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ADJUSTMENT, MAINTENANCE, AND REPAIR OF SMALL GASOLINE ENGINES. AGRICULTURAL MACHINERY--SERVICE OCCUPATIONS, MODULE NUMBER 12.

OHIO STATE UNIV., COLUMBUS, CENTER FOR VOC. EDUC.
REPORT NUMBER OSU-AGDEX-761-017-12 PUB DATE AUG 65
EDRS PRICE MF-$0.25 HC-$1.20 30P.

DESCRIPTORS- *TEACHING GUIDES, UNITS OF STUDY (SUBJECT FIELDS), *AGRICULTURAL EDUCATION, *AGRICULTURAL MACHINERY OCCUPATIONS, REPAIR, *ENGINES, MAINTENANCE, POST SECONDARY EDUCATION, BIBLIOGRAPHIES, COLUMBUS

ONE OF A SERIES DESIGNED TO HELP TEACHERS PREPARE POSTSECONDARY STUDENTS FOR THE AGRICULTURAL MACHINERY SERVICE OCCUPATIONS AS PARTS MEN, MECHANICS, MECHANIC'S HELPERS, OR SERVICE SUPERVISORS, THIS GUIDE AIMS TO DEVELOP STUDENT COMPETENCY IN THE ADJUSTMENT, MAINTENANCE, AND REPAIR OF SMALL GASOLINE ENGINES. IT WAS DEVELOPED BY A NATIONAL TASK FORCE ON THE BASIS OF RESEARCH FROM STATE STUDIES. SUGGESTIONS ARE INCLUDED FOR INTRODUCING THE MODULE. SUBJECT-AREA UNITS ARE--(10) NOMENCLATURE, (2) COMBUSTION PRINCIPLES, (3) IGNITION, (4) RUNNING GEAR, AND (5) GOVERNORS AND COOLING SYSTEMS. EACH UNIT INCLUDES SUGGESTED SUBJECT-MATTER CONTENT, TEACHING-LEARNING ACTIVITIES, MATERIALS, AND REFERENCES. CRITERIA FOR EVALUATING EDUCATIONAL OUTCOMES ARE SUGGESTED. SUGGESTED TIME ALLOTMENT IS 40 HOURS OF CLASS INSTRUCTION AND 68 HOURS OF LABORATORY EXPERIENCE. TEACHERS SHOULD HAVE A BACKGROUND IN AGRICULTURAL MACHINERY. STUDENTS SHOULD HAVE MECHANICAL APTITUDE AND AN OCCUPATIONAL GOAL IN AGRICULTURAL MACHINERY. THIS DOCUMENT IS ALSO AVAILABLE FOR A LIMITED PERIOD AS PART OF A SET (VT 00 488 THROUGH VT 000 504) FROM THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION, THE OHIO STATE UNIVERSITY, 980 KINNEAR ROAD, COLUMBUS, OHIO 43212, FOR $7.50 PER SET. (JM)

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ADJUSTMENT, MAINTENANCE, AND REPAIR OF SMALL GASOLINE ENGINES

One of Sixteen Modules in the Course Preparing for Entry in

AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS

Module No. 12

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

The development of these materials was supported by a grant from the
Division of Adult and Vocational Research
United States Office of Education

August, 1965

MEMORANDUM

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DATE: August 4, 1967

RE: (Author, Title, Publisher, Date) Module No. 12, "Adjustment, Maintenance, and Repair of Small Gasoline Engines," The Center for Vocational and Technical Education, August, 1969.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency The Center for Vocational and Technical Education
Address 980 Kinnear Road, Columbus, Ohio 43212
Limitation on Available Copies No Limit Price/Unit $ 7.50/set
(quantity prices)

(2) Means Used to Develop Material:
Development Group National Task Force
Level of Group National
Method of Design, Testing, and Trial Part of a funded project of the USOE, OE-5-85-009; materials based on research from state studies; see preface material in the course outline.

(3) Utilization of Material:
Appropriate School Setting Post high school
Type of Program General post high school class in agricultural machinery
Occupational Focus Agricultural machinery service occupations
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural machinery
Student Selection Criteria Post high school, mechanical aptitude, high school background, goal in agricultural machinery service occupation.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable
(Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

ADJUSTMENT, MAINTENANCE, AND REPAIR OF
SMALL GASOLINE ENGINES

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ADJUSTMENT, MAINTENANCE, AND REPAIR OF SMALL GASOLINE ENGINES

Major Teaching Objective

To develop the ability to adjust, maintain, and repair small gasoline engines effectively.

