

TEACHING OF THE OPERATION AND REPAIR OF THE
GASOLINE ENGINE, TRACTOR, AND AUTOMOBILE IN THE
VOCATIONAL AGRICULTURE FARM SHOP

by

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INTRODUCTION

The gas engines are becoming more and more a source of power on the farms of today; their operation and repair are important problems that confront the farmer. The farm boys who are enrolled in vocational agriculture, having "Dad's" problems at heart, naturally look to the vocational farm shop for a solution of their mechanical problems.

It was with the above thoughts in mind that this study was undertaken. The writer has attempted to determine the extent to which jobs pertaining to a gasoline engine, an automobile, and a tractor were being taught in vocational farm shop and also the methods used in presenting this information to the students.

STATEMENT OF PURPOSE

The purpose of this study was to determine:

1. The information and operative jobs that may be taught in connection with the gas engine, automobile, and tractor.
2. The construction and repair jobs that may be taught in connection with the gas engine, automobile, and tractor.
3. The information and operative jobs that are being taught in connection with the gas engine, automobile, and

tractor.

4. The construction and repair jobs that are being taught in connection with the gas engine, automobile, and tractor.
5. The methods of procedure that are being used in teaching information and operative jobs.
6. The methods of procedure that are being used in teaching construction and repair jobs.
7. The extent of equipment available in the teaching of repair jobs.

METHOD OF PROCEDURE

A questionnaire composed of three parts was set up. Part I, "Information and Operative Jobs", had to do with those jobs pertaining to the construction and operation of motor machines. Part II, "Repair Jobs", had to do with the jobs that pertain to the repairing and overhauling of motor machines. Part III, "Shop Tools", was simply the listing of shop tools on hand in the vocational farm shop that are used in construction and repair jobs.

The questionnaire was sent to eighty vocational agriculture teachers in Kansas and thirty-one vocational agriculture teachers in adjoining states. Replies were received from sixty-one.

THE QUESTIONNAIRE

Instruction Sheet

- I. An attempt was made to simplify this questionnaire by avoiding duplication of jobs. For example, valve grinding is listed only under the stationary gas engine. If you teach valve grinding, you will check your answer under the stationary gas engine even though you may have taught it on a tractor or an automobile.
- II. Answers. Answers are to be made with a check mark, except under Methods of Instruction, where you are asked to give a rating of the methods used. You will note that Methods of Instruction is in two parts; each are to be rated separately. The first part has to do with the size of group you work with and the second with the methods you use in getting the information across to the student.
- III. Definitions. For the purpose of this questionnaire the following definitions will be used.

Information Sheet. An information sheet simply gives information about a job or project and is used to substitute for a text book.

Exercise Sheet. An exercise sheet outlines the procedure in doing a job and has for its purpose the teaching of a skill.

Job Sheet. A job sheet outlines the procedure necessary in doing a job that the boy has to do.

Group. A group will be thought of as a part of the boys in any one class.
- IV. List of Tools. On the last page is a list of tools that may be used in doing the jobs listed in the questionnaire. Please check those that you have and write in the names of those not listed.

The Stationary Gas Engine
Information and Operative Jobs

		Do you teach this job?	Reason not taught	Year taught	Methods of instruction										Time of instruc- tion					
					Rate			Rate												
					1	2	3	1	2	3	4	5								
Yes	No		Lack reference material		First															
			Repair job not taught		Second															
			Not practical		Third															
					Individual															
					Group															
					Class															
					Information sheet															
					Exercise sheet															
					Job sheet															
					Text book study and discussion															
					As boy has job															
					Time set by teacher															
					On home farm while supervising projects															

GENERAL

1. Nomenclature of an engine.
2. Measure the size of piston and length of stroke.
3. Figure the piston displacement.

The above outline form is to be used in checking the information and operative jobs pertaining to the gas engine, automobile, and tractor.

In a similar manner check the jobs on the succeeding pages.

For example, the job "Nomenclature of an engine", as it is checked, is taught in the third year of vocational agriculture. The size of group for instruction is rated "Class" first, "Group" second, and "Individual" third. The teaching methods are rated "Text book study and discussion" first, "Information sheet" second, "Exercise sheet" third, and "Job sheet" fourth. The time of instruction is set by the teacher.

The job "Measure the size of piston and length of stroke" is not being taught, and "Lack of reference material" is given as the reason.

The Stationary Gas Engine

Information and Operative Jobs

General

1. Nomenclature of an engine
2. Measure the size of piston and length of stroke ..
3. Figure the piston displacement
4. Estimate the horse power by SAE formula
5. The meaning of horse power
6. Check the revolutions per minute
7. The meaning of cycle in an engine
8. Comparison of two and four cycle engines

Pistons and Cylinders

1. Types of cylinder heads
2. The arrangement of cylinders
3. Purpose of the removable sleeve
4. Purpose of the piston and rings
5. Kinds of piston rings
6. Materials from which pistons and rings are made ..
7. Location of the wrist pins and how held in place .

Connecting Rods and Crank Shaft

1. Kind of bearings in the connecting rod
2. Kind of main bearings

Fly Wheels and Belt Pulley

1. Purpose of the fly wheel
2. Balance of the fly wheel
3. How pulley is fastened to crank shaft
4. Reasons for lagging a pulley

Valves and Valve Mechanism

1. Purpose of the valve
2. Types of valves
3. Location of valves and types of engine heads
4. Valve operation
5. Speed of cam gear and cam shaft
6. Theory of valve timing
7. Effect of incorrect timing

Fuel System and Carburetion

1. Types of fuel supply systems
2. Location and use of the gas pump
3. Location and purpose of the check valve
4. Types of carburetors
5. Principles of carburetion
6. Purpose of the carburetor float
7. Purpose of the choker
8. Purpose of the priming cup
9. The meaning of rich and lean mixtures
10. Kinds of fuel to use in an engine
11. How and when to change from one fuel to another ...
12. Starting fuels

Ignition System

1. Purpose of an ignition system
2. Types of ignition systems
3. Low and high tension battery systems
4. Low and high tension magneto systems
5. Wiring batteries
6. Effect of advancing and retarding spark
7. Theory of ignition timing

Cooling System

1. Types of cooling systems
2. Purpose of the radiator
3. Purpose of the water jacket

Lubrication

1. Purpose of lubrication
2. Kind of lubricants
3. How the Zerk and Alemite work

Governors

1. Types of governors
2. Purpose of the governor
3. Working principle of the governor

Tractor

Information and Operative Jobs

General

1. Nomenclature of a tractor
2. Meaning of tractor horse power rating
3. Types of general purpose tractors
4. Types of standard tractors

Traction

1. Types of traction members
2. Location of traction members
3. Calculate pressure on traction and on non-driver wheels
4. Purpose of extension rims
5. Types of standard lugs

Motor

1. Methods of mounting tractor motors
2. Number and kinds of bearings on crankshaft
3. Meaning of balance of crankshaft
4. Methods of casting cylinders
5. Check revolutions per minute
6. Calculate piston speed

Fuel System and Carburetion

1. Purpose of heating fuels
2. Preheating devices
3. Use of water in the fuel
4. Purpose of carburetor adjusting screws
5. Path of fuel through the carburetor
6. Purpose of the three way valve
7. Types of air cleaners
8. Purpose of an air cleaner
9. How the air cleaner works

Ignition

1. Trace magneto troubles
2. Determine the firing order of cylinders
3. Common spark plug troubles
4. Purpose of an impulse starter
5. How the impulse starter works

Cooling System

1. Source of heat in an engine
2. What parts are included in the cooling system
3. Purpose of the water pump
4. Purpose of the thermostatic valve
5. How the radiator helps to cool
6. Cooling liquids
7. Trace the path of the cooling liquid

Lubrication

1. Characteristics of good oil
2. Parts of a tractor that need oil
3. Types of oil distributing
4. Kinds of oil pumps
5. Purpose of an oil filter
6. Purpose of an oil pressure gauge
7. Kind of oil used for gear lubrication
8. Methods of oiling gears
9. Purpose of the crank case breather

Clutch and Transmission

1. Speeds of a tractor
2. Construction and operation of the differential
3. Kinds of gears used in tractors
4. Types of transmissions
5. Purpose of the power take off
6. Types of clutches
7. Purpose of the clutch
8. Purpose of the clutch brake
9. Methods of operating the clutch

Frame and Axles

1. Types of tractor frames
2. Types of steering mechanism
3. Methods of mounting front axles
4. Methods of mounting rear axles
5. Kinds of tractor hitches

