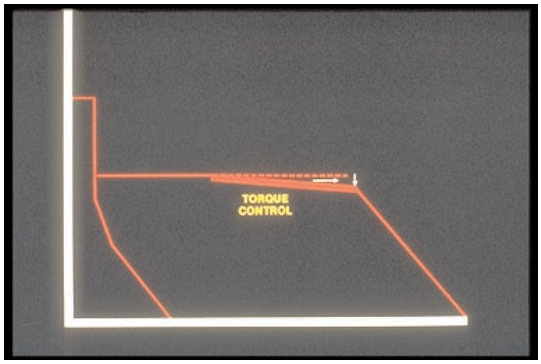


40. Turning in the full load screw will increase the limit — the amount the rack can travel.

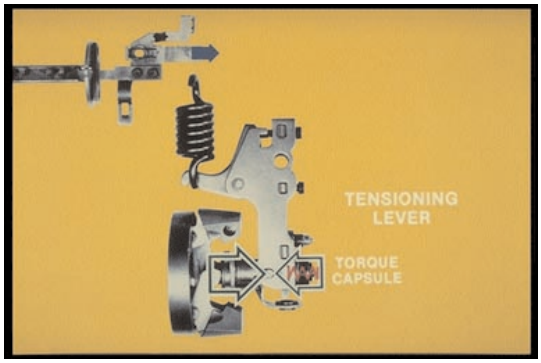


41. On the graph of rack travel, such a full load increase looks like this heavy red line.

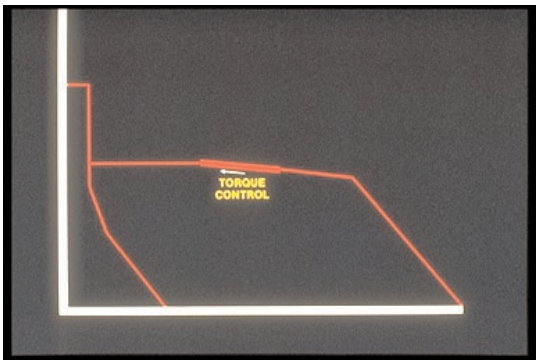
42. Whatever the full load setting, to avoid smoking and improve drivability, the governor must make a further adjustment in rack travel . . .



43. . . . called torque control. At full load, with an RPM increase, torque control will allow flyweights to pull the rack like this — reduce the full load limit. As RPM increases toward rated speed . . .

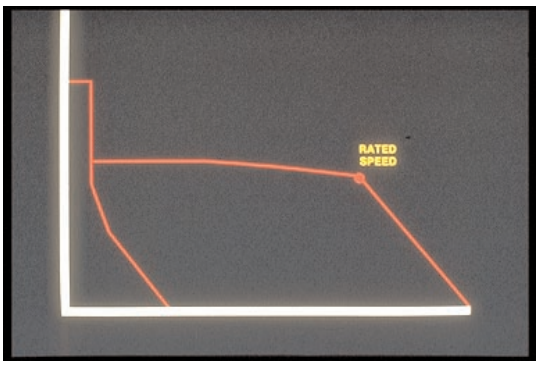


44. . . . flyweight force overcomes spring force of the torque capsule in the tensioning lever. This pulls the rack to reduce fuel delivery.

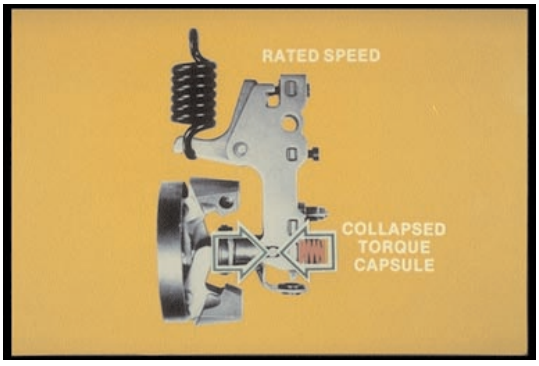


45. So, in the RW calibration, torque back-up is checked like this. The torque control capsule will expand at lower RPM, pushing the rack up to full load.