Suggested Time Allotment

At school

Class instruction	40 hours	
Laboratory experience	68 hours	
Total at school		108 hours
Occupational experience		0 hours
Total for Module		108 hours

Suggestions for Introducing the Module

The extensive use of small gasoline engines makes necessary the ability of many employees in agricultural machinery business to adjust, maintain, and repair small internal combustion engines. This is especially true for those employed as service supervisors, machinery mechanics, and machinery mechanics' helpers. The effective and efficient employee in this area has a thorough understanding of the nomenclature of small engines, an understanding of the relationship of the components to each other, a knowledge of tools common to this segment of mechanics, and the ability to apply these understandings and knowledge to practical situations.

The following may be used in creating interest in the module. Bring to class several different makes of small gasoline engines, selected on the basis of their operating efficiency. Before the class, start these engines to demonstrate their various operating speeds. Have the class attempt to determine why these engines run at different speeds. Point out that the differences in running speeds of the various engines are probably due to malfunctions that could probably be corrected with adjustment. As the students progress through the module, have them check these motors until they have identified the reasons they run at different speeds.

The teacher should impress upon the students that employers are expecting an increasingly higher degree of speed and efficiency from employees in the performance of their jobs. This demands the development of performance skills as well as understandings.

Competencies to be Developed

I.. To understand small gasoline engine nomenclature

Teacher Preparation

Subject Matter Content

A knowledge of the nomenclature of small gasoline engines and the function of each part is essential. The components of small gasoline engines vary according to manufacturers, but the following are applicable in most cases.

1. Main engine components

   a. Crankcase and cylinder block
   b. Cylinder head
   c. Spark plug grounding switch
   d. Crankcase breather
   e. Bearing plate
   f. Valves, springs, and keepers
   g. Tappet cover plate
   h. Governor control lever
   i. Governor weight assembly and shaft
   j. Valve tappets
   k. Spark advance weight and spring
   l. Cam gear
   m. Engine base
   n. Cam shaft and plug
   o. Governor crank assembly
   p. Governor lever assembly
   q. Throttle link
   r. Governor control rod
   s. Main bearings
   t. Piston, ring and pin assembly
   u. Connecting rod and oil slinger
   v. Crank shaft
   w. Reduction gear assembly

2. Air, fuel, and exahust system components

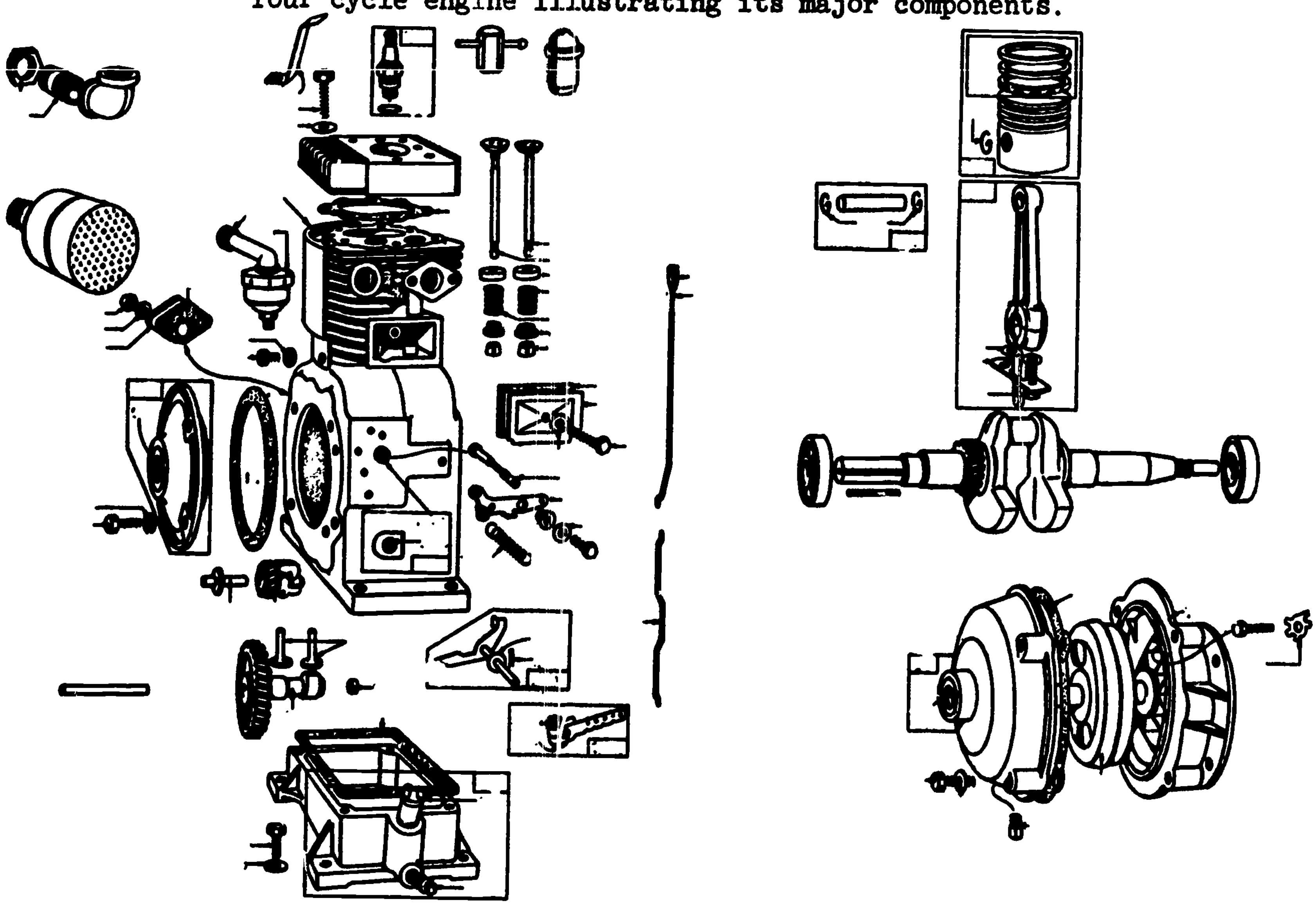
   a. Fuel tank
   b. Fuel tank outlet
   c. Exhaust outlet and muffler
   d. Carburetor lower body
   e. Carburetor upper body
   f. Throttle
   g. Butterfly (choke and/or throttle)
   h. Idle valve