Automobile

Information and Operative Jobs

General

1. Purpose of an automobile
2. How the automobile engine differs from the tractor and stationary engine

Motor

1. Types of automobile engines
2. Methods of mounting the engine
3. Meaning of floating power

Fuel Systems and Carburetion

1. Location of carburetors
2. Purpose of the vacuum feed
3. How the vacuum feed works
4. Location of fuel tanks
5. Types of gasoline gauges

Electrical Equipment

1. Kinds of ignition systems
2. How the ignition systems differ on an automobile and tractor
3. Purpose of the generator and how it works
4. Purpose of the battery
5. Use of water in a battery
6. Why a battery corrodes
7. How the starter works
8. Causes of shorts in electrical wires
9. How to detect a short
10. Methods of tracing a short
11. How the lights focus
12. How get dim and bright lights

Cooling System

1. Trace the course of the cooling liquid
2. Types of radiators
3. How cooling system differs from that of a tractor
4. Anti-freezing liquids

Lubrication

1. Parts that need oil
2. Kinds of lubrication systems
3. Capacity of crank case
4. Reasons for draining oil

Gears, Body and Chassis

1. Types of gears used in automobiles
2. Forward speed of an automobile
3. Purpose of the differential
4. What is meant by free wheeling
5. Advantages claimed for free wheeling
6. Meaning of floating rear axle
7. Purpose of the shock absorber
8. Types of springs
9. Types of brakes
10. Kind of wheels
11. Types of tires
12. Types of bodies
13. Mounting of front wheels
14. Kinds of glass used

The Stationary Gas Engine
Repair Jobs

GENERAL

1. Mount engine on skids.
2. Mount engine on trucks.
3. Mount automobile engine for stationary power.
4. Paint engine.

	Do you teach this job?		Reason not taught	Year taught,	Methods of instruction												Time of instruction	Do you use this job for home practice?										
	Yes	No			Rate			Rate																				
					1	2	3	1	2	3	4	5	6															
			No demand		First				Individual				Information sheet				Boy plan own job			As boy has a job				Keep mach. in shop inst				
			Lack equipment		Second				Group				Exercise sheet				Text book study			Boy brings job at a set time								
			Not practical		Third				Class				Job sheet				and discussion											
1. Mount engine on skids.	x							x	1	2	3	5	3	2	1	4			x									x
2. Mount engine on trucks.		x	x																									
3. Mount automobile engine for stationary power.																												
4. Paint engine.																												

The above outline form is to be used in checking the repair jobs pertaining to the gas engine, automobile, and tractor.

In a similar manner check the jobs on the succeeding pages.

For example, the job, "Mount engine on skids", as it is checked, is taught in the third year of vocational agriculture. The size of the group for instruction is rated "Individual" first, "Group" second, and "Class" third. The teaching methods are rated "Boy plans own job" first, "Job sheet" second, "Exercise sheet" third, "Text book study and discussion" fourth, and "Information sheet" fifth. The job is taught as the boy has the job to do, and it is not used for home practice work.

The job "Mount engine on trucks" is not taught, and "No demand" is given as the reason.

The Stationary Gas Engine

Repair Jobs

General

1. Mount engine on skids
2. Mount engine on trucks
3. Mount automobile engine for stationary power
4. Paint engine

Pistons and Cylinders

1. Install new pistons and rings
2. Install new cylinder sleeve
3. Install new wrist pin
4. Rebore cylinder
5. Hone cylinder walls

Connecting Rods and Crankshaft

1. Install new connecting rod
2. Rebabbitt connecting rod
3. Rebabbitt main bearings
4. Scrape bearings
5. Tighten connecting rods

Flywheels and Pulley Wheel

1. Install new drive pulley
2. Lag drive pulley
3. Install drive pulley on automobile engine
4. Install patented pulley on automobile engine

Valves and Valve Mechanism

1. Grind valves
2. Reface and reseal valves
3. Adjust tappets
4. Install new valves
5. Time valves
6. Scrape carbon
7. Cut and install new head gasket

Fuel System and Carburetors

1. Clean gas line
2. Repair fuel pump
3. Install new fuel pump
4. Repair carburetor parts
5. Install auxiliary fuel tank
6. Repair fuel tank
7. Install priming cup

Ignition System

1. Remove and clean magneto
2. Adjust magneto points
3. Install new magneto parts
4. Clean and adjust spark plug
5. Install new batteries
6. Install new coil
7. Adjust coil points
8. Install new coil points
9. Clean make and break points
10. Install new make and break points
11. Time ignition system

Cooling System

1. Clean cooling system
2. Install new hose connections
3. Repair cracked head

Lubrication

1. Clean crank case
2. Repair and adjust oil cups
3. Install zerks or alemites
4. Repair oil pump

Governors

1. Install new governor parts
2. Repair and adjust governor

Tractor

Repair Jobs

General

1. Paint tractor

Traction

1. Put on extension rim
2. Install new lugs
3. Install guide bands on front wheels

Fuel System and Carburetors

1. Clean water line to engine
2. Clean carburetor
3. Adjust carburetor
4. Install new carburetor parts
5. Service air cleaner
6. Repair air cleaner
7. Install new air cleaner
8. Repair fuel tank
9. Clean sediment bulb

Ignition

1. Install new magneto wires
2. Repair impulse starter
3. Install new impulse starter

Cooling System

1. Repair radiator
2. Repair water pump
3. Repair fan
4. Install new fan belt
5. Install radiator screen

Lubrication

1. Drain oil
2. Clean oil filter
3. Clean oil pressure gauge
4. Install new oil pressure gauge

Clutch and Transmission

1. Adjust clutch
2. Install new clutch plates

Hitch, Frame and Axles

1. Install new front wheel bearings
2. Hitch to power take off machine
3. Attach implement to general purpose tractor
4. Adjust steering mechanism
5. Repair steering mechanism

Automobile**Repair Jobs**Fuel Supply and Carburetors

1. Clean and repair vacuum
2. Clean sediment bulb
3. Repair fuel pump
4. Repair gasoline gauge
5. Solder gas line

Electrical Equipment

1. Clean and adjust ignition points
2. Trace short circuit in the wiring
3. Install new wires
4. Repair switch
5. Install new switch
6. Install new light connections
7. Focus lights
8. Clean and adjust generator
9. Clean battery and battery connections
10. Install new battery connections
11. Install new battery
12. Install new generator brushes
13. Install new cut out on generator
14. Repair windshield wiper

Lubrication

1. Repair oil pressure gauge
2. Grease chassis
3. Grease transmission and differential

Gears, Body and Chassis

1. Adjust shock absorbers
2. Repair shock absorbers
3. Install new springs

4. Install new shackle bolts
5. Adjust front wheel bearings
6. Install new bearings in steering apparatus
7. Adjust steering apparatus
8. Adjust brakes
9. Install new brake linings
10. Repair tires
11. Wash car
12. Polish car
13. Paint car

Shop Tools

Please check the tools you have in your department.

- | | |
|---|----------------------------|
| 1. Socket wrenches | 15. Thickness gauge |
| a. Speeder | 16. Hand drill |
| b. Ratchet | 17. Post drill |
| c. Sliding handle | 18. Drill bits 1/16" to 1" |
| d. Extension | 19. Vise |
| e. Universal | 20. Hoist |
| 2. Adjustable end wrenches | 21. Reboring equipment |
| 3. Screw driver | 22. Honing equipment |
| 4. Pliers | 23. Lathe |
| 5. Mechanist hammer | 24. Wrecking bar |
| 6. Pipe wrenches | 25. Blow torch |
| 7. Cold chisels | 26. Soldering copper |
| 8. Plain punches | 27. Easy out |
| 9. Center punch | 28. Paint spray |
| 10. Files | 29. Babbitting equipment |
| 11. Hack saw | 30. Zirk grease gun |
| 12. Valve grinder | 31. Alemite grease gun |
| 13. Valve lifter | 32. Bearing scraper |
| 14. Valve reseating and
facing equipment | 33. Bearing blue |

INTERPRETATION OF DATA SECURED

In the questionnaire each vocational agriculture teacher was asked to make a first, second, and third choice under the first part of "Methods of Instruction", which has to do with the size of group with which the teacher works. Under the second part of "Methods of Instruction", they were asked to make a first, second, third, fourth, and fifth choice. In either case where only one choice was made it was allowed to stand.

The material gathered was compiled on the basis of the per cent of teachers answering under each heading.

The answers were summarized under the same general heading as they were grouped in the questionnaire.

In those groups having several jobs and enough variation in answers, the jobs being taught by the greatest number of teachers and the jobs being taught by the least number were listed separately with the per cent of those reporting "Yes" and "No".

In addition, the average of the whole group was listed with the per cent reporting "Yes" and "No".

In groups having only a few jobs the average of the whole group was listed with the per cent reporting "Yes" and "No".