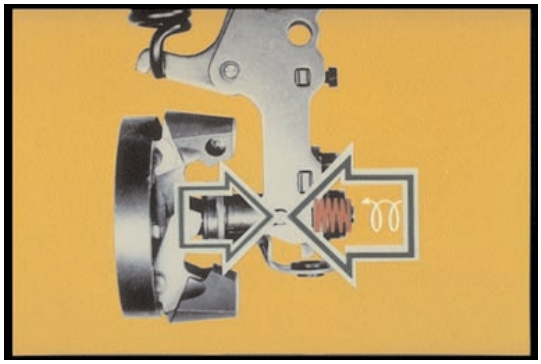
46. Now then, at full power, what happens as the engine approaches rated speed?



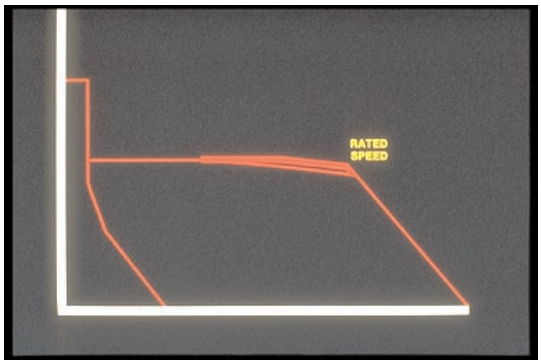
47. At full power, the governor will control the rack to deliver fuel for rated speed.



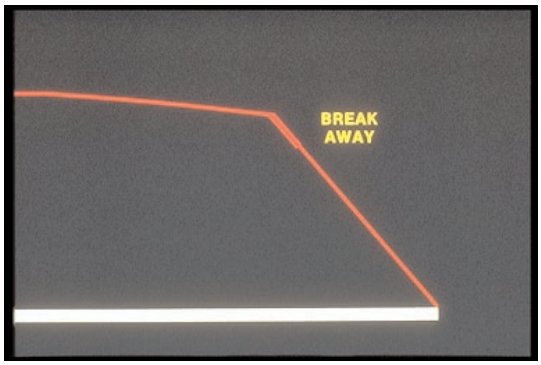
48. At rated speed, for the first time the flyweight force has pushed the guide sleeve against the tensioning lever. Why? Because it has moved in one slot against the collapsed torque capsule spring.



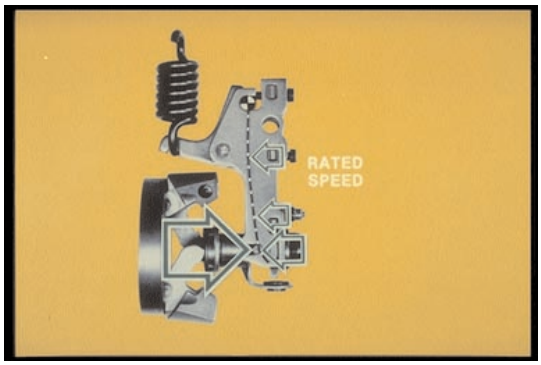
49. Turning the collapsed torque capsule against the guide sleeve will increase delivery. How will it increase delivery?



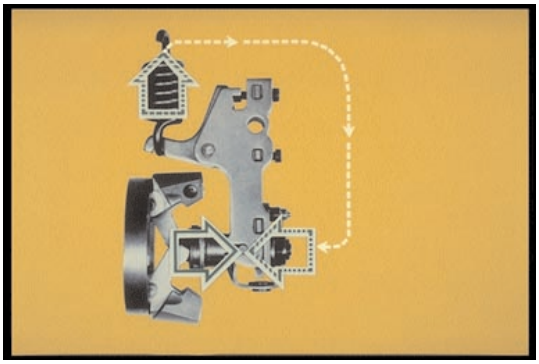
50. By increasing rack travel. Now you can see how this adjusts the amount of torque control or torque back-up.



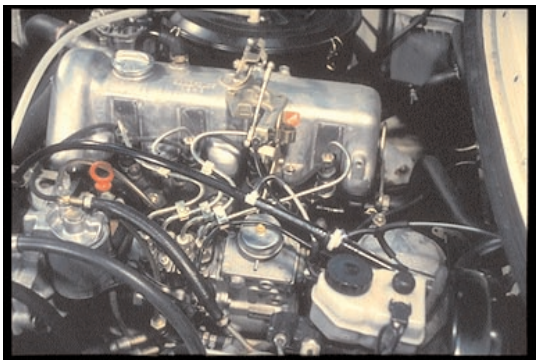
51. This is called breakaway. When the engine revs beyond rated speed, the governor will pull the rack.