i. Needle valve
j. Idle adjustor screw
k. Throttle lever
l. Choke lever
m. Float
n. Air cleaner

3. Ignition system components

a. Engine flywheel
b. Magneto (on magneto type)
c. Magneto armature (on magneto type)
d. Ignition coil (magneto and battery type)
e. Bearing plate
f. Breaker box cover and stop switch assembly
g. Breaker points
h. Point gap adjusting cam
i. Condenser
j. Breaker base
k. Breaker shaft
l. Spark plug
m. Flywheel housing
n. Distributor (on battery type)
o. Battery (on battery type)

Below is an exploded view of a sample single cylinder--four cycle engine illustrating its major components.



Suggested Teaching-Learning Activities

1. At the beginning of the class, place several small gas engine parts around the classroom and have each student attempt to identify them.

2. Demonstrate the terms work, torque, and horsepower to the class as they are being discussed. As these terms are being demonstrated, have the students compute work done, the amount of torque created, and the amount of horsepower created.

3. As the engine components are being discussed, have each student dismantle a small gasoline engine and identify on his engine the parts being discussed.

4. After all terms have been discussed by the teacher, tear a small gasoline engine down completely and have students identify the parts.

5. Supply students with a list of terms common to the language associated with small gasoline engines. Have students define the terms they know and find the definitions of those they do not know. Other terms may be added to the list in the content.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, preferably overlays, of the illustrations presented in the content

2. A fulcrum, a 1" x 4" x 5' board, and four 2" x 4" x 8" bricks for demonstrating work, torque and horsepower

3. A small gasoline engine for each member of the class and the instructor

4. Several small gasoline engine parts

5. A set of tools for each student to use when tearing down his engine

References

S*1. Small Engines Service Manual, pp. 20-23, 55-63.

S*2. All About Small Gas Engines, pp. 277-301.

*The symbol T (teacher) or S (student) denotes those references designed especially for the teacher or the student.

II. To understand combustion principles of internal combustion engines

Teacher Preparation

Subject Matter Content

The information presented in General Theories of Operation, pp. 3-10 should be used as the main reference in teaching this competency and supplemented with the following materials. The information should be presented to the class in the order that it is presented in this module.

The principle upon which internal combustion engines operate is simple but understood by relatively few outside the field of engine mechanics.

The internal combustion engine is a machine for converting potential chemical energy into mechanical power.

The essentials for combustion are

1. Fuel
2. Air
3. Ignition
4. Compression

The process by which internal combustion engines convert chemical energy into mechanical power involves four events

1. Intake
2. Compression
3. Power
4. Exhaust

Small gasoline engines are designed as

1. Four-stroke cycle engines. Four strokes (up or down movement of the piston) are required to complete the four events (intake, compression, power, and exhaust) involved in converting potential chemical power into mechanical power. One event is conducted with the completion of each stroke of the piston. (Refer to reference General Theories of Operation pp. 4 and 5.)