Gasoline Engine - Information and Operative Jobs

In Table 1, under the heading "General Jobs", it will be noted that 89 per cent of the teachers teach the job "The meaning of cycle in an engine", 25 per cent teach the job "Figure piston displacement", with an average of 58 per cent of the teachers teaching all the jobs in the group. The meaning of cycle is easily understood, and it is important in understanding the operation of an engine. Figuring piston displacement is less practical and involves more difficult mathematics, which doubtless is the reason why the job is taught least of any in the group. The group of jobs as a whole are given considerable consideration, as indicated by 58 per cent of the teachers teaching them.

The jobs pertaining to "Pistons and Cylinders" are taught on an average by 63 per cent of the teachers, which is enough to indicate their importance. The job "Purpose of pistons and rings" is taught the most, with 83 per cent of the teachers teaching it. The job "Materials from which pistons and rings are made" is taught the least of any in the group, and this no doubt can be explained by the fact that pistons are usually thought of with regard to their size and not the material from which they are made.

Table 1. Per cent of teachers reporting that they do or do not teach the groups of jobs, and the range between the jobs taught most and the jobs taught least within the larger groups of jobs.

Jobs	Per cent of teachers reporting	
	Yes	No
General Jobs		
a. Job taught most The meaning of cycle in an engine	89	11
b. Job taught least Figure the piston displacement	25	75
c. Average of all jobs	58	42
Pistons and Cylinders		
a. Job taught most Purpose of piston and rings	83	17
b. Job taught least Materials from which pistons and rings are made	40	60
c. Average of all jobs	63	37
Connecting Rods and Crank Shaft		
* a. Average of all jobs	58	42
Fly Wheels and Belt Pulley		
a. Job taught most Purpose of the fly wheel	78	22
b. Job taught least How pulley is fastened to crank shaft	34	66
c. Average of all jobs	51	49
Valves and Valve Mechanism		
a. Job taught most Purpose of the valve Valve operation	89	11

Table 1 (con't).

b. Job taught least Speed of cam gear and cam shaft	52	48
c. Average of all jobs	78	22
Fuel System and Carburetion		
a. Job taught most The meaning of rich and lean mixtures	86	14
b. Job taught least Starting fuels	33	67
c. Average of all jobs	59	41
Ignition System		
a. Job taught most Purpose of an ignition system Effect of advancing and retarding spark	86	14
b. Job taught least Low and high tension battery systems	45	55
c. Average of all jobs	63	37
Cooling System		
* a. Average of all jobs	64	36
Lubrication		
* a. Average of all jobs	62	38
Governors		
* a. Average of all jobs	60	40

* In small groups only the average is given.

The jobs pertaining to "Connecting Rods and Crank Shaft" are given considerable consideration, as indicated by the fact that 58 per cent of the teachers teach the jobs.

The group of jobs "Fly Wheels and Belt Pulley" is taught by 51 per cent of the teachers, which is a good showing in that no very great problems arise from that part of the engine.

The group of jobs under "Valves and Valve Mechanism" offer a greater source of study than any other group, as indicated by the fact that 78 per cent of the teachers teach the jobs. The job taught the least is taught by 52 per cent of the teachers, which is further indication of the importance of the jobs in this group. Other reasons are doubtless due to the fact that several of the common repair jobs have to do with valves and valve operation.

The group of jobs under "Fuel System and Carburetion" is an important group, but due to the fact that a number of jobs listed were of lesser importance, it brings down the general average of the group. "The meaning of rich and lean mixture" being taught most can easily be explained by the fact that it is so closely related to carburetor adjustment, which is important in the proper operation of an engine. "Starting fuels" do not present a very great problem in the operation of an engine and consequently

explains the low per cent of the teachers teaching the jobs.

The ignition system offers an important source of material for study and is also quite difficult for the student to understand; but with 63 per cent of the teachers teaching the jobs, it indicates that they are at least trying to get the information across to the students. "Low and high tension battery systems" are disappearing fast and consequently explains the low rating of that job.

The groups of jobs "Cooling System", "Lubrication", and "Governors" do not offer a wide range of jobs to study, but they are never the less important from the standpoint of the operation of an engine. The teachers reporting indicate their importance by the fact that 60 per cent or more teach the jobs.

Reasons Not Taught. Table 2 indicates that "Not practical" is the most common reason for not teaching the groups of jobs as a whole. The exceptions occur in "Cooling System", "Lubrication", and "Governors", where "Repair job not taught" is given as the main reason for not teaching the jobs. "Lack of reference material" is the common reason for not teaching "Pistons and Cylinders", "Fuel System and Carburetion", and "Ignition System" jobs. This part of the report deals with less than one-half of the teachers reporting, and one might expect quite a variation in answers given.

Table 2. Per cent of teachers reporting the reasons jobs are not taught. (Groups of jobs are given in the order in which they are rated "Not practical".)

Groups of jobs	Per cent of teachers reporting		
	Lack of reference material	Repair job not taught	Not practical
General Jobs	24	14	62
Fly Wheels and Belt Pulley	21	18	61
Connecting Rods and Crank Shaft	37	10	53
Valve and Valve Mechanism	25	29	46
Pistons and Cylinders	44	16	40
Fuel System and Carburetion	44	17	39
Governors	24	45	31
Ignition System	41	29 $\frac{1}{2}$	29 $\frac{1}{2}$
Cooling System	20	51	29
Lubrication	24	50	26

Year Taught. A study of Table 3 indicates that the second year in vocational agriculture is the most common year of teaching the gasoline engine jobs, with the first and third years rating about equally in importance. The first year is given to the teaching of the more elementary jobs. The second year offers a chance to teach a wider

scope of jobs and also more difficult jobs. In the third year less time is given to the teaching of shon jobs; doubtless the time that is used is given to the teaching of the more skilled jobs.

Table 3. Per cent of teachers reporting the years in which the jobs are taught.

Groups of jobs	Per cent of teachers reporting		
	First Year	Second Year	Third Year
General Jobs	31	44	25
Pistons and Cylinders	25	47	28
Connecting Rods and Crank Shaft	26	50	24
Fly Wheels and Belt Pulley	32	40	28
Valves and Valve Mechanism	35	45	20
Fuel System and Carburetion	25	47	28
Ignition System	26	57	17
Cooling System	20	51	29
Lubrication	24	50	26
Governors	24	45	31

Size of Group Taught. Table 4 indicates that the teachers as a whole are agreed on the size of group with which they should work in presenting information to the students. The information and operative jobs lend themselves well to class instruction and consequently rate

Table 4. Rating of the size of group with which the teachers work in presenting the information to the students.

Groups of jobs	# Summary of teachers' ratings		
	Indi- vidual	Group	Class
General Jobs	3	2	1
Pistons and Cylinders	3	2	1
Connecting Rods and Crank Shaft	3	2	1
Fly Wheels and Belt Pulley	3	2	1
Valves and Valve Mechanism	3	2	1
Fuel System and Carburetion	3	2	1
Ignition System	3	2	1
Cooling System	3	2	1
Lubrication	3	2	1
Governors	3	2	1

* Rating is based on per cent of the teachers answering.

first; doubtless the slower students are given further instruction as a group and finally as individuals, where still further information is needed.

Teaching Method. Table 5 indicates that the teachers as a whole are agreed on the teaching methods they should use in presenting the information to the students. The text book is the quickest and easiest source of information and

Table 5. Rating of the different teaching methods used in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings				
	Information sheet	Exercise sheet	Job sheet	Text book study and discussion	Miscellaneous method **
General Jobs	2	3	4	1	5
Pistons and Cylinders	2	3	4	1	5
Connecting Rods and Crank Shaft	2	3	4	1	5
Fly Wheels and Belt Pulley	2	3	4	1	5
Valves and Valve Mechanism	2	3	4	1	5
Fuel System and Carburetion	2	3	4	1	5
Ignition System	2	4	3	1	5
Cooling System	2	3	4	1	5
Lubrication	2	3	4	1	5
Governors	2	3	4	1	5

* Rating is based on per cent of the teachers answering.

** Miscellaneous methods include a number of methods written in by teachers in their answers.

consequently rates first. Where the text books are limited in number the next best thing is to make reprints

of the text in the form of information sheets. Once the boy has the information at hand the exercise for experience follows, and eventually the job is brought from the home farm.

Time of Instruction. A study of Table 6 indicates that the greater per cent of the teachers set the time at

Table 6. Per cent of teachers reporting the different times at which the instruction is given to the students.