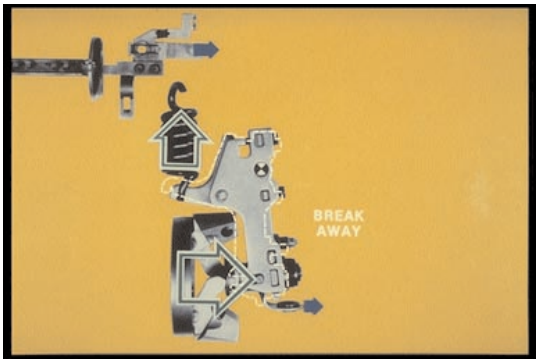
52. At rated speed, flyweight force has overcome all the spring forces in the tensioning lever, but not the main spring.



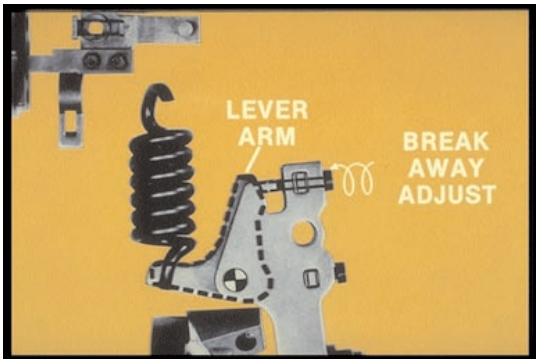
53. Just before breakaway, the main spring continues to oppose the flyweight force, working through the lever arm and the tensioning lever.



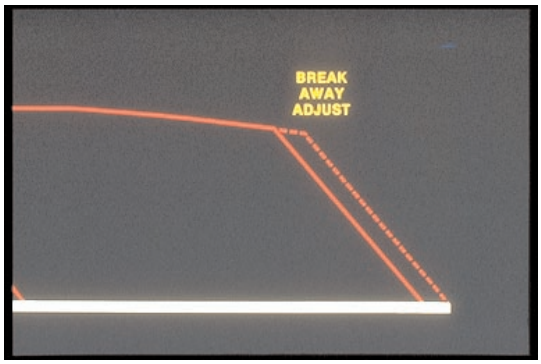
54. As RPM increases above rated speed, as in downhill . . .



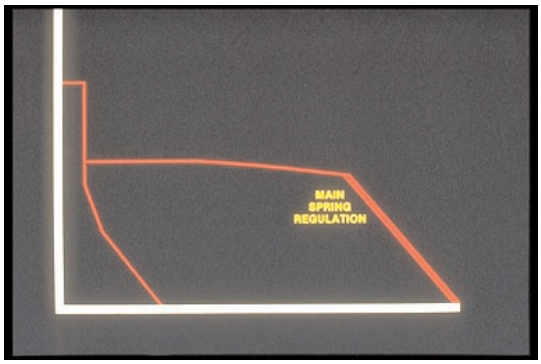
55. . . . flyweight force moves the tensioning lever, stretching the main spring. Guide sleeve movement pulls the rack.



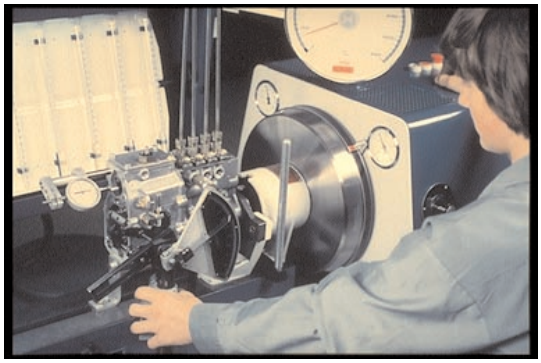
56. When you turn in the screw for breakaway adjustment, the lever arm stretches the main spring so it pulls harder on the tensioning lever.