2. Two-stroke cycle engines. Engines of this design require only two strokes of the piston to complete the four necessary events (intake, compression, power, and exhaust). On most small engines, the upward stroke of the piston draws a fuel-air mixture already in the cylinder above the piston. The downward stroke provides the power and exhausts the burned fuel-air mixture at the same time. (Refer to reference All About Small Gasoline Engines, p.14.)

Suggested Teaching-Learning Activities

1. Use cutaway models of four-cycle and two-cycle small engines to demonstrate the internal engine operating principles of each type.

2. After discussing the items in the subject matter content, show the movie, "The ABC of Internal Combustion".

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies illustrating the principles of internal combustion engines

2. A small engine with a cutaway view of the combustion chamber, piston, valves, etc.

3. "The ABC of Internal Combustion"

References

1. Small Engines Service Manual, pp. 2-4.

2. All About Small Gas Engines.

S*3. General Theories of Operations, pp. 3-10.

III. To understand ignition principles of small gasoline engines

Teacher Preparation

Subject Matter Content

The information present in General Theories of Operation pp. 19-24 should be used as the main reference in teaching the competency and supplemented with the following materials. The information presented in this reference should be presented to the class in the order that it is presented in these materials.

The two types of ignition systems used on small gasoline engines are magneto systems and battery systems.

1. Magneto ignition utilizes the principle of electro magnetic induction and produces electrical energy through the use of a dynamo or generator. The two main types are low tension and high tension magnetos. A typical magneto ignition system consists of the following major components:

    a. Impulse coupling

    b. Coil

    c. Magnetic rotor

    d. Frame laminations

    e. Breaker points

    f. Breaker arm

    g. Condenser

    h. Spark plug

    i. Flywheel

2. In engines with multiple cylinders, the magneto system may also include

    a. Distributor rotor

    b. Distributor gear

c. Distributor pinion

d. High-tension lead rod

3. A battery ignition system depends upon a storage battery as its source of electrical energy. A typical battery ignition system consists of

   a. Ignition coil

   b. Condenser

   c. Distribution system

      1) Cap
      2) Rotor seal
      3) Dust seal
      4) Weight spring
      5) Advance weight
      6) Weight base and shaft
      7) Bushing
      8) Coupling
      9) Grease cup
      10) Switch
      11) Wiring
      12) Spark plugs

<u>Suggested Teaching-Learning Activities</u>

1. Using overhead transparencies, charts, diagrams and teacher-made mock-ups, discuss the principles involved in ignition systems of small engines.

2. Have students define

   a. Vacuum advance

   b. Armature

   c. Spark advance

   d. Normal spark plug

   e. Cold spark plug

   f. Hot spark plug

   g. Spark plug fouling

h. Spark plug gaps

i. Primary winding

j. Secondary winding

k. SAE

3. Have each student carefully and completely disassemble both a magneto and a battery ignition system. Be sure the students mark each part to make certain it can be reassembled correctly.

4. Following the operator's manual to determine proper settings for plugs, points, etc., have students reassemble the torn down ignition systems.

5. Disassemble both a magneto- and battery-type ignition system and have the students identify each part.

6. Have students trouble shoot the ignition system of at least one engine that performs improperly.

7. Have students place a volt meter on the hot point of the engine magneto or battery to measure the voltage produced. Then place the volt meter on the plug to measure the amount of voltage going into the plug. Point out to the class that the coil is responsible for the increase in voltage.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, charts, and diagrams of small gas engine electrical systems

2. Display boards showing ignition system parts

3. One small engine per student

4. A cross section of a coil

5. A magneto and battery of the type used in small gasoline engine ignition systems

6. Various types of spark plugs used in small gasoline engines

References

1. All About Small Gas Engines, pp. 182-220.

2. Briggs and Stratton Repair Instructions II, pp. 13-22.

3. General Theories of Operation, pp. 19-24.

4. Small Engines Service Manual, pp. 5-14, 24-29.

IV. To understand combustion principles of small gasoline engine systems

Teacher Preparation

Subject Matter Content

The information present in General Theories of Operation pp. 10-19 should be used as the main reference in teaching the competency and supplemented with the following materials. The information prese... d in this reference should be presented to the class in the order that it is presented in these materials.

Small engine fuel systems consist primarily of a fuel tank and carburetor.

The primary function of the fuel tank is storage for fuel which is supplied to the carburetor through a fuel line.

The primary function of the carburetor is to produce and supply to the engine a mixture of fuel and air on which the engine operates.

The primary function of the air cleaner is to remove foreign particles from the air so that the air entering the carburetor will be clean.

1. Operation of carburetors, involves several principles. Carburetor designs are complicated, but the principle of carburetion is relatively simple. Air and fuel flow into a cylinder of an engine because of the difference between the pressure within the cylinder and atmospheric pressure outside the cylinder.

