AN EVALUATION OF INSTRUCTIONAL AIDS AVAILABLE FOR USE IN TEACHING AUTOMOBILE MECHANICS AND THE DEVELOPMENT OF ADDITIONAL INSTRUCTIONAL AIDS SUITABLE FOR USE IN TEACHING AUTOMOBILE MECHANICS IN INDUSTRIAL ARTS AT THE SECONDARY LEVEL

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CHAPTER I

INTRODUCTION

There are few Americans whose economic efficiency does not depend directly or indirectly upon the intelligent use of the automobile as a means of personal-social satisfaction. Undoubtedly, many of the boys of today have little or no opportunity to satisfy their curiosity or to develop an understanding of the modern motor car; and, as a result, the car is looked upon as a complicated and mysterious machine in the operation of its specialized parts. Because of these factors, automobile mechanics is being included more and more as a phase of the general curriculum designed to prepare youth for more effective living in an industrial and mechanical society. Therefore, it seems logical to suggest that instructional aids of various types be used, whenever possible, in the learning situations that involve the automobile because through their use the learning-teaching process can be made more effective. Often good instructional aids become the stimulus for learning the why, how, when, and where of certain objects.

Purposes of the Study

The purposes of this study are sixfold. They are as follows:

1. To study the various recommended courses of study for automobile mechanics and to ascertain the units of learning that are most commonly taught.

2. To obtain the various instructional aids that are available from the automotive industry to industrial arts teachers for use in teaching automobile mechanics at the secondary school level.

3. To develop suitable criteria for use in evaluating those instructional aids that are available.

4. To evaluate the instructional aids available in order to determine their probable effectiveness and practicability in teaching automobile mechanics.

5. To determine if there are instructional aids that can be developed and used by the instructor that are not available from commercial sources.

6. If there are instructional aids that can be developed but which are not available, one of the purposes of this study is to prepare plans and specifications for the construction of such aids.

Sources of Data

The data for this study were secured from the following sources: (1) from the courses of study pertaining to

automobile mechanics recommended for the secondary school level in Texas, (2) from materials prepared by the automotive industry, (3) from professional books and bulletins pertaining to the subject, and (4) opinions of professional people in the industrial fields.

Delimitation

This study will be limited to an evaluation of the instructional aids in the form of printed materials, posters, charts, diagrams, and schematic drawings available from the automotive industry for use in teaching automobile mechanics, and to a study of other aids that can be developed by industrial arts teachers. In this study, consideration will not be given to films or film strips.

Definition of Terms

In order to conduct the study and to clarify certain terms and concepts, it was necessary to define certain terms. These terms are as follows:

For the purpose of this study industrial arts is considered as that phase of general education which provides exploratory experiences with tools, equipment, materials, processes, and problems resulting from an industrial society.

Good has defined the term secondary school level as follows:

> The period of education, whether public or private, which usually consists of grades 7 to 12 or 9 to 12,

> during which pupils learn to use independently the tools of learning that they have previously mastered, in which education is differentiated in varying degrees according to the needs and interests of the pupils and which may be either terminal or preparatory.[1]

The term automobile mechanics is defined as follows: (1) servicing and maintenance of automotive equipment, (2) technical and scientific aspect of mechanized equipment, (3) skillful coordination of mind and hands, and (4) theory of present and future transportation.

An instructional aid has been defined as an "activity or illustrative material serving as a stimulus to learning."[2]

The term criterion has been defined as "a standard, norm, or judgment selected as a basis for quantitative and qualitative comparison."[3]

Evaluation refers to "the process of ascertaining or judging the value or amount of something by careful appraisal."[4]

Recent and Related Studies

In 1949, a study was conducted by Erwin on the types of audio-visual aids used in the junior high school industrial arts program in Texas. The purposes of his study were as follows: (1) to determine the types of audio-visual aids

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[1] Carter V. Good, Dictionary of Education.

[2] Ibid. [3] Ibid. [4] Ibid.

that were being used, (2) to ascertain the extent of their use, (3) to conduct an evaluation by the teachers in service of the various audio-visual aids used, and (4) to identify the needs recognized by the teachers in service for additional audio-visual aids and the needs of these teachers for additional instruction in the use of such aids.

In personal interviews with teachers of industrial arts, Erwin found that in both junior and senior high schools classes were larger than could be taught effectively by the accepted teaching methods which have been used for many years. Most of the teachers stated they did not have enough time to give individual attention and instruction to the students, and many of the teachers expressed a need for teaching aids that would enable them to teach larger groups and keep each student occupied with constructive work.

Erwin sent 126 questionnaires to junior high school industrial arts teachers, of which eighty-six were returned and seventy-eight were usable for statistical purposes. The questionnaire was designed to determine what audio-visual aids were being used, the extent of their use, an evaluation of the various audio-visual aids used by these teachers, the opinions of the teachers as to the types of

audio-visual aids that should be used, and the needs for further preparation in the use of audio-visual aids.[5]

The purpose of a study by Briggs in 1953 was to develop instructional aids for use in teaching electricity in junior and senior high schools. At the time this study was made it was found that there were very few aids available for use in teaching electricity, except for a few films, charts, and posters. Briggs attempted to ascertain what aids could be developed by the teacher for use in teaching electricity that would require a reasonable amount of knowledge and time for their construction. Teaching aids that would enrich the currently used methods of instruction were developed and presented. Consideration was given to the subject matter of a changing world, thereby suggesting units in electricity.

Briggs formulated a list of conclusions based upon the findings of the study, which are as follows: (1) there are insufficient teaching aids available for use in elementary electricity, (2) many aids may be built especially for a

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[5]William R. Erwin, "A Study of the Types of Audio-Visual Aids and the Extent of Their Use in the Industrial Arts Program in the Junior High Schools of Texas to Formulate a Program for Audio-Visual Aids Based upon Skills, Training, and Attitudes of Teachers in Service and upon Professional Literature," Unpublished Master's thesis, Department of Industrial Arts, North Texas State College, 1949.

given locality without excessive cost in materials or time, and (3) teaching aids may be used to enrich the program and are more effective than the spoken or printed word.

As a result of this study, Briggs recommended that a study be made to determine the extent and sequence of the material needed in elementary electricity, based upon the opinions of teachers of elementary electricity; that a study be made using control groups to determine merits of the aids he developed and presented; that teachers be made more aware of the possibilities of using teaching aids; and that institutions of higher learning preparing teachers for elementary electricity should encourage the development of information concerning the construction of effective teaching aids.[6]

In 1949, White made a study of the automobile mechanics courses taught in the senior high schools of Texas by using the opinions and recommendations of school administrators and industrial arts teachers. The purpose of this study was to analyze the adequacy of the automobile mechanics courses taught in certain Texas high schools; also, to determine what high schools of Texas offered courses in automobile mechanics; at what place in the curriculum were such courses

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[6] Cecil Lee Briggs, "The Development of Teaching Aids for Elementary Electricity," Unpublished Master's thesis, Department of Industrial Arts, North Texas State College, 1953.

offered; a study of the methods used to teach automobile mechanics; and how many units were offered. School administrators, automobile mechanics teachers, and other industrial arts teachers were questioned as to what they thought should be taught in industrial arts automobile mechanics.

A study of the questionnaires returned by teachers of twelve schools offering automobile mechanics showed that in all twelve schools theory was taught and that in ten schools class demonstrations were used; all twelve schools provided practice on live machines and eleven schools used cut-a-ways in the teaching of automobile mechanics. The teachers of seven schools indicated that the students practiced with dead machines, and three teachers stated that they supplemented work with the use of visual aids such as film slides, movie films, charts, and maps. Fifty-eight administrators gave their opinions concerning the methods of teaching automobile mechanics, as follows: thirty-seven recommended class demonstrations by the instructor; thirty-two recommended practice on dead machines; forty-nine administrators recommended practice on live machines; thirty-eight recommended the use of cut-a-ways; three thought that visual aids of other types should be used; and only one recommended work with a local garage. This study indicated that administrators place a high value on the use of visual aids in the teaching of automobile mechanics.

A group of 109 industrial arts teachers were questioned as to the method of teaching automobile mechanics that they thought would be of most benefit; of these, 81 per cent stated that theory was very important; 76.5 per cent recommended class demonstrations by the instructor; 60 per cent recommended practice on dead machines; 92.7 per cent of the industrial arts teachers recommended practice on live machines; and 81 per cent suggested the use of cut-a-ways in the teaching of automobile mechanics. In six of the twelve high schools in which automobile mechanics was taught, it was indicated that the courses were offered in a trades and industries program rather than as an industrial arts course. In the other six schools automobile mechanics were taught in both the industrial arts departments and the trades and industries program.

This study indicated that the senior high schools of Texas are not meeting their responsibility by supplying a practical course in automobile mechanics although the Texas State Department of Education recommended such courses at that time. As a result of the study, White made some recommendations as to the methods of teaching automobile mechanics. They concerned theory, class demonstrations by the instructor,

practice on dead machines, practice on live machines, the use of cut-a-ways, and the use of other visual aids.[7]

The three preceding studies may be summarized as follows: (1) Erwin considered audio-visual aids in industrial arts; (2) Briggs set up specifications of various types of teaching aids that could be developed by an instructor of elementary electricity in industrial arts; and (3) White attempted to determine what should be taught concerning automobile mechanics as a phase of industrial arts. Each of these studies has a direct relation to this study, in that criteria for evaluating instructional aids will be analyzed; units of learning for automobile mechanics will be examined; and instructional aids for automobile mechanics will be developed.

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[7]Alvin M. White, "A Study of the Automobile Mechanics Taught in the Senior High Schools of Texas and the Opinions and Recommendations of School Administrators and Industrial Arts Teachers Concerning Automobile Mechanics," Unpublished Master's thesis, Department of Industrial Arts, North Texas State College, 1949.

CHAPTER II

A REVIEW OF THE UNITS OF LEARNING RECOMMENDED FOR AUTOMOBILE MECHANICS FOR THE SECONDARY SCHOOL LEVEL

Four courses of study were reviewed to determine the units of learning in automobile mechanics which were recommended for students at the secondary level. These sources were as follows: (1) Bulletin Number 389, Industrial Arts Program in Junior and Senior High Schools of Texas, prepared by the State Curriculum Committee, and published by the Texas State Department of Education in 1938;[1] (2) the study by White which was discussed in Chapter I;[2] (3) a tentative bulletin, Suggestions for Organizing, Teaching, and Improving Industrial Arts in Texas, prepared by an advisory committee appointed by J. W. Edgar, Commissioner of

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[1]Texas State Department of Education, Industrial Arts Program in Junior and Senior High Schools of Texas, Bulletin Number 389.

[2]Alvin M. White, "A Study of the Automobile Mechanics Taught in the Senior High Schools of Texas and the Opinions and Recommendations of School Administrators and Industrial Arts Teachers Concerning Automobile Mechanics," Unpublished Master's Thesis, Department of Industrial Arts, North Texas State College, 1949.