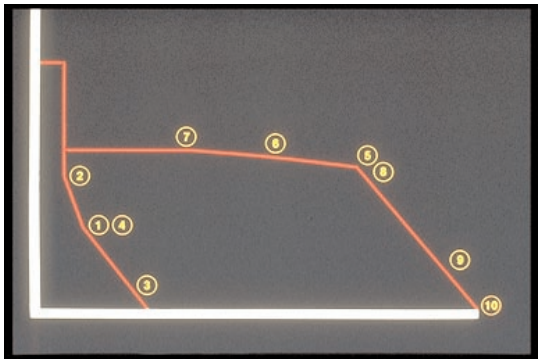
57. This breakaway adjustment means higher RPM and greater fly-weight force. After breakaway . . .



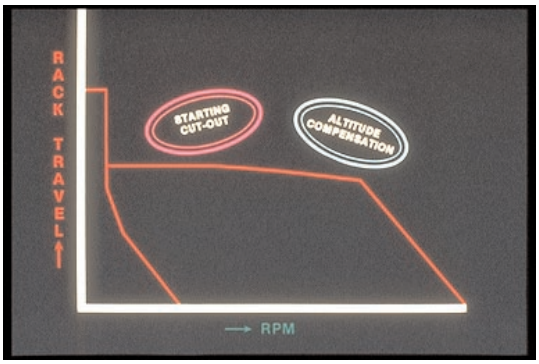
58. . . . as RPM rises, main spring regulation determines how the rack is pulled to high idle, and finally to cut-off.



59. Now you see why a test bench is necessary for all internal adjustments and why they must be done in the specified order.

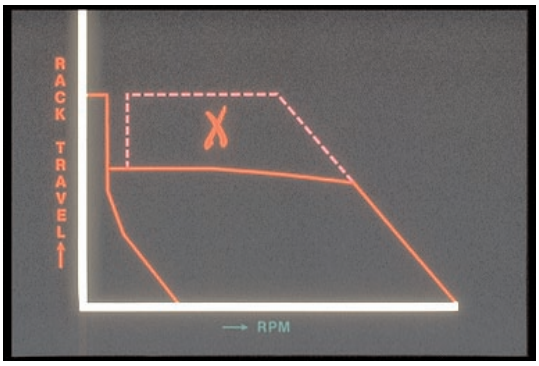


60. In order, one, low idle; two, loading; three, unloading; four, bumper spring. Then, at higher RPM's, five, rated speed; six and seven, torque control and full load; eight, breakaway; nine, high idle; and ten, fuel cut-off.

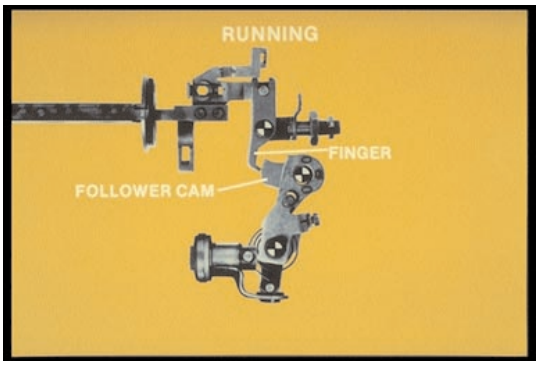


61. Finally, the governor provides start quantity, and insures start quantity cut-out; also altitude compensation. Let's see how.

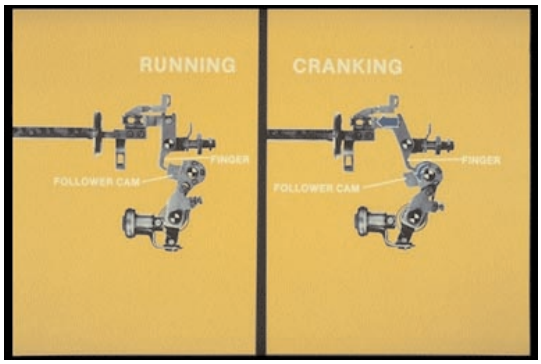
62. With the pump at cranking RPM, the governor should permit the full starting rack travel.



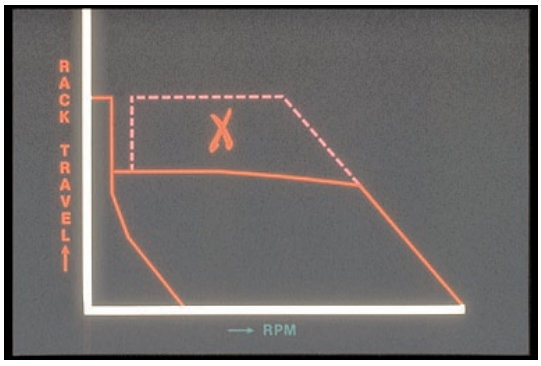
63. But at higher RPM's, the starting quantity cut-out must prevent rack travel above full load.