Principles of operation involve the following:

a. Venturi is the basic principle used in modern carburetors. This principle depends on the fact that gas or liquid flowing through a constricted section in a passage undergoes an increase in speed and a reduction in pressure as compared to its speed and pressure prior to and after passing through the restricted section.

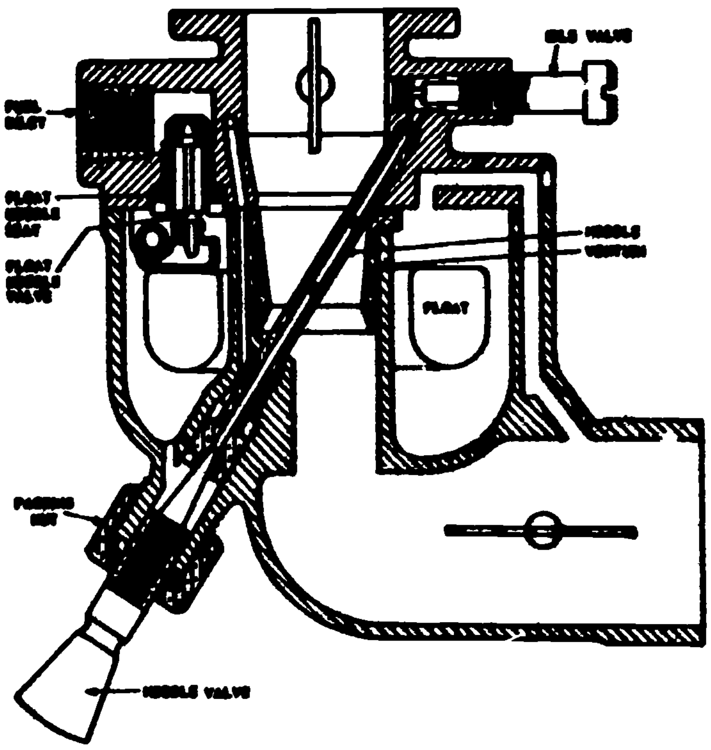
b. Air bleeding is the principle used in modern carburetors because it reduces the amount of fuel drawn from a carburetor jet, and it assists in atomization of fuels necessary for efficient combustion.

c. Fuel and air mixtures (the ratio of fuel and air) are determined by these factors:

   1) Weather (temperature)
   2) Speed of engine
   3) Load on engine

d. The level of fuel in the main discharge nozzle must be maintained at a fairly constant level to meet the varying demands of the engine. When the level becomes too low, the engine fails to operate, or to operate properly, because of an inadequate supply of fuel.

e. To assure dependability, many carburetor designs include a second or compensating nozzle. In combination with the main nozzle, the two give a substantially constant mixture.



An Elementary Carburetor With Major Components Identified

2. Carburetors are grouped according to design and type. Design, as used here, refers to air entrance into the carburetor.

   Basically, there are three carburetor designs.

   a. Updraft is the design by which air enters the bottom of the carburetor and must lift the fuel by air friction.

   b. Downdraft is the design by which the carburetor is placed above the engine; air enters the top, passes downward, mixes with the fuel, and then passes into the manifold and into the engine.

   c. Crossdraft or side outlet is the design by which air enters the side, mixes with the fuel in horizontal mixing tube, and passes into the manifold, which may be built into the engine block. This design is used on most lawn mowers.

3. Basically, there are three types of carburetors.

   a. Float type is used primarily with overhead fuel tanks. The level of fuel in the carburetor is controlled by a float which operates a valve that regulates the flow of fuel into the bowl of the carburetor.

b. Suction type is above the fuel tank and has a fuel pipe extending down into the fuel tank. Fuel is sucked into the carburetor when the movement of the piston in the cylinder creates a vacuum reducing the atmospheric pressure in the carburetor below that in the fuel tank.

c. Floatless (diaphragm) type serves a dual function by also serving as a fuel pump. This type maintains a constant level of fuel and operates satisfactorily when tilted to acute angles.

4. Air cleaners supply clean air to the carburetor. Unclean air is likely to reduce efficiency of the engine, and is also very detrimental to the life of the engine.

   Air cleaners are simple, and are easily maintained. The three basic types are

   a. Oil-bath cleaners

   b. Oil-foam cleaners

   c. Dry-element cleaners

5. Carburetor trouble shooting is necessary, since an efficient small engines mechanic must be aware that complete failure of an engine to operate seldom originates in the carburetor. Skill in recognizing carburetor malfunction should be developed through recognizing the following signs and following the proper procedures.

   a. Engine fails to operate

      Before examining the carburetor, check the ignition, compression and supply of fuel. If these prove satisfactory, examine the carburetor and make corrections through the following steps:

      1) Examine choke to see that it is operating properly.
      2) Check the flow of fuel to the carburetor. Fuel flow may be restricted by clogged lines or vapor lock.
      3) Check for air leaks where the carburetor is fastened to the manifold.
      4) Check for worn linkage
      5) Check for dirt in the carburetor.