Education;[3] and (4) Suggested Standards for Automotive Service Instruction in Schools, prepared by the Automotive Industry-Vocational Education Conference on Public School Automotive Instruction.[4]

In Bulletin Number 389 in which the types of general industries courses were recommended for Level II, Grades 9 to 12, automobile mechanics was listed as one of the general areas that might be added or substituted for the more common areas such as drawing, metal, wood, and electricity.[5] A further study of the bulletin under the general heading, "Suggested Courses of Study," however, revealed that a suggested course of study for automobile mechanics was not listed.[6] Under the general heading of "Electrical Industries," one of the five main divisions of the electrical industries listed was the electrical system of the automobile.[7] Some material was developed and presented concerning the automobile electrical division, as follows:

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[3]Texas State Department of Education, Suggestions for Organizing, Teaching, and Improving Industrial Arts in Texas.

[4]Automotive Industry-Vocational Education Conference on Public Schools, Suggested Standards for Automotive Service Instruction in Public Schools.

[5]Industrial Arts Program in Junior and Senior High Schools of Texas, op. cit., p. 64.

[6]Ibid., pp. 64-77.

[7]Ibid., p. 78.

Unit I. Battery problems

A. Processes

1. Replace wire and cable terminals
2. Install battery
3. Test battery
4. Reseal battery
5. Clean and protect terminals
6. Recharge battery

B. Technical knowledge

1. Proper connections
2. Check battery
3. Material of batteries
4. Chemistry of battery
5. Care and maintenance
6. Fluxes

C. Occupational information

1. Battery repair man
2. Parts man

Unit II. Generator problems

A. Processes

1. Cleaning commutator and refitting brushes
2. Installing new brushes
3. Adjusting third brush
4. Lubricating bearings
5. Testing generator

B. Technical knowledge

1. Operation of generator
2. Function of brushes and commutator
3. Lubrication
4. Adjustment and control
5. Cut-outs

C. Occupational information

Automobile electricians

Unit III. Starting motor

A. Processes

1. Cleaning commutators and refitting brushes
2. Install new brushes
3. Remove and replace starting motor
4. Locating trouble

B. Technical knowledge

1. Size of conductors
2. Bendix drive
3. Electrical construction and connection

C. Occupational information

Automobile electricians' local shops

Unit IV. Ignition system

A. Processes

1. Diagram ignition system
2. Assemble ignition system
3. Repair ignition switch
4. Adjust interrupter points
5. Test for condenser action
6. Clean and adjust spark plugs

B. Technical knowledge

1. Low voltage or primary conductors
2. Coils
3. Interrupter points
4. Condensers
5. Distributor
6. High voltage or secondary conductors
7. Spark plugs
8. Conventional symbols

C. Occupational information

Training required to become an automobile electrician

Unit V. Lighting system

A. Processes

1. Install new bulbs
2. Install fuses
3. Test a circuit
4. Diagram a circuit
5. Wire a typical circuit
6. Adjust lights for proper focus

B. Technical knowledge

1. Types of bulbs
2. Types of fuses
3. Circuits
4. Diagram a circuit
5. Wire a typical circuit
6. Adjust lights for proper focus

C. Occupational information

Amount of this type of work available in the community[8]

The above material pertains to the processes of the electrical system of the automobile and no mention was made of the other systems of the automobile such as the transmission, the engine, the chassis, the braking system, or the cooling system. Actually, when the foregoing materials were compared with the other materials presented concerning electrical power, house wiring, communication, electrical machinery, and electrical appliances, it was found that there was much similarity and repetition.

In his study on automobile mechanics in the senior high schools of Texas, White found that there was not much agreement in the teaching of the several phases or systems of

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[8]Ibid., pp. 78-79.

the automobile. This was evidenced by the data presented as shown in the following table:

TABLE 1

PLACEMENT OF THE VARIOUS PHASES OF AUTOMOBILE MECHANICS TAUGHT IN THE TWELVE HIGH SCHOOLS OF TEXAS*

Phase of the Course	Number of Schools Teaching the More Common Phases of Automobile Mechanics in the Following Units			
	I	II	III	IV
General care and maintenance	12	4	3	4
Lubricating system	12	4	4	4
Engine cooling system	11	5	4	4
Brake system	4	11	5	4
Front end	3	11	3	4
Steering system	4	11	4	4
Transmission and clutch	4	6	8	5
Differentials, axles, drive shafts	4	5	9	5
Shock absorbers and springs	3	8	7	3
Fuel system	5	6	7	6
Motor overhaul	3	3	9	7
Engine tune-up	5	4	8	8
Paint and body work	2	3	4	8

*White, op. cit., p. 19.

Courses involving the lubrication and general care and maintenance of the automobile were offered in Unit I in all twelve of the schools included in the survey. Eleven of the twelve schools in Texas also taught the cooling system in

Unit I. In only two schools were paint and body courses included in the first units of work. Of the remaining phases of automobile mechanics taught either in Unit I or the first one-half year's work, one school included the brake system, steering system, transmission and clutch, differentials, axles, and drive shafts. Three schools in which automobile mechanics courses were taught included the front end, shock absorbers and springs, and motor overhaul in the first unit of work; and five other schools included the fuel system and engine tune-up.

In Unit II or the second year of work, the brake system, front end system, and the steering system were included. Units III and IV covered the various phases or systems of the automobile fairly evenly, with the exception of a slight trend in Unit III to include the transmission and clutch, differential, axles and drive shafts, motor overhaul and tune-up. The fuel system, motor tune-up, motor overhaul, and paint and body work were usually taught in Unit IV.

White compiled recommendations that were offered by forty-five administrators with respect to the grade placement of the different phases of automobile mechanics to be taught in the senior high schools of Texas. These recommendations are shown in Table 2.

TABLE 2

RECOMMENDATIONS OF FORTY-FIVE ADMINISTRATORS AS TO THE PLACEMENT OF THE VARIOUS PHASES OF AUTOMOBILE MECHANICS TO BE TAUGHT IN THE AVERAGE SENIOR HIGH SCHOOLS OF TEXAS*

Phase of the Course	Number of Administrators Offering Opinions Concerning the More Common Phases of Automobile Mechanics To Be Taught in the Following Units			
	Unit I	Unit II	Unit III	Unit IV
General care and maintenance	42	26	7	7
Lubrication system	32	13	4	4
Engine cooling system	26	18	6	3
Brake system	24	25	5	4
Front end	18	21	3	3
Steering system	20	19	9	3
Transmission and clutch	15	19	9	10
Differentials, axles and drive shafts	14	20	9	2
Shock absorbers and springs	19	18	9	2
Fuel system	20	19	8	4
Motor overhaul	13	17	7	15
Engine tune-up	18	17	9	9
Paint and body work	18	8	4	13

*Ibid., p. 26.

As the table shows, most of the various phases of automobile mechanics were included in the first two units of work. White gave as the reason for the placement of this material the following statement:

> This was because forty-three, or 95.3 per cent, of the administrators recommended not more than two units of automobile mechanics for the average senior high school, and thus the work would have been confined to two units.[9]

Forty-five school administrators offered opinions concerning the phases they believed should be taught in automobile mechanics, as follows: forty-two of the administrators believed that the general care and maintenance of the automobile should be included in the first unit of work; thirty-two recommended the inclusion of the lubrication system in the first unit; twenty-six were in favor of including the cooling system in the first year of work; and approximately one half of the administrators recommended that the brake system be included. From one fourth up to one half of the administrators expressed their opinions in favor of the other phases of automobile mechanics to be taught in Unit I.

Since popularity lagged for many of the courses taught in Unit II, the administrators who expressed opinions were not in favor of offering automobile mechanics above Unit I. The phases of automobile mechanics in which Unit II courses did excel over those of Unit I, according to the administrators, were the front end, transmission, transmission and clutch, differentials, axles and drive shafts, engine tune-up, and overhaul. They were of the opinion that the phases to be taught in the third unit of automobile mechanics were of

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[9]Ibid., p. 25.

little importance; one-third of the number of administrators recommended many different phases. The fourth unit, according to the administrators was of less value than the third. The majority of opinions that were expressed concerning a fourth unit, however, were concerned with motor overhaul, paint and body work, and transmission and clutch.

Opinions concerning the placement of various phases of automobile mechanics courses to be taught in the senior high schools of Texas were received from 109 industrial arts teachers by White. The findings by White indicated a wide variation of opinions as to the placement and sequence of the various phases of automobile mechanics to be taught in the several units, except for the general care and maintenance, lubrication, the cooling system, and the brake system which were in the main assigned to Units I and II, or the first and second years of work. Paint and body work was recommended by twenty-three teachers to be taught in Unit I; twenty-four recommended teaching body work in Unit II; forty recommended teaching paint and body work in Unit III; and twenty-one thought paint and body work should be included in Unit IV, or in the fourth year of work. Table 3 contains data concerning the recommendations of the 109 industrial arts teachers.

This survey verified the fact that the general care and maintenance of the automobile were recommended by ninety-four

TABLE 3

RECOMMENDATIONS OF 109 INDUSTRIAL ARTS TEACHERS AS TO THE PLACEMENT OF THE VARIOUS PHASES OF AUTOMOBILE MECHANICS TO BE TAUGHT IN THE AVERAGE SENIOR HIGH SCHOOLS OF TEXAS*

Phase of the Course	Number of Teachers Offering Opinions Concerning the More Common Phases of Automobile Mechanics To Be Taught in the Following Units			
	Unit I	Unit II	Unit III	Unit IV
General care and maintenance	94	29	9	8
Lubrication system	80	22	10	8
Engine cooling system	62	32	9	10
Brake system	45	45	13	10
Front end	33	47	16	14
Steering system	38	40	19	11
Transmission and clutch	19	33	29	24
Differentials, axles and drive shafts	20	32	30	22
Shock absorbers and springs	32	40	23	9
Fuel system	35	42	24	14
Motor overhaul	20	31	33	50
Engine tune-up	30	36	32	32
Paint and body work	23	24	40	22

*White, op. cit., p. 31.

teachers to be taught in Unit I; twenty-nine recommended that this be taught in Unit II; nine in Unit III; and eight recommended that it be included in Unit IV. Opinions with respect to the lubrication system were as follows: eighty teachers recommended that lubrication be included in Unit I; twenty-two thought it should be in Unit II; ten believed

lubrication should be in Unit III; and eight would include it in Unit IV. Opinions concerning the brake and front end systems were of the same general trend. With the aid of White's study as a reference, recommendations for a course of study for automobile mechanics courses in Texas schools could be determined.