Groups of jobs	Per cent of teachers reporting		
	As boy has job	Time set by teacher	On home farm while supervising projects
General Jobs	26	70	4
Pistons and Cylinders	37	62	1
Connecting Rods and Crank Shaft	60	37	3
Fly Wheels and Belt Pulley	46	54	0
Valves and Valve Mechanism	38	60	2
Fuel System and Carburetion	35	63	2
Ignition System	34	64	2
Cooling System	32	68	0
Lubrication	40	60	0
Governors	19	81	0

which the jobs are to be taught. This is to be expected because as Tables 4 and 5 show, the jobs are taught to the class as a whole by the use of the text book. The procedure then is much the same as any other lesson; at a given time the teacher assigns a lesson to the class as a whole and the discussion follows. The one exception listed in the case of the "Connecting Rods and Crank Shaft" is easily understood, because the boy may need a review at the time he has a job, or his job may precede the class assignment.

Tractor - Information and Operative Jobs

It will be noted in Table 7 that on an average the tractor jobs are taught by less than 50 per cent of the teachers reporting. Table 8 gives as the main reason that the "Repair jobs are not taught". Table 27 shows very definitely that the reason that tractor repair jobs are not taught is that there is "No demand" for that type of work. Consequently the lack of demand for repair jobs is responsible for the teachers not teaching information and operative jobs.

The "General Jobs" as listed in the questionnaire offer opportunities for teaching to more than 44 per cent of the teachers, as reported in their answers. The same should hold true with "Traction" jobs, where only 18 per cent of

Table 7. Per cent of teachers reporting that they do or do not teach the groups of jobs, and the range between the jobs taught most and the jobs taught least within the larger groups of jobs.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
General Jobs		
* a. Average of all jobs	44	56
Traction		
* a. Average of all jobs	18	82
Motor		
* a. Average of all jobs	26	74
Fuel System and Carburetion		
a. Job taught most		
Purpose of carburetor adjusting screws	60	40
b. Job taught least		
Preheating devices	22	78
Purpose of the three way valve		
c. Average of all jobs	41	59
Ignition		
* a. Average of all jobs	44	56
Cooling System		
* a. Average of all jobs	39	61
Lubrication		
a. Job taught most		
Purpose of an oil pressure gauge	57	43
b. Job taught least		
Kinds of oil pumps	24	76
c. Average of all jobs	41	59

Table 7 (con't).

Clutch and Transmission		
a. Job taught most		
Purpose of the power take off	43	57
b. Job taught least		
Kinds of gears used in tractors	7	93
c. Average of all jobs	29	71
Frame and Axles		
* a. Average of all jobs	14	86

* In small groups only the average is given.

the teachers report that they are teaching the jobs, and likewise with the "Motor" jobs, where 26 per cent of the teachers are teaching the jobs.

The jobs pertaining to the "Fuel System and Carburetion" offer problems that are peculiar to the tractor, but they seem to be as well taken care of as any of the groups of tractor jobs, in that 41 per cent of the teachers teach the jobs.

The "Ignition System" offers important problems in tractor operation, but with 44 per cent of the teachers teaching the jobs, it indicates that those who do teach the jobs give consideration to the ignition system.

The "Cooling System" also offers its problems in tractor operation, and doubtless as the demand for tractor jobs increases the cooling system will be given more

consideration than is indicated by the 39 per cent who teach the jobs.

The jobs pertaining to "Lubrication" are recognized as important, as indicated by 41 per cent of the teachers teaching them. Their importance will no doubt increase with the increasing demand for tractor jobs.

The "Clutch and Transmission" jobs as a whole are given a minor rating, as indicated by only 29 per cent of the teachers teaching the jobs. The average of the group is brought down by the wide spread in the per cent of teachers teaching the jobs. The job taught most, "Purpose of the power take off", rates up well with other tractor jobs, as indicated by 43 per cent of the teachers teaching it. The job taught least, "Kinds of gears used in tractors", is taught by only 7 per cent of the teachers, and it brings down the average of the whole group.

There are important facts that may be taught in connection with "Frames and Axles", but the group of jobs is taught by a small per cent of the teachers. This is doubtless due to the fact that no very important operative problems arise from that part of the machine.

Reasons not Taught. Table 8 indicates that as a whole, the main reason for not teaching the "Tractor - Information and Operative Jobs" is that the "Repair jobs

Table 8. Per cent of teachers reporting the reasons jobs are not taught. (Groups of jobs are given in the order in which they are rated "Repair jobs not taught".)

Groups of jobs	Per cent of teachers reporting		
	Lack of reference material	Repair job not taught	Not practical
Cooling System	24	59	17
Lubrication	24	58	18
Ignition	27	56	17
Fuel System and Carburetion	38	51	11
Clutch and Transmission	40	43	17
Frame and Axles	31	39	30
General Jobs	33	35	32
Motor	34	33	30
Traction	38	32	30

are not taught". "Lack of reference material" and "Not practical" rate second and third respectively.

It will be noted in Table 8 that in the groups "General Jobs", "Traction", and "Motor" the three reasons for not teaching the jobs rate about equally in importance. In every other case the "Repair jobs not taught" is given as the most important reason for not teaching the jobs.

Year Taught. Table 9 indicates that as a whole the first and second years of vocational agriculture are the most common years for the teaching of the tractor information and operative jobs. The groups of jobs "General Jobs",

Table 9. Per cent of teachers reporting the years in which the jobs are taught.

Groups of jobs	Per cent of teachers reporting		
	First Year	Second Year	Third Year
General Jobs	45	31	24
Traction	31	44	25
Motor	35	38	27
Fuel System and Carburetion	41	34	25
Ignition	36	41	23
Cooling System	39	42	19
Lubrication	44	33	23
Clutch and Transmission	36	42	22
Frame and Axles	20	25	55

"Fuel System and Carburetion", and "Lubrication" are taught by a greater per cent of the teachers during the first year. The groups of jobs "Traction", "Motor", "Ignition System", and "Cooling System" covers more difficult phases of motor operation, and consequently they are taught by a greater per cent of teachers the second year. In the third year of

vocational agriculture less time is devoted to shop work; therefore the teacher can only spend time in teaching the more technical jobs or those missed in the first and second years.

Size of Group Taught. Table 10 indicates that the teachers are agreed on the size of group with which they should work in the teaching of tractor information and

Table 10. Rating of the size of group with which the teachers work in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings		
	Indi- vidual	Group	Class
General Jobs	3	2	1
Traction	3	2	1
Motor	3	2	1
Fuel System and Carburetion	3	2	1
Ignition	3	2	1
Cooling System	3	2	1
Lubrication	3	2	1
Clutch and Transmission	3	2	1
Frame and Axles	3	2	1

* Rating is based on per cent of the teachers answering.

operative jobs. The jobs lend themselves well to class instruction, and consequently the "Class" rated first.

The "Group" is rated second and doubtless is used for slower students who may need further instruction. The "Individual" is rated third, and no doubt but that it is used for the exceptionally slow student or for any of the class who wish further instruction on the subject.

Teaching Methods. Table 11 indicates that the teachers as a whole are agreed on the teaching methods that they should use in presenting information to the students. The text book is the quickest and easiest source of information; consequently the teachers rate "Text book study and discussion" first, as a teaching method. When text books are limited in number, the next logical thing to do is to make reprints from the text book in the form of "Information sheets", which is rated second. The "Exercise sheet" is rated third, and it follows in a logical order after the information is secured. Finally, the "Job sheet", which is rated fourth, may be used in teaching the job at hand.

Table 11. Rating of the different teaching methods used in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings				
	Information sheet	Exercise sheet	Job sheet	Text book study and discussion	Miscellaneous method **
General Jobs	2	3	4	1	5
Traction	2	3	4	1	5
Motor	2	3	4	1	5
Fuel System and Carburetion	2	3	4	1	5
Ignition	3	4	2	1	5
Cooling System	2	3	4	1	5
Lubrication	2	3	4	1	5
Clutch and Transmission	2	3	4	1	5
Frame and Axles	2	3	4	1	5

* Rating is based on per cent of the teachers answering.

** Miscellaneous methods include a number of methods written in by teachers in their answers.

Time of Instruction. Table 12 indicates that a greater per cent of the teachers set the time at which the jobs are to be taught. Table 10 shows that the jobs are

Table 12. Per cent of teachers reporting the different times at which the instruction is given to the students.

Groups of jobs	Per cent of teachers reporting		
	As boy has job	Time set by teacher	On home farm while supervising projects
General Jobs	12	86	2
Traction	14	76	10
Motor	13	80	7
Fuel System and Carburetion	35	58	7
Ignition	47	47	6
Cooling System	28	72	0
Lubrication	24	73	3
Clutch and Transmission	17	75	8
Frame and Axles	21	68	11

taught to the class as a whole. Table 11 shows that the "Text book study and discussion" rates first as a teaching method. The procedure, then, is that the teacher at a given time assigns a lesson in the text book to the class and the discussion follows.