6) Check for incorrect fuel level.
7) Check for worn parts.
8) Check for maladjustment.

Adjustments should be made according to the manufacturer's recommendations provided in the operator's manual.

b. Engine operates, but performance is poor.

Poor performance often results from too lean a mixture and may be remedied by checking and correcting the following possible causes:

1) Air leakage at carburetor or manifold
2) Clogged fuel lines
3) Defective fuel pump
4) Incorrect fuel level
5) Clogged fuel screen
6) Dirt in carburetor jets and passage
7) Damaged or wrong-size main metering jet
8) Worn idle needle valve and seat
9) Loose jets
10) Defective gaskets
11) Worn throttle shaft
12) Leaking vacuum lines to accessory equipment

c. Engine operates but idles poorly.

This condition may be caused by defective ignition, leaking engine valves, uneven engine compression, or faulty carburetor condition. The carburetor should be checked for the following:

1) Incorrect adjustment of idle needle valve
2) Incorrect float level
3) Sticking float needle valve
4) Air leaks at carburetor and manifold
5) Defective gaskets
6) Clogged idle discharge holes
7) Loose jets in carburetor
8) Leaking vacuum lines to accessory equipment

Suggested Teaching-Learning Activities

1. Demonstrate to students the principles of carburetion by using a simple atomizer or hand sprayer and candle.

2. Tear down a carburetor. As the principles of operation are discussed, show the class the carburetor part involved in making the principle turn into a function.

3. Attach a fuel meter in the gas line between the gas tank and the carburetor. Demonstrate to the class the increase in gas flow to the carburetor as the speed of the engine increases or slows down as a result of pull on the engine.

4. As the types and designs of carburetors are discussed in class, show the class an actual carburetor of each type and design. Disassemble each carburetor and show the class how each differs.

5. Have students disassemble, examine, clean, and adjust several carburetors on several different types of small gasoline engines.

6. Have students disassemble, examine, clean, make necessary maintenance repairs, and reassemble each type of air cleaner.

7. Foul up the carburetor system on several small gasoline engines. Have students trouble shoot these systems using the procedures outlined.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, preferably overlays in color, illustrating fuel systems, their function and operation

2. Charts illustrating carburetors, their major components and their functions

3. A disassembled carburetor mounted on a display board to present an exploded view

4. An atomizer or simple hand sprayer and candle

5. A carburetor of each type and design

6. A carburetor for each student

7. An air clearner for each student

References

1. All About Small Gas Engines, pp. 137-151.

2. Briggs and Stratton Repair Instructions II, pp. 23-40.

3. General Theroies of Operation, pp. 10-19.

4. Small Engines Service Manual, pp. 14-19, 29-31.

V. To understand the small gasoline engine running gear and its related parts

Teacher Preparation

Subject Matter Content

The heavy work load placed on the running gear necessitates its proper adjustment and maintenance to prevent excessive major repairs. The actual work produced by an engine is done by its running gear.

The main components of the running gear of a small engine are

1. Pistons, pins, and rings

2. Connecting rods

3. Crank shaft and cam gears

4. Lubricating system pump or splasher

5. Engine bearings

6. Engine valves and springs and retainers

   a. Intake

   b. Exhaust

(See Small Engine Service Manual, page 57, for a cutaway view of the running gear and its related parts.)

Related components are

1. Cylinders

2. Head

3. Frame

4. Base

5. Flywheel

A thorough knowledge of proper adjustment of running gear parts and of diagnostic procedures is necessary to overhaul a small engine effectively.

Conditions which result from improperly adjusted or defective running gear components and related parts are

1. High oil consumption

2. Loss of power

3. Engine overheating

4. Excessive engine noise

5. Engine failure to operate

A single defect can cause any one of the above conditions to exist, but in many cases the condition is caused by a combination of defects. Proper diagnostic procedures do not stop upon the location of one defect but demand close examination for all defects which may produce the condition. Careful study of materials related to the particular make of engine which are supplied by the manufacturers is essential for effective results.

Excessive friction causes rapid destruction of running gear parts. This cannot be eliminated, but it can be reduced to a minimum by the proper use of friction-reducing lubricants. Engine oil has five main functions.