Many school administrators and industrial arts teachers have come to the realization that automobile mechanics acquired through industrial arts courses should be available for all high school students in the State of Texas in order that the students might be more economically efficient in consumer living. To this end, a revised curriculum guide for industrial arts has been developed by the Texas Education Agency, in which an advisory committee prepared the following suggestions for automobile mechanics:

Automobile Mechanics for Level III, Grades 10-12

Suggestions for Planning and Developing Units of Learning

A. Processes
   1. Running system (analyzing)
      a. Frame
      b. Suspension shock absorbers and steering systems
      c. Brakes, wheels, and tires
   2. Power system (analyzing)
      a. Principles of engine operation
      b. Engine parts and functions
   3. Power train
      a. The clutch
      b. Transmission
      c. Propeller shafts
      d. Differential

4. Cooling system
5. Fuel system
6. Electrical system
   a. Battery
   b. Starting and generating systems
   c. Ignition, lighting, and electrical accessories
7. Lubrication system
8. Trouble shooting and tune-up
   a. Engine trouble
   b. Carburetor adjustment
   c. Carburetor and fuel system
   d. Ignition trouble
   e. Lubricating system trouble
   f. Generator
   g. Starting motor
9. Minor body repairs
   a. Removing dents
   b. Simple welding
   c. Touch-up and refinishing

B. Related and technical information
   1. General
      a. Opportunities in related fields of the automobile industry
      b. Terminology
      c. Common hand tools--use and care
      d. Safety factors
   2. Automobile design and construction
      a. Frames
      b. Front axle systems
      c. Steering mechanism
      d. Brakes
      e. Rear axles
      f. Transmission
      g. Clutches
      h. Springs, shock absorbers, and wheel suspension
      i. Wheels, rims, and tires
   3. Power plants and accessories
      a. Gasoline engine principles
      b. Engine parts
      c. Fuel system
      d. Combustion of fuels
      e. Carburetor system
      f. Lubrication
      g. Cooling system
      h. Ignition system

4. Mathematics
   a. Tire pressure and size
   b. Voltage
   c. Temperature
   d. Linear measurements, in inches and fractions
   e. Reading scales, micrometer
   f. Common fractions
   g. Applied ratio
   h. Speeds through gear train[10]

The foregoing suggestions for developing units of learning for automobile mechanics for the secondary school level are intended to provide a broad background and understanding of the automobile and differ greatly from the suggested course in Bulletin Number 389 as presented in the first part of this chapter. The suggestions in the older bulletin are limited to the electrical phase of the automobile only. This specialization in the electrical system only and the manner in which the suggestions are presented indicate that the suggestions in Bulletin Number 389 are vocational in nature.[11]

In 1946, the American Vocational Association appointed a committee to develop recommendations that might raise the general standards of automotive mechanics instruction in the public schools of the United States. Conferences were held, and, as a result, the Automotive Industry-Vocational Education Conference on Public School Automotive Instruction was

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[10] Suggestions for Organizing, Teaching, and Improving Industrial Arts in Texas, op. cit.

[11] Industrial Arts Program in Junior and Senior High Schools of Texas, op. cit.

formed.[12] The committee divided the content of the automotive course into five phases as follows: (1) automotive hand tools shop, (2) automotive chassis shop, (3) automotive engine shop, (4) automotive electrical shop, and (5) automotive service shop (including welding and minor body repair). Each of the five general areas were broken down into basic jobs; an example of the suggestions for the teaching-learning process is shown in the following outline:

3.09 Automotive Electricity

Simple electrical circuits

Job numbers

1. Check ohm's law using automobile head lamp
2. Measure voltage drop
3. Study volt-current relationships in series and parallel circuits

Magnetic circuits

4. Study properties of permanent magnets
5. Make and test an electro-magnet
6. Study principles of electro-magnetic induction
7. Construct a pair of coils and observe mutuals, induction

Batteries

8. Study and test dry cells and storage battery
9. Make complete service test on 6V battery (dead short voltage, specific gravity, capacity test)
10. Study battery charging systems and completely charge a battery

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[12]Automotive Industry-Vocational Education Conference on Public Schools, Suggested Standards for Automotive Service Instruction in Public Schools, p. 1.

Ignition circuits

11. Hook up and test the primary ignition circuit
12. Hook up and test the secondary ignition circuit

Coils

13. Study construction of coils
14. Test coils for continuity of capacity and resistance (cold test and hot test)

Condensers

15. Study construction and operation of condensers
16. Test condensers--simple discharge
17. Machine test coils for continuity, resistance and capacity

Distributors

18. Disassemble, inspect, and assemble distributors (various types)
19. Disassemble, inspect, and assemble automatic and vacuum advance systems
20. Test and adjust a distributor on a distributor testing machine

Spark plugs

21. Study construction and design of spark plugs
22. Machine clean and adjust spark plugs
23. Test spark plugs in a pressure chamber

Ignition timing

24. Ignition time an engine, a dead engine
25. Check ignition timing with timing light and dwell meter
26. Synchronize twin and/or dual ignition system

Starting motor

27. Dismantle, inspect, and assemble a starting motor
28. Recondition an armature commutator
29. Recondition an armature (windings, shaft and bearings)
30. Growler test an armature

31. Inspect, test and recondition brush rigging
32. Inspect, test, and recondition field coil
33. Inspect, test, and recondition automobile starter (locked-current draw)
34. Inspect, test, and recondition starter engaging systems

Generators

35. Disassemble, inspect and assemble generator (2 and 3 brush type)
36. Growler test a generator armature
37. Test and recondition field windings
38. Repair and motorize a generator
39. Test operating characteristics of a two-brush generator
40. Test operating characteristics of a three-brush generator

Regulators

41. Disassemble, inspect, sketch circuit diagrams, and assemble a 3-coil regulator
42. Inspect, and adjust air gap, clearances, point clearance, spring hanger tension for controlling regulator output
43. Check and adjust regulator output in a generator-regulator circuit

Light and warning device circuits

44. Study S.A.E. harness specifications
45. Adjust and tune warning horns
46. Trace and lighting circuits
47. Inspect and adjust a seal-beam unit

Tune-up

48. Make complete ignition system test using analyzer and test light on an engine
49. Inspect ignition circuits for "leakage" causing radio interference
50. Service department tune-up procedures[13]

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[13] Ibid., p. 16.

From the above example of the vocational automobile mechanics course of study, it is readily seen that the suggestions pertain to the electrical system of the automobile only. In developing courses of study suitable for automobile mechanics in industrial arts, efforts should be made to make the suggested units of study broad in scope so as not to be of a vocational nature. The tentative bulletin, Organizing, Teaching, and Improving Industrial Arts in Texas, includes automobile mechanics as a main division in recognition of this principle.

Four courses of study for automobile mechanics were studied in order to ascertain the units of learning most commonly taught. White made an interesting study, finding that the senior high schools of Texas were not meeting their responsibility in supplying a practical course in automobile mechanics; that the courses of study used in teaching automobile mechanics could be better organized; and that administrators and industrial arts teachers were in favor of a more practical course at the secondary school level concerning the maintenance and operation of the automobile.

It was found that a suggested unit of learning for automobile mechanics for the secondary school level was available through the Texas Education Department prior to the establishment of the Texas Education Agency, yet that it was very narrow

in scope. A course of study developed for automobile mechanics for vocational schools was found to be too technical for use in an industrial arts program.

The Texas Education Agency has recently released a bulletin of suggestions for organizing, teaching, and improving industrial arts in Texas. This bulletin contains a suggested course of study for automobile mechanics and was found to be more adequate in that the suggested units of learning were broad in scope and emphasis was not placed on the overhaul of various systems which involve a degree of skill and understanding.

CHAPTER III

CRITERIA FOR USE IN EVALUATING AVAILABLE INSTRUCTIONAL AIDS FOR AUTOMOBILE MECHANICS

Thirty industrial firms manufacturing automobiles or accessory parts of automobiles were queried as to what materials and instructional aids they prepared and made available for use in teaching automobile mechanics. A total of 290 manuals, charts, diagrams, brochures, parts lists, service training books, and other materials were supplied by these companies. In all probability, these materials were developed for two major reasons: (1) advertising the various features of the automobiles and their accompanying parts manufactured by each of the leading automobile corporations; and (2) for use by those engaged in the repair and servicing of automobiles used by the general public.

In order to determine the usefulness and practicability of the wealth of materials available that were received from the companies, it was necessary to evaluate them critically by suitable criteria designed to determine or indicate their use and probable value in the teaching-learning process. This chapter will pertain to the development of suitable criteria to be used in evaluating the

instructional aids for automobile mechanics at the secondary school level that are available from commercial sources.

Weaver and Bollinger are of the opinion that many teaching aids are available in great variety from industry and that teachers may improve and expedite the teaching-learning process with teaching aids when they are used properly. Concerning the selection of commercial instructional aids, Weaver and Bollinger formulated the following criteria for use:

> 1. Sound, in terms of the educational philosophy and program that the school adopted.
> 2. Significant, in the sense that it promotes the educational program better at the time than any pedagogic material that is available.
> 3. Timely, contributing information too recent to be included in available textbooks, thus helping the curriculum to keep up with current life as it develops. Each contribution should be dated.
> 4. Well balanced, articulating with the adopted educational program without disturbing the relative values that education assigns to its details.
> 5. Accurate in facts, without concealment or exaggeration.
> 6. Fair in the presentation of a point of view in a controversial matter.
> 7. Concerned with principles or products in general rather than with specific brands only.
> 8. Adapted to the needs, the interest, and the maturity level, the economic level, and the locality of the students who will use it.
> 9. Truthful, presenting not only what is in itself true, but as far as possible insuring against conclusions or attitudes not in accord with the whole truth. Misleading statements or supression of important relevant information should invalidate any material.
> 10. Objective in presentation, without making or influencing interpretations that promote sales rather than the learner's education.
> 11. Responsible. Since even with the best intentions of objectivity and impartiality, a writer may

> manifest, by statement or by omission, prejudice in favor of the product or the point of view that he represents, the source of every commercial supplementary teaching material should be clearly, but not obtrusively and repetitiously stated.[1]

In the opinion of Schwartz, suitable criteria for evaluating instructional aids are invaluable. Schwartz compiled a group of principles for use in making an evaluation of audio-visual aids. These principles are as follows:

> 1. An understanding of students and their needs.
> 2. An understanding of curriculum construction.
> 3. An understanding of the environmental influences affecting life today.
> 4. The implementation of student and curricular needs with concrete materials.[2]

When compared with the criteria developed by Weaver and Bollinger, these principles are not so extensive in listing and emphasize the necessity of the teacher's possessing a thorough understanding of the student, his interest, needs, and the over-all curriculum.

Risk made a study concerning the evaluation of teaching aids and developed the following criteria which he believed to be suitable for use in the evaluation of instructional aids:

> 1. The importance of the aid in attaining the objectives of the work. Is the aid essential in such class work?

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[1] Gilbert G. Weaver and Elroy W. Bollinger, Visual Aids--Their Construction and Use, p. 4.

[2] John Charles Schwartz, Jr., Evaluating Criteria for an Audio-Visual Instructional Program, p. 1.

2. The adaptability of the aid as compared with other aids.
3. The availability of the aid when compared with other aids.
4. The amount of time involved in the use of such an aid. Is it economical of time, both in preparation before class and in use during class relative to its importance?
5. Relative effectiveness of the aid as compared with other available aids.[3]

Risk and Weaver and Bollinger are in agreement in that they believed that an instructional aid must help attain the objectives of the work. They also agree that the aid must be better adapted to the work than other available aids, that it must have availability, and that its effectiveness must be comparable to that of other aids. Weaver and Bollinger did not refer to the amount of time involved in the use of teaching aids in preparation before and during class, as did Risk.