Automobile - Information and Operative Jobs

It will be noted in Table 13 that on an average approximately 40 per cent of the teachers report that they teach the "Automobile - Information and Operative Jobs".

Table 13. Per cent of teachers reporting that they do or do not teach the groups of jobs, and the range between the jobs taught most and the jobs taught least within the larger groups of jobs.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
General Jobs		
* a. Average of all jobs	42	58
Motor		
* a. Average of all jobs	23	77
Fuel System and Carburetion		
* a. Average of all jobs	26	74
Electrical Equipment		
a. Job taught most		
Purpose of the generator and how it works	66	34
b. Job taught least		
How get dim and bright lights	26	74
c. Average of all jobs	56	44
Cooling System		
* a. Average of all jobs	36	64
Lubrication		
* a. Average of all jobs	54	46

Table 13 (con't).

Gears, Body and Chasis		
a. Job taught most		
Purpose of the differential	54	46
b. Job taught least		
Types of gears used in automobiles	11	89
c. Average of all jobs	25	75

* In small groups only the average is given.

The 60 per cent who report that they do not teach the jobs rate the three reasons listed in Table 14 about equally in importance, with a slight advantage to "Repair jobs not taught". Table 34 shows very definitely that the reason that repair jobs are not taught is that there is no demand for that type of work; consequently it seems that the information and operative jobs are not taught because there is no demand for the repair jobs.

The "General Jobs" as listed are being taught by 42 per cent of the teachers. This is above the average for all the automobile jobs, so it would seem that the "General Jobs" are given enough consideration.

The jobs pertaining to the "Motor" are being taught by 23 per cent of the teachers. This low rating may be explained by the fact that the jobs as listed in the questionnaire were of lesser importance.

The "Fuel System and Carburetion" jobs are being taught by 26 per cent of the teachers, and it would seem that they should come in for further consideration than is indicated by the per cent of teachers who teach them.

The jobs pertaining to "Electrical Equipment" offer a variety of jobs which are common to any one who operates an automobile. This doubtless accounts for the high rating of those jobs as indicated by the 56 per cent of the teachers who teach them.

The "Cooling System" might easily come in for further consideration than is indicated by the 36 per cent of the teachers who teach the jobs. However, with the improved cooling systems on the present day cars, there are no very great problems arise from that part of the machine.

The group of jobs "Gears, Body and Chasis" offer a variety of jobs for study, but as a whole they are apparently of lesser importance, as indicated by only 25 per cent of the teachers teaching them.

Reasons not Taught. Table 14 shows that as a whole the reasons listed for not teaching the jobs are rated about equally. A majority of the teachers give "Lack of reference material" as the main reason for not teaching "Motor" and "Gears, Body and Chasis" jobs. "Repair jobs not taught" is given as the most important reason for not

Table 14. Per cent of teachers reporting the reasons jobs are not taught. (Groups of jobs are given in the order in which they are rated "Repair jobs not taught".)

Groups of jobs	Per cent of teachers reporting		
	Lack of reference material	Repair job not taught	Not practical
Cooling System	27	54	19
Electrical Equipment	26	44	30
Lubrication	16	33	51
Fuel System and Carburetion	32	33	35
General Jobs	27	30	43
Gears, Body and Chasis	53	29	18
Motor	44	25	31

teaching "Cooling System" and "Electrical Equipment" jobs, and "Not practical" is given as the most important reason for not teaching "General Jobs", "Fuel System and Carburetion", and "Lubrication" jobs.

Year Taught. Table 15 shows that there is quite a variation in the per cent of teachers reporting under each of the three years and with each of the groups of jobs. The jobs pertaining to the "Cooling System" are being taught by a greater per cent of the teachers than is being taught in

Table 15. Per cent of teachers reporting the years in which the jobs are taught.

Groups of jobs	Per cent of teachers reporting		
	First Year	Second Year	Third Year
General Jobs	28	36	36
Motor	17	22	61
Fuel System and Carburetion	33	42	25
Electrical Equipment	26	44	30
Cooling System	41	28	31
Lubrication	36	51	13
Gears, Body and Chasis	33	19	48

either of the other two years. The second year of vocational agriculture is given to the teaching of "General Jobs", "Fuel System and Carburetion", "Electrical Equipment", and "Lubrication" jobs by a greater per cent of the teachers. The third year consideration is given by a greater per cent of the teachers to the teaching of "Gears, Body and Chasis", and "Motor" jobs.

Size of Group Taught. Table 16 indicates that the teachers as a whole are agreed on the size of group with which they should work in presenting the "Tractor - Information and Operative Jobs" to the students. The jobs lend themselves well to class instruction, and consequently the

Table 16. Rating of the size of group with which the teachers work in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings		
	Indi- vidual	Group	Class
General Jobs	3	2	1
Motor	3	2	1
Fuel System and Carburetion	2	1	3
Electrical Equipment	3	2	1
Cooling System	3	2	1
Lubrication	3	2	1
Gears, Body and Chasis	3	2	1

* Rating is based on per cent of the teachers answering.

"Class" rates first. The "Group" rates second, and doubtless it is being used in the giving of further instruction to slower students. The "Individual" rates third, and no doubt but that it is being used to give instruction to students that are especially interested or to the very slow student.

Teaching Methods. Table 17 indicates that the teachers as a whole are agreed on the teaching methods that they should use in presenting the information to the students. The text book is the quickest and easiest source of

Table 17. Rating of the different teaching methods used in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings				
	Information sheet	Exercise sheet	Job sheet	Text book study and discussion	Miscellaneous method **
General Jobs	2	3	4	1	5
Motor	2	3	4	1	5
Fuel System and Carburetion	2	3	4	1	5
Electrical Equipment	2	3	4	1	5
Cooling System	2	3	4	1	5
Lubrication	2	3	4	1	5
Gears, Body and Chasis	2	3	4	1	5

* Rating is based on per cent of the teachers answering.

** Miscellaneous methods include a number of methods written in by teachers in their answers.

information; consequently the teachers rate "Text book study and discussion" first as a teaching method. When text books are limited in number the next logical thing to do is to make reprints from the text book in the form of

"Information sheets", which is rated second. The "Exercise sheet" is rated third, and it follows in a logical order after the information is secured. Finally the "Job sheet", which is rated fourth, may be used in teaching the job that the boy has at hand.

Time of Instruction. Table 18 indicates that a greater per cent of the teachers set the time at which the

Table 18. Per cent of teachers reporting the different times at which the instruction is given to the students.

Groups of jobs	Per cent of teachers reporting		
	As boy has job	Time set by teacher	On home farm while supervising projects
General Jobs	29	71	0
Motor	27	73	0
Fuel System and Carburetion	47	47	6
Electrical Equipment	29	68	3
Cooling System	38	62	0
Lubrication	33	67	0
Gears, Body and Chasis	28	70	2

jobs are to be taught. Table 16 shows that the jobs are taught to the class as a whole. Table 17 shows that the "Text book study and discussion" rates first as a teaching method. The procedure, then, is that at a given time the teacher assigns the lesson in the text book, and the discussion follows the study of the lesson.

Gasoline Engine - Repair Jobs

It will be noted in Table 19 that there is a wide variation in the per cent of teachers who report that they teach the various groups of repair jobs in connection with the gasoline engine. Those who do not teach the jobs give as their main reason that there is no demand for that type of work.

The "General Jobs" are being taught by 32 per cent of the teachers. This may seem to be a low per cent, but the jobs as listed in the questionnaire were not of such a nature that there would be a common demand for them.

The "Pistons and Cylinders" jobs are being taught by only 32 per cent of the teachers. This is an important group of jobs, and doubtless the lack of equipment is more of a factor in their not being taught than is indicated in Table 20. Some of the jobs require special equipment, and Table 40 shows that not over five per cent of the shops

Table 19. Per cent of teachers reporting that they do or do not teach the groups of jobs, and the range between the jobs taught most and the jobs taught least within the larger groups of jobs.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
General Jobs		
* a. Average of all jobs	32	68
Pistons and Cylinders		
* a. Average of all jobs	32	68
Connecting Rods and Crank Shaft		
* a. Average of all jobs	56	44
Fly Wheels and Belt Pulley		
* a. Average of all jobs	22	78
Valves and Valve Mechanism		
a. Job taught most Grind valves	91	9
b. Job taught least Scrape carbon	51	49
c. Average of all jobs	79	21
Fuel System and Carburetion		
a. Job taught most Repair fuel tank	74	26
b. Job taught least Install priming cup	17	83
c. Average of all jobs	46	54
Ignition System		
a. Job taught most Clean and adjust spark plug	80	20
b. Job taught least Install new make and break points	34	66

Table 19 (con't).

c. Average of all jobs	59	41
Cooling System		
* a. Average of all jobs	53	47
Lubrication		
* a. Average of all jobs	41	59
Governors		
* a. Average of all jobs	25	75

* In small groups only the average is given.

have the necessary equipment.