1. It reduces friction which results in reduced wear.

2. It serves as a cushion between shafts and bearings.

3. It serves as a coolant.

4. It helps to keep the interior of the engine clean.

5. It seals power between piston rings and cylinder walls.

Engine oils are classified according to viscosity and the American Petroleum Institute (API) service classifications. Viscosity

refers to the weights or thickness of the oil and API service classifications refer to the quality of the oil. API service classifications are

1. Service ML (Motor Light)
2. Service MM (Motor Moderate)
3. Service MS (Motor Severe)
4. Service DG (Diesel General)
5. Service DM (Diesel Moderate)
6. Service DS (Diesel Severe)

An oil may meet the specifications for all grades and be labeled as such.

Additives, as detergents, are often used with engine oils to give them more cleaning ability.

Suggested Teaching-Learning Activities

1. Using overhead transparencies, charts, and diagrams, familiarize students with the running gear components and related parts, their functions, and the relationship of the various parts to each other.
2. Have students disassemble and reassemble the running gear of a small gasoline engine.
3. Have students accuartely perform the following activities:
    a. Grind valves
    b. Seat valves
    c. Replace all running gear bearings
    d. Replace piston rings
    e. Hone a cylinder
    f. Resize a cylinder and insert a sleeve
    g. Adjust or repair lubricating system

h. Replace gaskets

i. Reassemble and properly adjust each part

4. Have a lubricant specialist speak to the class to explain types and grades of engine oil.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, charts, diagrams, and mockups of the running gear and its related parts

2. One small gasoline engine per student

3. A set of tools for each student

4. A clear plastic model of an engine

5. Samples of oils and other lubricants used in small engines

6. Operators' manuals

7. Special equipment needed to carry out the jobs listed under item 3 of the teaching-learning activities

References

1. All About Small Gas Engines, pp. 39-136.

2. Small Engines Service Manual, pp. 53-57.

3. Briggs and Stratton Repair Instructions II, pp. 41-59.

4. Gulf Farm Tractor Guide, pp. 12-18.

VI. To understand small gasoline governors and cooling systems.

Teacher Preparation

Subject Matter Content

The purpose of the governor is to maintain, with certain limits, a desired engine speed under varying loads.

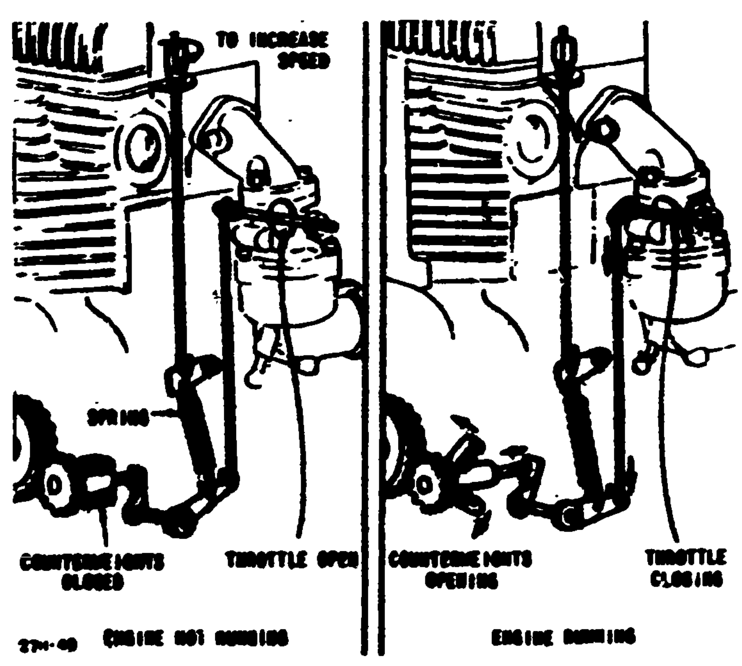
Governors may be either mechanical or velocity types. The three basic designes of governors are classified according to the force upon which they operate.

1. Engine speed governor operates by weights which tend to fly outward as the speed of the engine increases. The action involves the movement of a rod attached to the throttle to open or close the throttle.

2. Velocity governor operates by the velocity of the gas going through the manifold. This passage through the manifold acts on a spring-loaded floating obstruction in the shape of a ball or disk attached to the throttle.

3. Vacuum governor operates on the intake manifold vacuum. This vacuum decreases as the engine load increases and and increases as the engine load decreases.

The purpose of the governor is to maintain a desired engine speed under varying loads. It must serve as an automatic means of opening and closing the throttle. When the load is increased, the engine speed tends to decrease, so the throttle must be gradually opened in order to maintain the desired speed. The opposite is true when the load is decreased.



Exploded View of a Typical Governor
Used on Many Small Engines.