Haas and Packer in Preparation and Use of Visual Aids[4] devoted a chapter to each type of instructional aids that could be made. Although this book was written for use by the instructor who makes his own visual aids, it would seem logical to assume that criteria designed for evaluating "home-made" and commercial visual teaching aids would be similar. Instructional aids, whether made by the instructor

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[3]Thomas M. Risk, Principles and Practices of Teaching in Secondary Schools, p. 575.

[4]K. B. Haas and H. Q. Packer, Preparation and Use of Visual Aids, pp. 1-136.

or obtained from commercial sources, should comply with the following standards as set forth by Haas and Packer:

> 1. They should be concise, simple, and clear.
> 2. They should be prepared to appeal to the readers; to encourage them to read and study the materials. Printed materials should not be a dry statement of facts.
> 3. They should be of a size convenient for use.
> 4. They should be illustrated as fully as the need requires.[5]

The foregoing criteria developed by Haas and Packer for use in the evaluation of instructional aids are not extensive. The criterion set forth by Haas and Packer that the aid should be prepared to appeal to the reader is comparable to the principle advocated by Weaver and Bollinger concerning the interest and maturity of the student who will use the aid. This same principle was also emphasized by Schwartz. As was stated earlier, Haas and Packer's book was concerned more with the making of instructional aids than with the effective use to be made of them.

Two recent studies concerning instructional aids and their use in industrial arts have been made. According to Erwin's study on the evaluation of teaching aids,[6] good

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[5] Ibid., p. 187.

[6] William R. Erwin, "A Study of the Types of Audio-Visual Aids and the Extent of Their Use in the Industrial Arts Program in the Junior High Schools of Texas to Formulate a Program for Audio-Visual Aids Based upon Skills, Training, and Attitudes of Teachers in Service and upon Professional Literature," Unpublished Master's thesis, Department of Industrial Arts, North Texas State College, 1949.

teaching aids assist the teaching-learning process in the following ways:

1. Provision of more learning in less time.
2. Enablement of teachers to teach large groups and still have time to assist individuals.
3. Enablement of longer retention of the facts learned.
4. Provision of vital, happy learning instead of the old-fashioned verbal learning in related areas.
5. Increase of interest and uniformity of training and information.
6. Reinforcement of previous teaching.
7. Display of working parts of machinery that would take several hours to tear down and put back together.
8. Provision of good reviews of what has been taught.
9. Aid in developing keen observation.
10. Display of the result of accidents and of broken tools that would be dangerous and expensive to demonstrate.
11. Stimulation of initiative and creative responses.
12. Enrichment and clarification of instruction.[7]

Erwin stated that a teaching aid should help promote learning in less time. This criterion is not found in any of the previous references. Determining the rate of learning, however, would involve a controlled testing program that might not be practical in many situations. Erwin's statement that teaching aids should be used instead of old-fashioned verbal learning was mentioned also by Weaver and Bollinger. The statement by Erwin that a teaching aid should increase interest and uniformity of training and information was also stated as a principle for use in the evaluation of teaching aids by Weaver and Bollinger,[8] as well as by Haas and Packer.[9]

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[7] Ibid., pp. 48-49. [8] Weaver and Bollinger, op. cit., p. 4.

[9] Haas and Packer, op. cit., p. 187.

Another study pertaining to instructional aids and their use was made by Briggs, who developed a guide for use in choosing good teaching aids.[10] Actually, this guide consists of four questions, as follows:

> 1. Does the aid give a true picture of the ideas that are to be presented?
> 2. Is the aid appropriate to the age and experience of the student?
> 3. Is the aid worth the time and expense involved in its production?
> 4. Is the aid an improvement over existing types of presentation?[11]

The foregoing questions formulated by Briggs concerning the selection of teaching aids are also similar to the criteria developed by Weaver and Bollinger and by Risk. Risk did not mention the age of the students who will use the aids. The age factor was emphasized, however, by Haas and Packer. The questions presented by Briggs are broad in scope and when compared with the criteria developed for use in evaluating teaching aids developed by Erwin, they were found to be similar. It is probable that both Erwin and Briggs had the same goal in mind in conducting their studies.

Research has revealed studies and miscellaneous writings concerning the selection, use, evaluation of instructional aids, and descriptive accounts of instructional aids and

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[10]Cecil Lee Briggs, "The Development of Teaching Aids for Elementary Electricity," Unpublished Master's thesis, Department of Industrial Arts, North Texas State College, 1953.

[11]Ibid., pp. 42-43.

their development. These studies and miscellaneous writings were concerned, however, with instructional aids in general. No doubt, continued research and study would reveal additional principles and criteria which could be further developed and used to study and evaluate instructional aids. No doubt the principles and criteria that have been presented could be further refined and their reliability tested and established. It is believed, however, that the foregoing principles and criteria, when developed into an evaluative instrument in the form of a checklist, applied to the various instructional aids available for use in teaching automobile mechanics, and presented in this study will reveal information concerning their value or probable value in the actual teaching-learning situation.

In the following paragraphs those principles, questions, and criteria which have been developed and set forth by various individuals concerning the selection and evaluation of instructional aids available for automobile mechanics will be presented; other criteria which will be needed in order to evaluate the instructional aids under study will be developed. To develop criteria for this study, it was necessary to study and analyze the principles and criteria presented to prevent duplication. After the various principles and criteria were studied for meaning and implications, ten principles were selected. It was necessary to restate each

principle or criterion that pertained to the evaluation of an instructional aid for automobile mechanics and to formulate and present criteria by which its actual value or probable value could be determined.

The principles and criteria are stated as follows:

Principle I

The instructional aid should be "timely, contributing information too recent to be included in available textbooks."[12]

Criterion

Is the information presented in or through the aid too recent to be included in available textbooks which treat automobile mechanics designed for the secondary school level?

Principle II

The instructional aid should be "objective in presentation, without making or influencing interpretations that promote sales, rather than the learner's education."[13]

Criterion

Is the instructional aid objective in that it can be used to promote the learner's education in the area of automobile mechanics, rather than in promoting sales?

Principle III

The instructional aid should be "accurate in facts, without concealment or exaggeration."[14]

Criterion

Is the aid accurate in presenting facts as related to automobile mechanics and free from exaggeration?

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[12]Weaver and Bollinger, op. cit., p. 4.

[13]Ibid. [14]Ibid.

Principle IV

The instructional aid should "implement student and curricular needs with concrete materials."[15]

Criterion

Does the instructional aid implement student and curricular needs in the form of concrete material for use in teaching automobile mechanics?

Principle V

The instructional aid should have availability when compared with other or similar instructional aids.[16]

Criterion

Is the aid available for use in teaching automobile mechanics at the secondary school level?

Principle VI

The instructional aid "should be concise, simple, and clear."[17]

Criterion

Is the aid concise, simple, and clear?

Principle VII

The instructional aid "should be of a size convenient for use."[18]

Criterion

Is the aid of a size convenient for use?

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[15]Schwartz, op. cit., p. 1. [16]Risk, op. cit., p. 575.

[17]Haas and Packer, op. cit., p. 187.

[18]Ibid.

Principle VIII

The instructional aid "should display working parts of machinery that would take several hours to tear down and put back together."[19]

Criterion

Does the aid, or cut-a-way, show working parts of the automobile that cannot be seen unless the machine is torn down?

Principle IX

The instructional aid should "give a true picture of the idea to be presented."[20]

Criterion

Does the aid or cut-a-way give a true picture of the principle or idea to be presented?

Principle X

The instructional aid should be an improvement over existing types of presentation.[21]

Criterion

Is the aid an improvement over existing types of presentation?

Evaluative criteria were deemed necessary in choosing satisfactory instructional aids for automobile mechanics. Consideration was given to the fact that the aids to be included would be secured from commercial sources. These sources had prepared the aids as either advertising material or instructional aids for automotive repair men. Six authoritative publications from the field of visual

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[19]Erwin, op. cit., pp. 48-49.

[20]Briggs, op. cit., pp. 42-43. [21]Ibid.

education were reviewed as to principles of good teaching aids. For the purpose of this study, ten criteria of measure were developed from the principles presented by these six sources. The criteria for choosing desirable commercial instructional aids will be used to evaluate the aids to be presented in an ensuing chapter.

CHAPTER IV

PRESENTATION AND EVALUATION OF AVAILABLE INSTRUCTIONAL AIDS THAT ARE PREPARED BY COMMERCIAL SOURCES

In Chapter I, two of the purposes of this study were stated as follows: first, to ascertain what instructional aids were prepared by and available from the automobile industry for use in teaching automobile mechanics; second, to evaluate the available aids by the use of suitable criteria to determine their value or probable value in teaching automobile mechanics.

Thirty major industrial firms engaged in the manufacture of automobiles or accompanying parts of automobiles were contacted concerning such aids. These thirty industrial firms supplied a total of 290 manuals, charts, diagrams, brochures, parts lists, and service training books. Instructional aids obtained from commercial sources will be treated as described in the following paragraphs.

Material in the form of manuals will be divided into two groups (1) general service manuals that include information concerning all units of the automobile, and (2) specific service manuals that bear upon only one unit of the automobile such as a manual relating to the fuel system of the automobile.

Various materials of pamphlet form will be considered and presented under the heading of brochures. The third group of instructional aids will consist of charts having to do with specific systems or units of the automobile.

The general service manuals will be presented by a brief description, and their availability from various sources of the automotive industry that were contacted will be shown in tables. All available general service manuals will be evaluated to ascertain their value or probable value as instructional aids for use in teaching automobile mechanics. The criteria for evaluating these instructional aids were developed and presented in Chapter III of this study.

Specific service manuals will be grouped according to the system or unit of the automobile to which they pertain, using as a guide the recommended unit of learning suggested for automobile mechanics in Chapter II of this study. The presentation of the specific service manuals will include a brief description of each. Each group of specific service manuals available from commercial sources will be treated and evaluated by the criteria used to evaluate the general service manuals. The brochures and charts will be presented as separate aids and treated in the same manner as the specific service manuals.

The Appendix to this study will include a listing of all instructional aids presented as to the source and the instructional aids which the various companies make available to instructors of automobile mechanics.

General Service Manuals Prepared by Commercial Sources

Letters were written to General Motors Corporation, Detroit, Michigan; Packard Motor Car Company, Detroit 32, Michigan; Hudson Motor Car Company, Detroit 15, Michigan; the Studebaker Corporation, South Bend 27, Indiana; Chrysler Corporation, Detroit 31, Michigan; Ford Motor Company, Dearborn, Michigan; and Nash Motor Car Company, Kenosha, Michigan. The object of these letters was to inquire as to what shop manuals were available to teachers of automobile mechanics in the secondary schools. A reply was received from each of the companies and all, with the exception of Ford Motor Company, Nash Motor Car Company, and Studebaker Corporation, stated that such manuals were available for school use and supplied a copy for this study.