The jobs pertaining to "Connecting Rods and Crank Shaft" are being taught by 56 per cent of the teachers. There are important jobs in connection with this group, and it might seem that more teachers would be teaching them, but "No demand" is given as the reason.

The "Fly Wheel and Belt Pulley" jobs are being taught by 22 per cent of the teachers. There are no very important problems in connection with this group, and consequently the low per cent of teachers teaching them.

The jobs pertaining to "Valves and Valve Mechanism" are important jobs, and it is indicated by the high per cent of teachers who teach them. The job taught most is "Grind valves", with 91 per cent of the teachers teaching it. The job taught least is "Scrape carbon", and 51 per cent of the

teachers teach it. The average of all jobs is taught by 79 per cent of the teachers.

The "Fuel System and Carburetion" jobs have a wide range in the per cent of teachers teaching them. There is quite a variation in the importance of the jobs as listed in the questionnaire, and no doubt but that their importance is indicated by the per cent of teachers who teach them. The job "Repair fuel tank" is taught by 74 per cent of the teachers, while only 17 per cent teach the job "Install priming cup". The average of all jobs is taught by 46 per cent of the teachers.

The "Ignition System" offers a number of jobs that are common in the repair of a gas engine. They vary, however, in their importance, as is indicated by the per cent of teachers teaching them. The job "Clean and adjust spark plug" is taught by 80 per cent of the teachers, while only 34 per cent teach "Install new make and break points". The group as a whole is taught by 59 per cent of the teachers, which shows that the ignition system is given considerable consideration in the repair of a gas engine.

The "Cooling System" jobs are being taught by 53 per cent of the teachers, which is enough to indicate their importance in connection with the repair of a gas engine.

The groups of jobs "Lubrication" and "Governors" as listed in the questionnaire were not of any great importance, and consequently explains the low per cent of teachers teaching them.

Reasons not Taught. A study of Table 20 indicates

Table 20. Per cent of teachers reporting the reasons jobs are not taught. (Groups of jobs are given in the order in which they are rated "No demand".)

Groups of jobs	Per cent of teachers reporting		
	No demand	Lack of equipment	Not practical
Governors	94	0	6
Fly Wheels and Belt Pulley	93	5	2
Lubrication	90	5	5
Ignition System	86	6	8
Fuel System and Carburetion	83	4	13
Cooling System	80	12	8
General Jobs	74	11	15
Valve and Valve Mechanism	69	19	12
Connecting Rods and Crank Shaft	55	24	21
Pistons and Cylinders	54	28	18

that the main reason for not teaching "Gasoline Engine - Repair Jobs" is that there is "No demand". "Lack of equipment" limits some of the teachers from teaching the jobs, and a small per cent consider the jobs "Not practical".

Year Taught. Table 21 indicates that the second year

Table 21. Per cent of teachers reporting the years in which the jobs are taught.

Groups of jobs	Per cent of teachers reporting		
	First Year	Second Year	Third Year
General Jobs	40	41	19
Pistons and Cylinders	34	41	25
Connecting Rods and Crank Shaft	37	48	15
Fly Wheels and Belt Pulley	15	65	20
Valves and Valve Mechanism	29	48	23
Fuel System and Carburetion	31	46	23
Ignition System	33	45	22
Cooling System	27	45	28
Lubrication	26	46	28
Governors	29	50	21

of vocational agriculture is the most common year for teaching "Gasoline Engine - Repair Jobs". The first and third year are rated about equally in importance. During the first year only the simpler repair jobs can be taught.

The second year offers a chance to teach a wider scope of jobs and also more difficult jobs. In the third year less time is given to shop work, and consequently there would be only time for the teaching of the more skilled jobs.

Size of Group Taught. Table 22 indicates that the teachers regard "Individual" instruction as the best way to

Table 22. Rating of the size of group with which the teachers work in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings		
	Indi- vidual	Group	Class
General Jobs	1	2	3
Pistons and Cylinders	2	1	3
Connecting Rods and Crank Shaft	1	2	3
Fly Wheels and Belt Pulley	1	2	3
Valves and Valve Mechanism	2	1	3
Fuel System and Carburetion	1	2	3
Ignition System	1	2	3
Cooling System	1	2	3
Lubrication	1	2	3
Governors	2	1	3

* Rating is based on per cent of the teachers answering.

teach "Gasoline Engine - Repair Jobs", with the exceptions in the groups of jobs pertaining to "Pistons and Cylinders", "Valves and Valve Mechanism", and "Governors", where the "Group" is rated first. The "Class" is rated third in every case. It will be remembered in the study of "Information and Operative Jobs" that the "Class" was rated first. It would seem then, that information concerning a job can be taught to the class as a whole, but when it comes to doing the job in the shop the instruction must be given individually or to a small group who may happen to have a job in common.

Teaching Methods. Table 23 indicates that there is some difference of opinion as to the rating of the teaching methods as they apply to the groups of gas engine jobs. A final rating, however, may be made in the following order:

First - Boy plans own job.

Second - Exercise sheet.

Third - Job sheet.

Fourth - Information sheet.

Fifth - Text book study and discussion.

Sixth - Miscellaneous methods.

The boy making his own plans fits in well with individual instruction, as shown to be most common in

Table 23. Rating of the different teaching methods used in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings					
	Information sheet	Exercise sheet	Job sheet	Boy plans own job	Text book study and discussion	Miscellaneous method**
General Jobs	4	3	2	1	5	6
Pistons and Cylinders	3	2	4	1	5	6
Connecting Rods and Crank Shaft	4	2	1	3	5	6
Fly Wheels and Belt Pulley	3	2	5	1	4	6
Valves and Valve Mechanism	4	5	3	2	1	6
Fuel System and Carburetion	4	3	2	1	5	6
Ignition System	4	3	5	1	2	6
Cooling System	4	2	5	1	3	6
Lubrication	4	2	3	1	5	6
Governors	2	4	1	5	3	6

* Rating is based on per cent of the teachers answering.

** Miscellaneous methods include a number of methods written in by teachers in their answers.

Table 22. The exercise sheet is used to give the boy experience in some particular repair jobs and doubtless is being used to precede the job which is brought from home. The job sheet is used to assist the boy with the job he has to do. The text book and information sheet are two of the same thing, and it will be remembered that they rated high as a method of teaching "Information and Operative Jobs", but as a method of teaching repair jobs, they are not commonly used.

Time of Instruction. Table 24 indicates that a very few teachers require the jobs to be brought in at a set time. In some of the shops a machine is kept for instructional purposes, but the greater per cent of the teachers teach the jobs as the boy has the job to do. The procedure then, is about in the following order. The boy brings in the job at such times as it is convenient or whenever he has need for it on his home farm. He works out his own plan for doing the job, and any instruction he needs is given to him individually. In only a few cases, as indicated in Table 22, the jobs might lend themselves to group instruction.

Table 24. Per cent of teachers reporting the different times at which the instruction is given to the students.

Groups of jobs	Per cent of teachers reporting		
	As boy has job	Boy brings job at a set time	Keep machine in shop for instruction
General Jobs	94	6	0
Pistons and Cylinders	79	8	13
Connecting Rods and Crank Shaft	86	5	9
Fly Wheels and Belt Pulley	81	0	19
Valves and Valve Mechanism	74	5	21
Fuel System and Carburetion	72	8	20
Ignition System	74	6	20
Cooling System	83	4	13
Lubrication	91	6	3
Governors	82	6	12

Home Practice Jobs. Table 25 shows that approximately 45 per cent of the teachers use the "Gasoline Engine - Repair Jobs" for home practice jobs. The repair jobs lend themselves better to home instruction than do information

Table 25. Per cent of teachers reporting that they do or do not use the groups of jobs for home practice work.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
General Jobs	51	49
Pistons and Cylinders	44	56
Connecting Rods and Crank Shaft	35	65
Fly Wheels and Belt Pulley	39	61
Valves and Valve Mechanism	29	71
Fuel System and Carburetion	36	64
Ignition System	35	65
Cooling System	50	50
Lubrication	75	25
Governors	50	50

and operative jobs, and it will be remembered from Table 6 that a very small per cent of the teachers report that information and operative jobs are taught on the farm.