64. At all normal engine running speeds, this follower cam is moved by the flyweights so the finger on the full load stop limits rack travel.

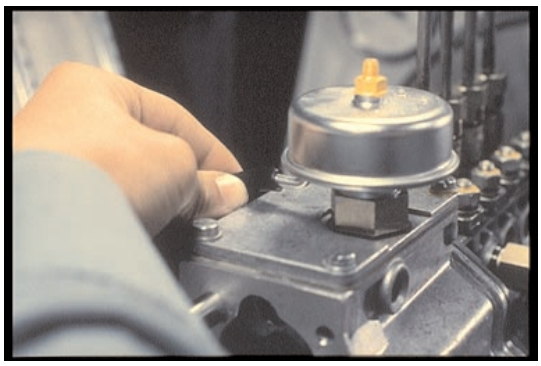


65. In comparison, at cranking RPM, the guide sleeve moves left so the swivel lever lowers the follower cam. The finger drops into the slot so the rack can be pushed to start quantity.

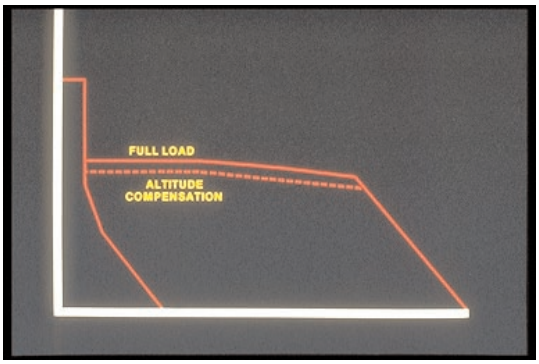


66. Above cranking RPM, the rack cannot travel above the full load limit. But for emission control, that full load limit may be reduced with altitude.

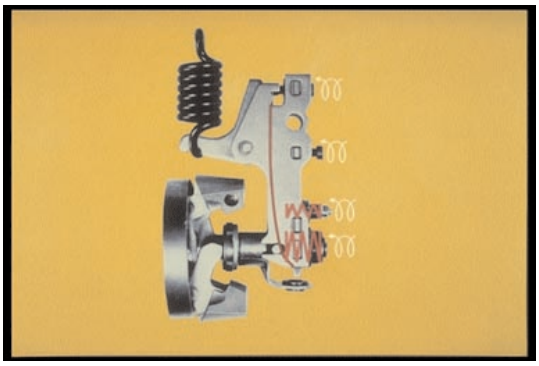
67. Why does high altitude change that full load limit? Because thinner air requires less fuel delivery; otherwise, we have a smoking problem.



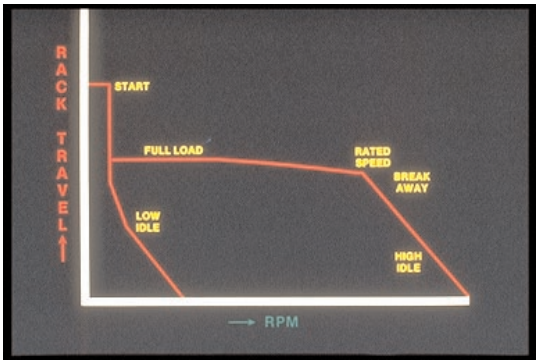
68. In most cars, altitude compensation is automatic; it can be manual in some vehicles. Vacuum is pulled on the test bench to simulate altitude.



69. Depending on altitude, full load rack travel is reduced by altitude compensation.



70. Adjustments of several spring forces balance changing flyweight force . . .



71. . . . to control rack travel and regulation for low RPM's, high RPM's and full load . . .

72. . . . in cars and other vehicles using the RW governor, brought to you by Robert Bosch.

REVIEW EXERCISE ANSWER PAGE: RW GOVERNOR OPERATION

1. rack travel, delivery
2. balance, flyweight
3. guide sleeve, swivel lever
4. opposite, swivel lever
5. increases, guide sleeve
6. full load
7. guide sleeve, increase
8. lever arm, main spring
9. test bench
10. permit, prevent