Dewey F. Barich, Manager of the Education Relations Department of Ford Motor Company, stated that the supply of such materials was rather limited.[1] Only four charts were received from the Ford Motor Company; they will be presented later.

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[1]Letter from Dewey F. Barich, Manager, Educational Relations Department, Ford Motor Company, Dearborn, Michigan.

H. Allen, Jr., Assistant to Technical Service Manager, Nash Motors of Detroit, Michigan, replied to the effect that the company had no materials suitable for use in teaching automobile mechanics, and that he would contact the zone office located in Dallas, Texas.[2] Through correspondence, W. H. Sullins, Technical Service Manager of the Dallas office, stated that such material was very limited but that technical service manuals were available. The technical service manuals available for the Rambler, Ambassador, and Statesman in the 1950 models are free of charge. The technical manuals for the 1952 models are available for $1.50 each. Reference was also made to the effect that the Dallas Zone Office would not be in a position to furnish technical service manuals for the various models to too many schools.[3]

V. S. Sutton of the Owner Relations Division of Studebaker furnished a passenger car shop manual for the 1953 Studebaker. This manual includes information pertaining to the body, brake system, climatizer, clutch, cooling system, electrical system, the engine, frames, front end, steering system, gasoline system, lubrication, preparing car for delivery, propeller shafts and universal joints, rear axles,

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[2]Letter from H. Allen, Jr., Assistant to Technical Service Manager, Nash Motors, Detroit 32, Michigan.

[3]Letter from W. H. Sullins, Technical Service Manager, Nash Motors, Dallas 9, Texas.

springs and shock absorbers, transmission, wheels and tires, and torque specifications of the Studebaker car. A complimentary copy of this manual was sent for use in this study but it was understood from the correspondence with Sutton that this manual would not be supplied to schools offering automobile mechanics.[4]

The Chrysler Corporation, which consists of four major divisions, exhibited much interest in the study and supplied various materials in quantity. A reply from the Plymouth Division, Detroit 31, Michigan, stated that they maintained a training program known as the Master Technicians Service Conference, and its services were available to their dealers and to others.[5] This corporation made available a complete parts list and service manuals for the 1953 and prior models of passenger cars for each of the Plymouth, Dodge, De Soto, and Chrysler automobiles. These manuals include a wealth of technical information, pictures, and schematic drawings covering the following units of the automobile: front wheel suspension, rear axle, brakes, clutches, fluid drives, cooling system, electrical system, shock absorbers, steering system, the transmission, universal joints and propeller

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[4]Letter from V. S. Sutton, Owner-Relations Division, the Studebaker Corporation, South Bend 27, Indiana.

[5]Letter from H. W. Bremer, Service Department, Plymouth Division, Chrysler Corporation, Detroit 31, Michigan.

shaft, wheels and tires, body and sheet metal, lubrication, and radio and heater.

Two divisions of the General Motors Corporation in reply to letters of inquiry had the following information to offer: J. L. Wilson, Service Department, Cadillac Motor Car Division, stated that they furnished their manuals, charts, brochures, and other information only to distributors and dealers at factory costs.[6] A supplement to the 1953 shop manual and 1952 shop manual were sent, however, for this study. The Pontiac Motor Division in Pontiac, Michigan, had the following to offer: B. R. Sweeney of the Service Department sent a complete set of Pontiac shop manuals and service training materials, which he stated were available to schools and libraries.[7] These manuals include information covering general lubrication, body, frame, front end suspension, rear end suspension, brakes, engine fuel, engine clutch, engine cooling and oiling, transmission and gear-shift control. Also included is information concerning the fuel tank and exhaust, steering, wheels and tires, chassis sheet metal, electrical and instruments, accessories, and handicap controls. These same units of the automobile and

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[6]Letter from J. L. Wilson, Service Department, Cadillac Motor Division, General Motors Corporation, Detroit 32, Michigan.

[7]Letter from B. R. Sweeney, Service Department, Pontiac Motor Division, General Motors Corporation, Pontiac 11, Michigan.

their principles are included in the 1951 Shop Manual Supplement.[8] Two similar supplements are concerned with changes and service procedures for the 1952 and 1953 model Pontiacs. The prices of these and other available materials are as follows: A series of service training booklets for 25 cents each; the general shop manuals for the 1949 and 1950 model Pontiacs are available for $1.50 each; and various supplements and a body manual are available for 50 cents each. A manual for the models from 1948 to 1953 concerning hydramatic drive is available for $1. Pontiac has other instructional aids available to schools; these are as follows: Salvage engines, differentials, transmissions, power steering and hydramatic transmissions.[9] This material will be treated in detail later in this chapter.

The Service Promotion Manager of Packard Motor Car Company, M. J. Ulaga, supplied the following material: Service manuals for the latest models of Packard card, certain educational charts, miscellaneous service men's training booklets concerning power brakes, power steering, and four-barrel carburetors. Ulaga stated that it was the policy of the Packard Motor Car Company to supply one copy of service

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[8] 1951 Shop Manual Supplement, Pontiac Motor Division, General Motors Corporation, Pontiac 11, Michigan.

[9] Letter from B. R. Sweeney, op. cit.

literature, such as mentioned, to schools at no charge.[10] The Packard general service manual is divided into sections pertaining to the following units of the automobile: body, brakes, chassis, cooling, clutch, electrical, engine, frame, front suspension, fuel system, mechanical specifications, overdrive, rear axles, steering, transmission, ultramatic drive, universal joints, and propeller shaft, and wheels and tires. The various training booklets and technical charts available from Packard Motor Car Company will be treated later in this chapter.

F. J. Snyder, Technical Service Department, of Hudson Motor Car Company, stated in correspondence that the following manuals are published by the Hudson Motor Car Company. These manuals are a 1942-1947 Mechanical Procedure Manual for six and eight cylinder engines, and are available for $1.50; the same type of manual for the 1948-1953 models may be obtained at a cost of $2. Manuals pertaining to the Jet and Super Jet automobiles are available for $1; also a hydramatic manual is published and priced at $1. Various supplement manuals are printed and priced at 75 cents each. Hudson Motor Car Company has no provision whereby schools, in which automobile mechanics is taught, may obtain material free.[11]

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[10]Letter from M. J. Ulaga, Service Promotion Manager, Packard Motor Car Company, Detroit 32, Michigan.

[11]Letter from F. J. Snyder, Technical Service Department, Hudson Motor Car Company, Detroit 15, Michigan.

Seven general service manuals are available for school use and may be secured without charge by the instructor of automobile mechanics. One automobile manufacturer has set a fixed cost on manuals published, but four manufacturers do not practice making their general service manuals available for use in teaching automobile mechanics. The availability of these manuals has been recorded in Table 4 for further comparison.

TABLE 4

INFORMATION CONCERNING THE AVAILABILITY OF GENERAL SERVICE MANUALS FROM EIGHT MANUFACTURERS OF AUTOMOBILES

Source	Number of Manuals Published	Availability of Manuals for School Use		
		Free	Fixed Cost	Not Available
Cadillac Motor Division	1			X
Chrysler Corporation	4	X		
Ford Motor Company	?			X
Hudson Motor Car Company	3		X	
Nash Motor Car Company	2			X
Studebaker Corporation	1			X
Packard Motor Car	1	X		
Pontiac Motor Division	2	X		

As may be seen in the preceding table, three automotive concerns have available, at no cost, service manuals for use in

teaching automobile mechanics. The Hudson Motor Car Company has placed a charge on their manuals. Although the number of manuals published by the Ford Motor Company is not known, it is assumed that such manuals would not be available for teaching automobile mechanics in the secondary schools of Texas. Four automotive manufacturers do not make their manuals available for school use under any conditions, as shown in Table 4.

In order to evaluate the group of general service manuals available to determine their value or probable value for use as instructional aids in the teaching of automobile mechanics, it was necessary to develop a checklist containing the criteria developed and presented in Chapter III. To describe the degree to which each group of aids meet each criterion, the following terms were selected. The word "No" was used to indicate that the group of materials did not meet the criterion of measure to any noticeable or appreciable degree. "Moderately" was selected to be used to indicate that the group of materials meet each criterion to a noticeable or appreciable extent. The term "Yes" was selected to be used to indicate that each group of materials met each criterion to a satisfactory degree.

Table 5 contains information concerning the evaluation of ten general service manuals that may be obtained from

TABLE 5

AN EVALUATION OF TEN AVAILABLE SERVICE MANUALS PERTAINING TO THE STUDY OF AUTOMOBILE MECHANICS

Criteria	Degree to Which Manuals Meet Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education, rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-a-way show working of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid or cut-away give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

automotive manufacturers. As stated before, seven of the manuals are available without cost to the instructor of automobile mechanics. When the manuals were examined with respect to meeting the criteria included in Table 5, it was found that, in the main, all of the manuals would be valuable as instructional aids in teaching automobile mechanics.

Specific Service Manuals Prepared by Commercial Sources

As previously stated in this study, suggestions for planning and developing units of learning for automobile mechanics by various individuals and educational agencies are used as a guide for presenting and evaluating the instructional aids presented in this study. Twenty-five specific service manuals are available concerning the running system of the automobile; they are available from the following sources: The Packard Motor Car Company has manuals concerning the chassis, and front suspension and steering. The Pontiac Motor Division of General Motors Corporation publishes a technical training booklet concerning the front end and suspension. The Chrysler Corporation has available a service reference book covering the transmission, brakes, and shock absorbers. The Bear Manufacturing Company of Rock Island, Illinois, has produced a manual on wheel and steering alignment. Literature in the form of a specific service manual is available from the Packard Motor Car Company

and concerns the brake system of the Packard automobile. The Pontiac Motor Division has published a training manual pertaining to the principles of the Pontiac brake system. The brake shoe adjustment and alignment is presented in a separate manual published by the Chrysler Corporation. Friction Materials Standards Institute of 370 Lexington Avenue, New York 17, New York, made available in 1953 a book concerning the brake and clutch lining of the automobile. The Gatke Corporation of Chicago has made available a 1953 specification catalogue and suggested price list having to do with brake lining on the automobiles manufactured in the United States; a brake reliner's manual is available through the courtesy of the Johns-Manville Corporation of New York 16, New York. The Wagner Electric Corporation of Saint Louis, Missouri, has developed manuals for automobile mechanics, and these manuals center around the maintenance and adjustment of the two types of Wagner Lockheed hydraulic brake systems; also available from this source is a complete brake maintenance manual, which is priced at $1, and a manual concerning brake fluid and the part it plays in the hydraulic brake system used on the majority of the automobiles manufactured today.

Manuals pertaining to wheels and tires are available and are as follows: The Rubber Manufacturers Association, 444 Madison Avenue, New York, has prepared a manual of

information concerning tires for passenger cars; Schrader's Son Division, 470 Vanderbilt Avenue, Brooklyn 17, New York, has available a manual of air servicing methods.

The ten companies mentioned have made available for teaching automobile mechanics the various manuals described. The materials mentioned above are included in the following table of availability. These manuals pertain to the running system of the automobile.