Tractor - Repair Jobs

It will be noted in Table 26 that only a small per cent of the teachers teach "Tractor - Repair Jobs". Table 27 shows very clearly that there is a lack of demand for the tractor jobs. The "Cooling System", "Clutch and

Table 27. Per cent of teachers reporting that they do or do not teach the groups of jobs.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
General Jobs		
a. Average of all jobs	14	86
Traction		
a. Average of all jobs	4	96
Fuel System and Carburetion		
a. Average of all jobs	22	78
Ignition System		
a. Average of all jobs	9	91
Cooling System		
a. Average of all jobs	25	75
Lubrication		
a. Average of all jobs	17	83
Clutch and Transmission		
a. Average of all jobs	23	77
Hitch, Frame and Axles		
a. Average of all jobs	12	88

Transmission", and "Fuel System and Carburetion" take the lead in the per cent of teachers teaching the jobs, which might indicate that those groups of jobs present more problems in tractor repair or that they lend themselves better to the teaching in the vocational agriculture shop.

Reasons not Taught. Table 27 shows that there is a decided lack of demand for "Tractor - Repair Jobs". The nature of the machine is no doubt partially responsible for

Table 27. Per cent of teachers reporting the reasons jobs are not taught. (Groups of jobs are given in the order in which they are rated "No demand".)

Groups of jobs	Per cent of teachers reporting		
	No demand	Lack equipment	Not practical
Traction	100	0	0
Fuel System and Carburetion	100	0	0
Clutch and Transmission	100	0	0
Cooling System	99	0	1
Lubrication	98	0	2
Ignition System	96	0	4
Hitch, Frame and Axles	94	6	0
General Jobs	91	9	0

that lack of demand in that they move slowly, and it would often be necessary to move them several miles to get them to the shop. Table 40 shows also that the shops are not equipped to do tractor repair work. In view of the fact that it is difficult to get tractor jobs into the shop, the school boards evidently are not investing in equipment necessary in doing tractor repair work.

Year Taught. A study of Table 28 indicates that the second year of vocational agriculture is the most common year for the teaching of tractor repair jobs. The third

Table 28. Per cent of teachers reporting the years in which the jobs are taught.

Groups of jobs	Per cent of teachers reporting		
	First Year	Second Year	Third Year
General Jobs	25	50	25
Traction	0	50	50
Fuel System and Carburetion	29	42	29
Ignition System	44	44	12
Cooling System	25	44	31
Lubrication	30	30	40
Clutch and Transmission	29	29	42
Hitch, Frame and Axles	33	28	39

and first years rate second and third respectively. It would be expected that only the elementary jobs could be taught the first year, leaving the more skilled jobs for the second and third years.

Size of Group Taught. Table 29 indicates that in general the teachers are agreed that the tractor repair jobs should be taught by individual instruction. Group instruction is used in a few cases where the jobs lend

Table 29. Rating of the size of group with which the teachers work in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings		
	Indi- vidual	Group	Class
General Jobs	2	1	3
Traction	1	2	3
Fuel System and Carburetion	1	2	3
Ignition System	2	1	3
Cooling System	1	2	3
Lubrication	1	2	3
Clutch and Transmission	1	2	3
Hitch, Frame and Axles	1	2	3

* Rating is based on per cent of the teachers answering.

themselves well to study in groups. The "Class" is rated third in every case. It will be remembered in the study of Information and Operative Jobs that the "Class" was rated first. It would seem then that information concerning a job may be taught to the class as a whole, but when it comes to doing the job in the shop, the instruction must be given individually or to a small group who may happen to have a job in common.

Teaching Methods. Table 30 shows that there is a wide variation in the rating of the teaching methods and

Table 30. Rating of the different teaching methods used in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings					
	Information sheet	Exercise sheet	Job sheet	Boy plans own job	Text book study and discussion	Miscellaneous method **
General Jobs	3	2	1	4	5	6
Traction	1	2	3	4	5	6
Fuel System and Carburetion	4	3	2	5	1	6
Ignition System	3	2	5	1	6	4
Cooling System	4	3	2	5	1	6
Lubrication	2	3	4	5	1	6
Clutch and Transmission	4	3	2	5	1	6
Hitch, Frame and Axles	4	3	6	5	1	2

* Rating is based on per cent of the teachers answering.

** Miscellaneous methods include a number of methods written in by teachers in their answers.

no satisfactory final rating can be made. Since there was only a small per cent of the teachers who report that they teach the jobs, it may seem that this is not a

representative opinion of the teachers as a whole, but simply the scattered opinions of the few who happen to be teaching the jobs.

Time of Instruction. Table 31 indicates that about the only time that the tractor repair jobs are being taught

Table 31. Per cent of teachers reporting the different times at which the instruction is given to the students.

Groups of jobs	Per cent of teachers reporting		
	As boy has job	Boy brings job at a set time	Keep machine in shop for instruction
General Jobs	100	0	0
Traction	100	0	0
Fuel System and Carburetion	84	6	10
Ignition System	100	0	0
Cooling System	81	14	5
Lubrication	94	0	6
Clutch and Transmission	90	0	10
Hitch, Frame and Axles	93	7	0

is whenever the boy has the job to do. In a few cases the boy brings in the job at a set time, and in some of the

shops the machine is kept for instructional purposes, but for the most part the boy's job determines the time of instruction. The procedure, then, is that the boy brings in the job at such times as he has need for it. He is given individual instruction, as indicated in Table 29, and no definite teaching method is used, as indicated in Table 30.

Home Practice Jobs. Table 32 shows that on an average over 50 per cent of the teachers report that they use the

Table 32. Per cent of teachers reporting that they do or do not use the groups of jobs for home practice work.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
General Jobs	66	34
Traction	54	46
Fuel System and Carburetion	58	42
Ignition System	31	69
Cooling System	49	51
Lubrication	45	55
Clutch and Transmission	75	25
Hitch, Frame and Axles	56	44

"Tractor - Repair Jobs" for home practice work. The tractor is a heavy machine and difficult to move into the

shop for repair. There is a small per cent of the teachers who teach tractor jobs in the shop, as shown in Table 26, but the vocational teachers are meeting the situation by giving instruction on the farm.

Automobile - Repair Jobs

A study of Table 33 indicates that approximately 45 per cent of the teachers teach "Automobile - Repair Jobs". It may seem that the automobile should be given consideration by a higher per cent of the teachers. It will be noted, however, that some of the more common jobs, as "Solder gas line", "Clean and adjust ignition points", and "Adjust brakes" are being taught by a high per cent of the teachers.

The "Fuel Supply and Carburetors" jobs are being taught on an average by 38 per cent of the teachers, with a range between 83 and 17 per cent. The job "Repair gasoline gauge" does not come in for much consideration on any automobile with which the boy would be working, and consequently a low per cent of the teachers teach the job.

The jobs pertaining to "Lubrication" are being taught by 45 per cent of the teachers, which shows that the jobs come in for at least average consideration.

Table 33. Per cent of teachers reporting that they do or do not teach the groups of jobs, and the range between the jobs taught most and the jobs taught least within the larger groups of jobs.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
Fuel Supply and Carburetors		
a. Job taught most Solder gas line	83	17
b. Job taught least Repair gasoline gauge	17	83
c. Average of all jobs	38	62
Electrical Equipment		
a. Job taught most Clean and adjust ignition points	83	17
b. Job taught least Focus lights	31	69
c. Average of all jobs	53	47
Lubrication.		
* a. Average of all jobs	45	55
Gears, Body and Chassis		
a. Job taught most Adjust brakes	87	13
b. Job taught least Polish car	21	79
c. Average of all jobs	49	51

* In small groups only the average is given.

The jobs pertaining to "Gears, Body and Chassis" offer a variety of jobs, and their importance is indicated by the range in the per cent of teachers who teach them. The job "Adjust brakes" is taught by 87 per cent of the teachers, while only 21 per cent teach how to polish a car. The group as a whole, however, is given more than average consideration, in that 49 per cent of the teachers teach the jobs.

Reasons not Taught. Table 34 indicates that the main reason for not teaching the "Automobile - Repair Jobs" is that there is a lack of demand for the work. Some of the

Table 34. Per cent of teachers reporting the reasons jobs are not taught. (Groups of jobs are given in the order in which they are rated "No demand".)

Groups of jobs	Per cent of teachers reporting		
	No demand	Lack equipment	Not practical
Lubrication	93	7	0
Fuel Supply and Carburetors	91	0	9
Electrical Equipment	84	5	11
Gears, Body and Chassis	78	12	10

teachers consider a part of the jobs not practical, and

others report that they do not have the necessary equipment to do the jobs.

Year Taught. Table 35 indicates that the first and second years in vocational agriculture rate about equally in importance when it comes to repairing an automobile; no doubt but the jobs requiring less skill are taught in the first year. The second year may be given to the teaching of more skilled jobs, and also in the third, so far as the time in the shop program will permit.

Table 35. Per cent of teachers reporting the years in which the jobs are taught.