The purpose of the cooling system is to regulate the temperature of the engine. Engines will not operate efficiently if they are too cool. Engines operate most efficiently at a temperature of

about 200 degrees F. If the temperature exceeds this, the engine may be damaged.

Basically, there are two types of cooling systems used on small engines.

1. Air

2. Water

Air-cooled engines are used almost exclusively for small machinery. Water-cooled engines may be used on small machinery but are used primarily on larger machinery. The typical water-cooled enigne is much more rugged in construction than the smaller air-cooled engines, which are usually lighter in weight.

The principles of operation of air-cooled and water-cooled engines are basically the same. Heat created by the burning fuel in the combustion chamber is transferred to the water or air as it flows around the cylinder walls. This constant transfer of heat helps maintain the desired engine temperature. Approximately one-third of the heat created by the burning fuel must be removed by the cooling system. A defective cooling system will cause much damage to the engine.

Periodic checking and servicing is essential to a properly-maintained cooling system. Servicing an air-cooled system involves two basic activities.

1. Keeping all air passages around the engine free of dirt and foreign matter

2. Checking to make certain the fins on the flywheel are in good condition

Suggested Teaching-Learning Activities

1. Using overhead transparencies, models, mockups, etc. show the parts of a governor, explain their functions, and identify the air flow in the engine cooling system.

2. Have students remove the governor from a small gasoline engine, disassemble it, reassemble it, properly adjust it, and replace it on the engine. Repeat this operation on a different type of governor.

3. Using a clear plastic model of a small gasoline engine, force chalk dust through the cooling system to show how the air enters, circulates through, and leaves the engine.

4. Have students clean and service the cooling systems on several types of small gasoline engines.

5. Have students bring several small gasoline engines to the shop that need repairing and have students overhaul them using the Small Engines Service Manual and Briggs and Stratton Repair Instructions II as guides.

Suggested Instructional Materials and References

Instructional materials

1. Overhead transparencies, charts, etc.

2. Disassembled governors mounted on a display board.

3. Small engines with both types cooling systems

4. A clear plastic model of a small gasoline engine

5. A small gasoline engine for each student

References

All About Small Gas Engines, pp. 97-100, 113-114.

Suggestions for Evaluating Educational Outcomes of the Module

Educational outcomes of this module should be evaluated by the abilities and attitudes developed by the students.

1. Ability of students to repair small engines should be evaluated by assigning each student to an engine that needs several adjustments and repairs. Observation of the procedure followed by the student, his ability to use the necessary tools for the job, and the thoroughness and effectiveness of the job done will indicate his level of proficiency.

2. Evaluate student attitudes according to

   a. Interest of students

   b. Extent of participation in class activities

Source of Suggested Instructional Materials and References

Instructional materials

"The ABC of Internal Combustion," 16mm film, 18 minutes, color, sound. General Motors Corporation, Detroit, Michigan.

References

1. Briggs and Stratton Repair Instructions II, Form MS 4750-54. Milwaukee, Wisconsin: Briggs and Stratton Corporation. No charge.

2. General Theories of Operation, Form MS 3553-31. Milwaukee, Wisconsin: Briggs and Stratton Corporation. No charge.

3. Gulf Farm Tractor Guide, Sp 10293-R63. Houston, Texas: Gulf Oil Corporation, Gulf Building. Free.

4. Long, Kenneth F. Small Engines Service Manual, Sixth Edition. Technical Publications, Inc., 1014 Wyandotte Street, Kansas City 5, Missouri. Price: $4.95.

5. Purvis, Jud. All About Small Gas Engines. Goodheart-Wilcox Company, 18050 Harwood Avenue, Homewood, Illinois. 1963. Price: $3.38.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
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INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name______________________________

2. Name of school______________________State______________

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
_____Ornamental Horticulture--Service Occupations
_____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report______________________

5. To what group (age and/or class description) was this material presented?____
____

6. How many students:
   a) Were enrolled in class (total) ________
   b) Participated in studying this module ________
   c) Participated in a related occupational work experience program while you taught this module ________

7. Actual time spent teaching module: / Recommended time if you were to teach the module again:

Actual time spent teaching module		Recommended time if you were to teach the module again
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (√) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE					NOT APPROPRIATE
8. The suggested time allotments given with this module were:						
9. The suggestions for introducing this module were:						
10. The suggested competencies to be developed were:						
11. For your particular class situation, the level of subject matter content was:						
12. The Suggested Teaching-Learning Activities were:						
13. The Suggested Instructional Materials and References were:						
14. The Suggested Occupational Experiences were:						

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____ No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____ No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

______________________ ____

(Date) (Instructor's Signature)

____

(School Address)