TABLE 6

INFORMATION CONCERNING THE AVAILABILITY OF SPECIFIC SERVICE MANUALS FROM TEN MANUFACTURERS OF AUTOMOBILES AND ACCOMPANYING PARTS PERTAINING TO THE RUNNING SYSTEM OF THE AUTOMOBILE

Source	Number of Manuals Published	Availability of Manuals for School Use		
		Free	Fixed Cost	Not Available
Bear Manufacturing Co.	1	X		
Chrysler Corporation	2	X		
Friction Materials Standards Institute	1	X		
Gatke Corporation	2	X		
Packard Motor Company	3	X		
Pontiac Motor Company	2	X		
Schrader's Son	1	X		
Johns-Manville	1	X		
The Rubber Manufacturing Association	1	X		
Wagner Electric Corporation	4	X		

As may be seen in Table 6, nineteen volumes of printed material in the form of specific service manuals are available to instructors of automobile mechanics. These nineteen manuals pertain to various phases of the running system of the automobile.

Table 7 gives an evaluation of the manuals that are available as instructional aids for automobile mechanics. (See page 57.) After checking the manuals which pertain to the running system of the automobile with the criteria of evaluation, it was found that the entire group of manuals did meet the criteria to a satisfactory degree.

Presentation and Evaluation of Specific Service Manuals Pertaining to the Power System of the Automobile

The second process in the suggested units of learning mentioned earlier for automobile mechanics involves the power system of the automobile. The power system, more commonly called the "engine," is the heart of the automobile. The general service manuals, as previously presented in this study, have a wealth of information concerning the power system of the automobile, although only three specific service manuals are published and presented in this study. These specific service manuals are as follows: Packard Motor Car Company has available a manual on the internal combustion engine, and Chrysler Corporation has prepared two manuals concerning the V-8 type of engine and power engine facts. These are the

TABLE 7

AN EVALUATION OF EIGHTEEN SPECIFIC SERVICE MANUALS PERTAINING TO THE RUNNING SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner in education rather than the manufacturer's sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?		X	
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid or cut-away give a true picture of the particular idea or principle to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

only specific service manuals published and available to instructors of automobile mechanics from the manufacturers supplying instructional aids for this study.

The three manuals concerning the power system of the automobile met the criteria, as shown in Table 8, to an adequate degree.

TABLE 8

AN EVALUATION OF THREE SPECIFIC SERVICE MANUALS PERTAINING TO THE POWER SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid or cut-away give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Presentation and Evaluation of Specific Service Manuals Pertaining to the Power Train of the Automobile

The Packard Motor Car Company has two specific service manuals pertaining to the power train of the automobile, which was the third suggested unit of learning for automobile mechanics. One manual contains information concerning the clutch and electromatic clutches as well as transmissions with overdrive. The second manual offered by Packard has to do with the reconditioning of rear axles. A third manual pertaining to universal joints and propeller shaft is available from the Chrysler Corporation. The power train is made up of the clutch system, transmission, propeller shaft, and differential; as may be seen by the various manuals presented, there are sufficient specific service manuals available to cover the study of the power train.

Table 9 is devoted to an evaluation of these specific service manuals, in that the manuals are evaluated as a group. As may be seen in Table 9, all of the specific service manuals available for use as instructional aids in teaching automobile mechanics met the criteria to a satisfactory degree.

TABLE 9

AN EVALUATION OF THREE SPECIFIC SERVICE MANUALS PERTAINING TO THE POWER TRAIN OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education, rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?		X	
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Presentation and Evaluation of Specific Service Manuals Concerning the Cooling System of the Automobile

The cooling system of the automobile is the fourth unit of learning suggested for a course in automobile mechanics.

Two specific service manuals concerning the cooling system have been published and are available from two sources. They are as follows: The Chrysler Corporation has prepared a manual concerning the function and principles of the automobile cooling system, and the National Carbon Company will send to any automobile mechanics instructor a manual published by the Society of Automotive Engineers. The latter manual has to do with the general care and maintenance of the automobile cooling system and variations of antifreezes that could be used in the automobile. The manuals mentioned above are the only specific service manuals that are published and available from the sources contacted in this study.

These manuals will be evaluated in Table 10. The same measure of evaluating the other instructional aids will be used to evaluate these specific service manuals. (See page 62.) The manuals concerning the cooling system of the automobile met the criteria to a satisfactory degree.

Presentation and Evaluation of Specific Service Manuals Concerning the Fuel System of the Automobile

Various manuals pertaining to the fuel system of the automobile are available and are as follows: Pontiac Motor Division of General Motors Corporation has prepared a manual concerning the carburetor; two manuals are available from Chrysler Corporation, one of which pertains to the story of combustion, and the other concerns fuel economy. The AC

TABLE 10

AN EVALUATION OF TWO SPECIFIC SERVICE MANUALS PERTAINING TO THE COOLING SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education, rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?		X	
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Division of General Motors Corporation has made available to instructors of automobile mechanics a manual describing the 4-barrel carburetor; and the Ethyl Corporation has published a group of technical notes in manual form that would be beneficial in the study of the fuel system.

Of the four sources preparing materials concerning the fuel system, five manuals are available, as may be seen in Table 11. As shown in the table, the six manuals evaluated are available to teachers of automobile mechanics at no charge. The listing as shown in Table 11 includes all material that was available from the concerns offering material.

TABLE 11

INFORMATION CONCERNING THE AVAILABILITY OF SPECIFIC SERVICE MANUALS FROM FOUR MANUFACTURERS OF AUTOMOBILES AND ACCOMPANIMENT PARTS PERTAINING TO THE FUEL SYSTEM OF THE AUTOMOBILE

Source	Number of Manuals Published	Availability of Manuals for School Use		
		Free	Fixed Cost	Not Available
AC Division of General Motors	1	X		
Chrysler Corporation	2	X		
Ethyl Corporation	1	X		
Pontiac Motor Division	1	X		

It has now been established that five specific service manuals pertaining to the fuel system are available. These manuals are evaluated in Table 12. The six manuals, pertaining to the fuel system of the automobile, met the criteria to a satisfactory degree.

TABLE 12

AN EVALUATION OF SIX SPECIFIC SERVICE MANUALS PERTAINING TO THE FUEL SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education, rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or ideato be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Presentation and Evaluation of Specific Service Manuals Pertaining to the Electrical System of the Automobile

Fifteen specific service manuals concerning the electrical system of the automobile are available. These manuals

are as follows: Willard Storage Battery Company has prepared four manuals pertaining to the battery. These manuals consist of a battery service manual, a battery catalog, reference data and information concerning the principles of the storage battery, and a catalog of battery cables and accessories. The Pontiac Motor Division of General Motors Corporation has published three manuals pertaining to the electrical system and these are as follows: Advanced electrical service, ignition and tune-up diagnosis, and the starting and generating systems of the automobile. The Chrysler Corporation has made available four manuals treating V-8 engine electrical systems, gauges, windshield wiper repair, and radio service procedures.

Four specific service manuals are available concerning spark plugs. The AC Division of General Motors Corporation has prepared a manual containing specification and data pertaining to the proper use of spark plugs. Two manuals concerning the spark plug are available from the Champion Spark Plug Company; one is a tune-up manual for spark plugs, and the other is an engineering manual concerned with the principles of the spark plug. The Defiance Spark Plug Company has prepared a manual that is available to instructors of automotive mechanics; it concerns tune-up specifications and adjustments of spark plugs.

A total of fifteen specific service manuals is prepared by the various manufacturers listed in Table 13. As may

be seen in the following table, six different sources are listed. As shown by the table, all specific service manuals are free of cost to instructors of automobile mechanics.

TABLE 13

INFORMATION CONCERNING THE AVAILABILITY OF SPECIFIC SERVICE MANUALS FROM SIX MANUFACTURERS OF AUTOMOBILES AND ACCOMPANIMENT PARTS PERTAINING TO THE ELECTRICAL SYSTEM OF THE AUTOMOBILE

Source	Number of Manuals Published	Availability of Manuals for School Use		
		Free	Fixed Cost	Not Available
AC Division of General Motors	1	X		
Champion Spark Plug Company	2	X		
Chrysler Corporation	4	X		
Defiance Spark Plug Company	1	X		
Pontiac Motor Division	3	X		
Willard Storage Battery Company	4	X		

Table 14 contains information showing the extent to which the manuals found to be available as shown in Table 13 met the criteria used to evaluate them. The manuals available concerning the electrical system, as shown in the table, met the criteria and should be of value as instructional aids in the teaching of automobile mechanics.

TABLE 14

AN EVALUATION OF FIFTEEN SPECIFIC SERVICE MANUALS PERTAINING TO THE ELECTRICAL SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education, rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principles or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Presentation and Evaluation of Specific Service Manuals Pertaining to Trouble Shooting and Tune-up of the Automobile

Another unit of learning included in the recommended units of learning for automobile mechanics is trouble shooting and tune-up. Much information is available concerning this phase in various specific service manuals. The Ford Motor Company has prepared a group of specifications concerning their 1953 model cars. Data on the various 1953 model of cars are available from the Ethyl Corporation, and the Chrysler Corporation has published six manuals pertaining to carburetor adjustments, ignition system servicing, servicing tips in general, common repair facts, and other unusual cases. Seven other manuals are available to instructors of automobile mechanics, and these have to do with various models of each of the four automobiles manufactured by the Chrysler Corporation.

Fifteen separate instructional aids concerning trouble shooting and tune-up work are available to instructors of automobile mechanics. These aids have been grouped according to the source from which they are available, and will be presented in Table 15. The ordering address for these companies as well as the sources of the other instructional aids presented in this study may be found in the Appendix. As may be seen in Table 15, all of the service manuals mentioned concerning trouble shooting and tune-up work are free to

TABLE 15

INFORMATION CONCERNING THE AVAILABILITY OF SPECIFIC SERVICE MANUALS FROM THREE MANUFACTURERS OF AUTOMOBILES AND ACCOMPANIMENT PARTS PERTAINING TO TROUBLE SHOOTING AND TUNE-UP WORK ON THE AUTOMOBILE

Source	Number of Manuals Published	Availability of Manuals for School Use		
		Free	Fixed Cost	Not Available
Chrysler Corporation	13	X		
Ethyl Corporation	1	X		
Ford Motor Company	1	X		

instructors for use as instructional aids for a course in automobile mechanics.

With the availability of the preceeding fifteen specific service manuals established, Table 16 will serve as an evaluative measure in order that these manuals may be evaluated concerning their use or probable use as qualified instructional aids for automobile mechanics. As shown by the table, the fifteen specific service manuals pertaining to the unit of learning of trouble shooting and tune-up fully met each criterion to a sufficient degree. (See Table 16 on page 70.)

Presentation and Evaluation of Specific Service Manuals Pertaining to Minor Body Repairs of the Automobile

Minor body repairs was the ninth suggested unit of learning for automobile mechanics for the secondary school level.