Groups of jobs	Per cent of teachers reporting		
	First Year	Second Year	Third Year
Fuel Supply and Carburetors	41	37	22
Electrical Equipment	35	43	22
Lubrication	41	37	22
Gears, Body and Chassis	37	38	25

Size of Group Taught. Table 36 indicates that the teachers are agreed on the size of group with which they should work in the teaching of the "Automobile - Repair Jobs". "Individual" instruction is rated first, with "Group" and "Class" rating second and third respectively. The teaching of repair jobs fits in well with individual instruction and also with the time of instruction, as

indicated to be the case in Table 28, in that the jobs are taught whenever the boy has the job to do.

Table 36. Rating of the size of group with which the teachers work in presenting the information to the students.

Groups of jobs	* Summary of teachers' ratings		
	Indi- vidual	Group	Class
Fuel Supply and Carburetors	1	2	3
Electrical Equipment	1	2	3
Lubrication	1	2	3
Gears, Body and Chassis	1	2	3

* Rating is based on per cent of the teachers answering.

Teaching Methods. Table 37 indicates that the teachers in general are agreed on the teaching method they should use in the teaching of the "Automobile - Repair Jobs". There is some variation in their ratings of the teaching methods, but a final rating may be made in the following order:

First - Boy plans own job.

Second - Text book study and discussion.

Third - Information sheet.

Fourth - Exercise sheet.

Fifth - Job sheet.

Sixth - Miscellaneous methods.

Table 37. Rating of the different teaching methods used in presenting the information to the students..

Groups of jobs	* Summary of teachers' ratings					
	Information sheet	Exercise sheet	Job sheet	Boy plans own job	Text book study and discussion	Miscellaneous method **
Fuel Supply and Carburetors	4	3	5	1	2	6
Electrical Equipment	4	5	3	2	1	6
Lubrication	4	3	5	1	2	6
Gears, Body and Chassis	2	3	5	1	4	6

* Rating is based on per cent of the teachers answering.

** Miscellaneous methods include a number of methods written in by teachers in their answers.

Time of Instruction. Table 38 indicates that for the most part the "Automobile - Repair Jobs" are taught as the boy has the job to do. In some of the shops the machine is kept for instruction purposes, and in a few cases the boy brings in the job at a set time. The ideal procedure, then, is that the boy brings in the job at such times as he has

need for it. He plans his own work, and any instruction he needs is given to him individually.

Table 38. Per cent of teachers reporting the different times at which the instruction is given to the students.

Groups of jobs	Per cent of teachers reporting		
	As boy has job	Boy brings job at set time	Keep machine in shop for instruction
Fuel Supply and Carburetors	90	4	6
Electrical Equipment	87	6	7
Lubrication	88	3	9
Gears, Body and Chassis	90	6	4

Home Practice Jobs. Table 39 shows that over 50 per cent of the teachers use the "Automobile - Repair Jobs" for home practice work, which indicates that even though there may not be a demand for the repair work in the vocational agriculture shop, there is a demand for repair work on the farm and that the teachers are meeting the situation by giving instruction on the farm.

Table 39. Per cent of teachers reporting that they do or do not use the groups of jobs for home practice work.

Groups of jobs	Per cent of teachers reporting	
	Yes	No
Fuel Supply and Carburetors	52	48
Electrical Equipment	63	37
Lubrication	74	26
Gears, Body and Chassis	51	49

Tools in the Vocational Farm Shops. It will be noted in Table 40 that a number of the tools listed may also be used in jobs other than mechanical jobs, and it may justify their place in the shop over other tools.

A study of the table shows that there is a lack of equipment in many of the shops that is necessary in doing a number of the common repair jobs. Only five per cent of the shops are equipped to hone or rebore cylinders, a job that is common in the repairing of a motor, but it requires expensive equipment and on the part of the student it may require more knowledge and skill than can be expected of a boy from 14 to 18 years of age.

Fifty per cent of the shops are equipped to reseat and reface valves, a job that is common in repairing gas engines. The equipment is not especially expensive, and no

Table 40. Common tools that may be used in repair jobs and the per cent of teachers having the tools in their shops.

Tools	Per cent of teachers reporting
Screw driver	100
Pliers	100
Pipe wrenches	100
Cold chisels	100
Plain punches	100
Center punch	100
Files	100
Hack saw	100
Post drill	100
Vise	100
Wrecking bar	100
Blow torch	100
Soldering copper	100
Adjustable end wrenches	95
Hand drill	95
Drill bits 1/16" to 1"	95
Valve grinder	90
Valve lifter	90
Speed wrenches	80
Ratchet	80
Mechanist hammer	80

Table 40 (con't).

Socket wrenches	70
Socket sliding handle	70
Socket extension	70
Socket universal	70
Hoist	70
Bearing scraper	70
Valve reseating and refacing equipment	50
Easy out	30
Bearing blue	30
Babbitting equipment	30
Alemite grease gun	30
Zirk grease gun	30
Wheel puller	15
Paint spray	15
Lathe	10
Reboring equipment	5
Honing equipment	5

doubt but that it could be used to an advantage in more than 50 per cent of the shops.

Seventy per cent of the shops have the socket wrenches and attachments necessary in doing common repair jobs. All of the shops have the tools and equipment incidental to the

doing of repair jobs, but 30 to 95 per cent lack the tools and equipment necessary in doing many of the common repair jobs and most of the more skilled jobs.

The teachers report that there is a lack of demand for mechanical work, and at the same time there is a decided lack of equipment in the shops. The question then arises, has the lack of demand for mechanical work caused schools not to equip their shops, or would more and better equipment cause an increase in demand for that type of work.

SUMMARIZATION

1. All of the jobs listed in the questionnaire are being taught by some of the teachers. The per cent of teachers teaching them vary between four and 91 per cent.

2. The "Information and Operative Jobs" are taught by a greater per cent of the teachers than are the "Repair Jobs".

3. The stationary gasoline engine is used more than either the tractor or the automobile in the teaching of "Information and Operative Jobs".

4. The tractor is used least in the teaching of "Information and Operative Jobs".

5. The stationary gasoline engine is used more than either the tractor or automobile in the teaching of

"Repair Jobs".

6. The tractor is used least in the teaching of "Repair Jobs".

7. There apparently is no definite time in the course of study when the jobs are taught. The "Information and Operative Jobs" are taught at such times as the teacher sees fit to teach them. The "Repair Jobs," are taught whenever the boy has the job to do.

8. The "Information and Operative Jobs" are taught to the class as a whole. "Repair Jobs" are taught by the giving of individual instruction.

9. "Text book study and discussion" is the most common way of presenting material in "Information and Operative Jobs".

10. The teaching of the "Repair Jobs" is done, largely, by the boy planning his own work with the assistance of the instructor.

11. The principal reason for not teaching "Information and Operative Jobs" is that "Repair jobs are not taught". "Lack of reference material" and "Not practical" are other reasons which rate about equally in importance.

12. "Repair Jobs" are not taught because there is a lack of demand for that kind of work.

13. The repairing of the gasoline engine, tractor,

and automobile is used by about one-half of the teachers for home practice work.

14. The teaching of "Information and Operative Jobs" is not generally done on the farm.

15. The vocational farm shops in general lack equipment for the teaching of many of the more common repair jobs and most of the more complex repair jobs.

CONCLUSIONS

1. The traditional type of teaching, namely that of text book assignment and discussion, still persists and is being used in the teaching of farm shop jobs.

2. The vocational agriculture teachers have a tendency to follow the lines of least resistance, in that "Information and Operative Jobs" are being taught by the use of text book study and discussion; "Repair Jobs" are taught whenever the boy has the job to do, and he makes out his own plan of procedure.

3. The vocational agriculture teachers are making an effort to fill the gap made by the lack of demand for repair jobs, by teaching a greater per cent of the "Information and Operative Jobs" and by the teaching of repair jobs on the boy's home farm.

4. "Information sheets", "Job sheets", and "Exercise sheets" are not commonly used in the presenting of

information to the students.

5. The stationary gasoline engine lends itself better to shop instruction than does the automobile or tractor in the teaching of "Repair Jobs" and "Information and Operative Jobs".

6. The extended use of the tractor is limited to the western half of the state; therefore, the teaching of tractor repair jobs is limited to those sections where tractors are commonly used.

7. There is a need for a more definite schedule in the teaching of repair jobs--a schedule that will offer instruction to all of the boys in the class and not just to those who happen to have the job to do.

8. There is room for expansion in the teaching of repair jobs. The expansion must be brought about by creating a demand for the work.

9. There is need for more equipment necessary in the teaching of the common repair jobs in the vocational farm shops.

10. The gasoline engine, tractor, and automobile have not been used to the extent that they might have been for instructional purposes, and they are therefore potential sources for teaching material in the vocational farm shops.

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