TABLE 16

AN EVALUATION OF FIFTEEN SPECIFIC SERVICE MANUALS PERTAINING TO TROUBLE SHOOTING AND TUNE-UP OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education, rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?		X	

Eleven specific service manuals were found to be available pertaining to the principles of automobile construction and body repair. These eleven manuals are as follows: Packard Motor Car Company has prepared a manual concerning the principal parts of the automobile body. Hudson Motor Car Company has published two manuals dealing with this unit of learning, priced at 50 cents and 75 cents each, which contain information pertinent to the repair of any late model of Hudson automobiles. Five manuals are published by the Chrysler Corporation, which are free to instructors of automobile mechanics. These manuals concern the following: three of the manuals available from the Chrysler Corporation contain information necessary for explaining the principles of construction of the Chrysler automobiles; one includes a reference list of body parts, windshield service, and windshield and rear window service adjustments; the other two manuals may be used when explaining automobile painting in general since they include a story of paint and procedures of automobile refinishing.

The Martin Senour Automotive Finish Company has made available, free of cost, three specific manuals regarding automotive finishes. These three manuals contain such information as refinishing undercoats, proper use of hot lacquer, and techniques for better automotive refinishing.

Table 17 contains information concerning the four manuals available for use in teaching a unit on minor body repairs. From the four sources shown, thirteen specific service manuals are available and with the exception of Hudson Motor Car Company's manual, all are free to schools for use in teaching automobile mechanics.

TABLE 17

INFORMATION CONCERNING THE AVAILABILITY OF SPECIFIC SERVICE MANUALS AVAILABLE FROM FOUR MANUFACTURERS OF AUTOMOBILES PERTAINING TO MINOR BODY REPAIRS OF THE AUTOMOBILE

Source	Number of Manuals Published	Availability of Manuals for School Use		
		Free	Fixed Cost	Not Available
Chrysler Corporation	5	X		
Hudson Motor Car Company	2		X	
Martin-Senour Company	3	X		
Packard Motor Car Company	1	X		

As shown in the preceding table, eleven manuals are available to instructors of automobile mechanics. The Hudson Motor Car Company has set a slight charge for their manuals.

As a general rule, automobile bodies change in design and shape from one year to the next. For proper repair jobs, automotive manufacturers must keep their repair men supplied with current body information. This factor was of primary

concern in determining the degree to which specific service manuals met the first criterion of measure included in Table 18 of this study. The manuals evaluated by the items included

TABLE 18

AN EVALUATION OF ELEVEN SPECIFIC SERVICE MANUALS WHICH PERTAIN TO MINOR BODY REPAIR OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education, rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

in Table 18 met all the criteria to a satisfactory degree. The first criterion pertaining to whether or not the material was too recent for available textbooks was met to a high degree by these manuals on minor body repair. To facilitate a more thorough job of repair on these automobile bodies, instructional aids must be prepared for each body style that is manufactured.

Presentation and Evaluation of Brochures Pertaining to Various Units of the Automobile

Two brochures are available for use when teaching the principles of the cooling system. A brochure is available from the United States Department of Commerce, National Bureau of Standards, concerning the preparation of automotive antifreeze. The American Society for Testing Materials has published a brochure on the use and care of antifreeze as used in automotive equipment. Each of these brochures is available for school use.

A brochure is available to instructors of automobile mechanics from the Champion Spark Plug Company that concerns the electrical system of the automobile. This brochure includes pictures of the various types of spark plugs and conditions through which engine failure will occur from using faulty spark plugs.

The Ethyl Corporation has made available a brochure concerning primarily the fuel system of the automobile,

bringing to light various conditions that are a result of using improper fuel. This brochure gives practical pointers on general engine maintenance as an added feature.

For the purpose of clarity, the three groups of brochures previously mentioned will be evaluated together in Table 19 because these three groups of brochures contain the same type of information. (See Table 19 on page 76.)

As shown in Table 19, the brochures concerned with several units of the automobile were found to be lacking in the respect that they would promote only moderately the learner's education because they were developed to encourage the purchase of manufactured products. It was also noted that the information included in these brochures could be further expanded to another form of instructional aid.

Specific Service Manuals and Brochures Pertaining to Related and Technical Information of the Automobile

Some general and technical information of the automobile is available in two manuals published by the automotive industry. The Chrysler Corporation has prepared a manual on good driving practices and the General Motors Corporation has released a manual concerning hand tools common to the automotive industry.

A mass of brochures may be secured pertaining to related and technical information concerning the automobile in general.

TABLE 19

AN EVALUATION OF BROCHURES PERTAINING TO THE COOLING, ELECTRICAL AND FUEL SYSTEMS OF THE AUTOMOBILE

Criteria	Degree to Which Brochures Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?		X	
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?		X	

Five brochures have been prepared by the Chrysler Corporation and concern the following: Opportunities in the automotive industry; a trip through the Plymouth motor plant; the founding and progress of the Chrysler Corporation; and two of the brochures have to do with true stories of men in the retail automotive business. The General Motors Corporation has prepared a brochure on matalurgy and wheels; and Schrader's Son makes available a safety brochure pertaining to new tubes in new tires.

Table 20 has been prepared to show the availability of brochures and specific service manuals that have a direct relation to various technical and related fields of the automotive industry. In this table it may be noticed that all

TABLE 20

INFORMATION CONCERNING THE AVAILABILITY OF SERVICE MANUALS AND BROCHURES FROM THREE MANUFACTURERS OF AUTOMOBILES AND ACCOMPANIMENT PARTS CONTAINING RELATED AND TECHNICAL INFORMATION PERTAINING TO THE AUTOMOBILE

Source	Number of Manuals and Brochures Published	Availability of Manuals and Brochures for School Use		
		Free	Fixed Cost	Not Available
Chrysler Corporation	6	X		
General Motors Corporation	2	X		
Schrader's Son	1	X		

brochures and manuals are free for school use. From the three companies included in Table 20, nine pieces of literature are available.

The manuals and brochures presented in Table 20 will be evaluated as a group. Table 21 contains criteria for use in choosing suitable aids to be used in a course of automobile mechanics. As a general rule, it was found that the brochures were published to advertise, to promote, or to sell a product rather than for educational purposes. It may also be noted, as shown in Table 21, that an instructional aid of the brochure form is not believed to be the most beneficial form of instructional aid concerning a particular subject. This is because the brochures published by automotive manufacturers are for selling purposes. (See Table 21 on page 79.)

Presentation and Evaluation of Specific Service Manuals Concerning Design and Construction of the Automobile

The second section pertaining to related and technical information as found in the suggested units of learning presented earlier in this study deals with automobile design and construction. Seventeen manuals are available. Chrysler Corporation has prepared materials concerning hydraulic tappets, hydraulic power steering, principles of fluid torque drive, care and repair of fluid torque drive, maintaining power steering, hydraulic transmission, automatic overdrive

TABLE 21

AN EVALUATION OF NINE BROCHURES AND SPECIFIC SERVICE MANUALS PERTAINING TO RELATED AND TECHNICAL INFORMATION OF THE AUTOMOBILE

Criteria	Degree to Which Manuals and Brochures Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?		X	
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?		X	

principles, controls as used on automatic overdrive, and principles of Plymouth Hy-Drive overdrive. Other material available from Chrysler Corporation concerns convertible tops and Plymouth Hy-Drive repairing procedures. Packard Motor Car Company has available some material on the hydraulic system of the 1948 model convertible automobile and power steering. The Hudson Motor Car Company has available a manual concerning the hydra-matic transmission; this manual is priced at one dollar. Two other manuals concerning the hydra-matic transmission are available from the Pontiac Division of the General Motors Corporation. These two manuals concern principles of training and general service connected with hydra-matic transmissions.

Information concerning the availability of the material discussed in the preceding paragraph pertaining to automobile design and construction is shown in Table 22. As indicated in the table, the manuals concerning automobile design and construction are free for school use with the exception of one manual published by the Hudson Motor Car Company. The manual obtainable from the Hudson Company has a charge of one dollar. (See Table 22 on page 81.)

Table 23 shows the extent to which the service manuals met the criteria when evaluated. It was found that all sixteen manuals met the criteria in a positive manner. (See Table 23 on page 82.)

TABLE 22

INFORMATION CONCERNING THE AVAILABILITY OF SPECIFIC SERVICE MANUALS FROM FOUR MANUFACTURERS OF AUTOMOBILES PERTAINING TO DESIGN AND CONSTRUCTION OF THE AUTOMOBILE

Source	Number of Manuals Published	Availability of Manuals for School Use		
		Free	Fixed Cost	Not Available
Chrysler Corporation	11	X		
Hudson Motor Car Company	1		X	
Pontiac Motor Division	2	X		
Packard Motor Car Company	2	X		

Presentation and Evaluation of Brochures Concerning Automobile Design and Construction

Some twelve brochures have been prepared by the automotive industry that pertain to the general design and construction of the automobile. The Ethyl Corporation has prepared a brochure concerning valves as used in the internal combustion engine. The General Motors Corporation has published brochures available to instructors of automobile mechanics that pertain to the following: Two brochures concerning principles of the power train of the automobile; a brochure pertaining to electricity and wheels; another on optics and wheels; and a fifth relating to the principles of power. The General Tire and Rubber Company has published a

TABLE 23

AN EVALUATION OF SIXTEEN SPECIFIC SERVICE MANUALS PERTAINING TO DESIGN AND CONSTRUCTION OF THE AUTOMOBILE

Criteria	Degree to Which Manuals Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?		X	
5. Is the teaching aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

brochure describing a trip through their tire company. The Goodrich Tire and Rubber Company has a brochure showing the fabrication of the automobile tire from the raw materials to a finished product. Schrader's Son, 470 Vanderbilt Avenue, Brooklyn 17, New York, prepared four brochures covering the following subjects: proper balance of tire valve cores; proper care and maintenance of tires; special tire guages; and methods of keeping a steady customer.

Table 24 contains information concerning the availability of these twelve brochures published pertaining to the design and construction of automobiles. There are five sources of such materials as indicated in the table.

TABLE 24

INFORMATION CONCERNING THE AVAILABILITY OF BROCHURES FROM FIVE MANUFACTURERS OF AUTOMOBILES AND ACCOMPANIMENT PARTS PERTAINING TO THE DESIGN AND CONSTRUCTION OF THE AUTOMOBILE

Source	Number of Brochures Published	Availability of Brochures for School Use		
		Free	Fixed Cost	Not Available
Ethyl Corporation	1	X		
General Motors Corporation	5	X		
General Tire and Rubber Company	1	X		
Goodrich Tire and Rubber Company	1	X		
A. Schrader's Son	4	X		

As shown in Table 24 the twelve brochures are all available and free of cost to instructors of automobile mechanics. A complete address of each source is listed in the Appendix of this study.

An evaluation of the previously mentioned twelve brochures pertaining to design and construction of the automobile is shown in Table 25. The brochures to be evaluated by use of this table are evaluated as a group. Although the majority of the brochures met each criterion to a certain degree, there were very few of the brochures that ranked much higher than others included in the evaluation. In general the brochures evaluated do promote sales rather than the learner's education; although there are existing types of presentation that are an improvement over these brochures. Only moderately would these aids implement student and curricular needs and to a lesser extent would these aids show the working parts of the automobile which cannot be seen unless the machine is dismantled. For use as instructional aids with a group of students, these brochures do not give a true picture of the principles that should be presented in conveying ideas pertaining to design and construction of the automobile. (See Table 25 on page 85.)

TABLE 25

AN EVALUATION OF BROCHURES PERTAINING TO DESIGN AND CONSTRUCTION OF THE AUTOMOBILE

Criteria	Degree to Which Brochures Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?	X		
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?		X	
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?		X	
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?		X	
10. Is the aid an improvement over existing types of presentation?	X		

Presentation and Evaluation of Brochures Concerning Power Plants and Accessories as Related to Technical Information of the Automobile

It was found that five brochures are available pertaining to power plants and accessories of the automobile. The Chrysler Corporation has available a brochure on the industrial engine and a brochure on the various systems of the Plymouth automobile. The General Motors Corporation has published two brochures which concern the fuel system of the automobile, and the fuel systems of other engine types. The Oil Information Committee of the American Petroleum Institute has prepared a brochure concerning the numerous ways in which oil serves the nation.

Table 26 shows the various sources which make available for school use the five brochures previously presented concerning power plants and accessories.

TABLE 26

INFORMATION CONCERNING THE AVAILABILITY OF BROCHURES FROM THREE MANUFACTURERS OF AUTOMOBILES AND ACCOMPANIMENT PARTS PERTAINING TO RELATED AND TECHNICAL INFORMATION OF POWER PLANTS AND ACCESSORIES OF AUTOMOBILES

Sources	Number of Brochures Published by Manufacturers	Availability of Brochures for School Use		
		Free	Fixed Cost	Not Available
Chrysler Corporation	2	X		
General Motors Corporation	2	X		
American Petroleum Institute	1	X		

As shown in Table 26 all five brochures are available free of cost to instructors of automobile mechanics from the sources listed in the table. In the Appendix of the study may be found the complete ordering address of the sources included herein.

Presentation and Evaluation of Charts Concerning the Automobile

There are eight excellent charts pertaining to the running system of the automobile; they are as follows: The frame of the automobile is covered by two charts; General Motors Corporation has prepared a chart pertaining to the automobile chassis which is twenty-two by thirty-four inches in size and which is in color. This chart gives a splendid view of the complete chassis in such a manner that the complete frame of the automobile may be easily seen. A twenty-five by thirty-six inch wall chart distributed by the Packard Motor Car Company includes a diagram of the complete frame assembly with emphasis placed upon the complete front end assembly.

The principle of the shock absorber is covered by three separate charts. A chart by the General Motors Corporation is a thirty-four by twenty-two inch colored illustration of the shock absorber as related to the front-end suspension of the modern motor car. The Packard Motor Car Company has also prepared a chart concerning the relation of shock absorbers to the suspension system of the automobile. A twenty-four by

thirty-seven inch, black and white chart is printed by the Chrysler Corporation that contributes cut-away views of the rebound and the compression stroke of the shock absorbers. All parts of the shock absorber are labeled on this chart.

Four charts relating to the steering system and wheel alignment are as follows: Bear Manufacturing Company has available a chart pertaining to alignment factors of wheels with animated examples of each. The geometry of caster angle, camber angle, king-pin angle, toe-in angle, and wheel tracking examples are given on this thirty-four by twenty-nine inch, black and white chart. A chart by General Motors Corporation shows cut-away views of the worm and roller type and the recirculating ball type steering gear assemblies; also included are diagrams of various linkage systems previously mentioned on this colored, twenty-two by thirty-four inch chart. Packard Motor Car Company has available a chart which is twenty-five by thirty-six inches in size. This chart gives a cut-away view of a complete front end, which includes coil spring suspension, tires, tubes, wheels, wheel brakes and other information concerning the steering system of an automobile. Conventional steering gear alignment adjustments and steering system mounting methods are offered by Chrysler Corporation on a twenty-four by thirty-seven inch, black and white chart.

Table 27 lists four commercial sources of charts that pertain to the running system of the automobile. The total number of charts from each source is checked as to their availability for use in teaching automobile mechanics.

TABLE 27

INFORMATION CONCERNING THE AVAILABILITY OF CHARTS FROM FOUR MANUFACTURERS OF AUTOMOBILES AND ACCOMPANIMENT PARTS PERTAINING TO THE RUNNING SYSTEM OF THE AUTOMOBILE IN 1953

Sources	Number of Charts Published					Availability of Charts for School Use from Commercial Sources		
	Frame	Shocks	Steering System & Wheels	Wheels and Tires	Brakes	Free	Fixed Cost	Not Available
Bear Manufacturing			1	1		X		
General Motors	1	1	1		1	X		
Packard Motor	1	1	1		1	X		
Chrysler Corporation		1	1			X		

In the above table, four commercial sources are listed and make available a total of twelve charts pertaining to the various phases of the running system. These charts are available without charge to instructors of automobile mechanics.

Table 28 will serve as an evaluated checklist to determine the value or probable value of twelve charts concerning the running system of the automobile. All twelve charts pertaining to the running system of the automobile met the criteria when evaluated to a very positive degree. (See Table 28 on page 91.)

Presentation and Evaluation of Charts Concerning The Power System of the Automobile

Six charts were obtained that illustrated the power system of an automobile. The General Motors Corporation has published a colored, twenty-two by thirty-four inch chart that pertains to the principles of four cycle engines; this chart also shows individual pictures concerning phases of combustion, which are the ignition charge, the starter combustion, a smooth combustion, and a knocking combustion. The International Harvester Company has available a chart on the four stroke cycle engine. This chart presents the principles of the four stroke engine by using the example of loading, ramming, firing, and cleaning an old ball cannon. Below each of these examples a cut-away picture of the various engine cycles is also given. This chart, twenty-eight by thirty-eight inches in size and in black and white color would be an excellent aid for one who would have difficulty understanding the principles by seeing only the cut-away views of an actual engine.

TABLE 28

AN EVALUATION OF TWELVE CHARTS PERTAINING TO THE RUNNING SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Charts Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

The Chrysler Corporation has available three charts on the principles of the automobile engine; two are directly

related to principles of internal combustion engines. One chart illustrates a cut-away engine also having the parts named and including pictures and names of parts concerning the carburetor, spark plugs, distributor, and ignition timing. Another chart gives excellent cut-away views of the valve system of the V-8 engine, including the hydraulic valve lifting parts. The third chart prepared by Chrysler Corporation, also in black and white color and twenty-four by thirty-seven inches in size like the preceding charts, illustrates the hydraulic valve lifting principles as used on the Chrysler automobile. The Packard Motor Car Company has published a group of wall charts of valuable pictures pertaining to the internal combustion engine. Side and lengthwise cut-away views of their engine make for easy recognition of the various parts.

Table 29 shows the four sources of instructional aids and the number of charts available from each. The conditions as to how these various charts may be obtained will be noted, such as being free, having a fixed cost, or not being available for school use. All of the charts are free to instructors teaching automobile mechanics. (See Table 29 on page 93.)

The six charts were evaluated as a group to ascertain their use or probable use, and the degree to which the group met the criteria is indicated in Table 30. (See Table 30 on page 94.) When the group of charts were examined to

TABLE 29

INFORMATION CONCERNING THE AVAILABILITY OF CHARTS FROM FOUR MANUFACTURERS OF AUTOMOTIVE EQUIPMENT PERTAINING TO THE POWER SYSTEM OF THE AUTOMOBILE IN 1953

Source	Engine Principles Number of Charts Published	Availability of Charts for School Use		
		Free	Fixed Cost	Not Available
General Motors	1	X		
International Harvester	1	X		
Chrysler Corporation	3	X		
Packard Motor Car Company	1	X		

determine if they were too recent to be included in available textbooks, it was found that the material was very new and would not be found in current textbooks designed for public school use. These charts are accurate in facts and free from exaggeration because they were prepared for use by repairmen in the automotive field.

Presentation and Evaluation of Charts Concerning The Power Train of the Automobile

The third unit of study for automobile mechanics is the power train. This unit of learning includes the clutch, transmission, propeller shafts, and the differential. Nine charts were found to be available that could be used in teaching this unit.

TABLE 30

AN EVALUATION OF CHARTS PERTAINING TO THE POWER SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Charts Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or ideato be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Two charts illustrating the clutch system are as follows: The Chrysler Corporation has published a black and white chart

that is twenty-four by thirty-seven inches in size. This chart shows cut-away views and names of the various clutch disc parts. Also concerning the clutch system, the Packard Motor Car Company has prepared a chart having pictures of the clutch system by use of an exploded view. Included in this chart are pictures of the flywheel, clutch disc, pressure plate and cover assembly. The chart presented by the Packard Motor Car Company is in black and white color and twenty-five by thirty-six inches in size.

The second unit of the power train is the transmission. Two charts are available concerning this unit, as follows: The General Motors Corporation has released a colored, twenty-two by thirty-four inch chart concerned with the three speed gear transmission. This chart has views of the various gear shift positions such as the transmission engaged in reverse, low, intermediate, high, and neutral. The various gears are labeled and the number of teeth of each is also given. The second chart pertaining to the transmission is prepared by the Packard Motor Car Company. This is a black and white chart, twenty-five inches in width by thirty-six inches in length, and is composed of cut-away views, as may be seen from the top and side of the transmission. Also included on this chart are exploded views of the transmission with overdrive.

Propeller shafts are the third phase of the power system. Two charts are available concerning this phase. Chrysler Corporation by means of a twenty-four by thirty-seven inch, black and white chart has presented extremely valuable exploded views concerning the ball and trunnion, also the cross and roller type propeller shafts; all parts of these two type universal joints are named. Four views on installing rubber dust covers on universal joints are also included on this chart. The Packard Motor Car Company has available a black and white, twenty-five by thirty-six inch chart covering the same type of universal joints as mentioned above, but the chart does not give the name of any parts nor instructional pictures on installing dust covers.

To emphasize the importance of the differential, three separate charts are presented. A chart of educational value for automobile mechanics is available through the courtesy of the General Motors Corporation. This is a colored, twenty-two by thirty-four inch chart containing an exploded view of the differential case and hypoid gear, and an exploded view of the differential gears. A cross sectional view of the complete differential is shown from the top and side position to illustrate better the unit, and all parts shown on this chart are complete with their names. The Packard Motor Car Company has prepared a black and white, twenty-five by thirty-six inch chart having views of ample size,

illustrating both the cross sectional view and exploded view of the differential. The second chart by Packard Motors has a very good view of the complete rear wheel; this is a cross sectional view and includes everything from the wheel to the axle and the axle housing. The remaining portion of this chart is devoted to an exploded view of the rear axle housing assembly showing the axle, wheel bearings, grease retainers, and other parts of the differential.

Table 31 presents information concerning the various charts published by the sources listed pertaining to the

TABLE 31

INFORMATION CONCERNING THE AVAILABILITY OF CHARTS FROM THREE MANUFACTURERS OF AUTOMOBILES PERTAINING TO THE POWER TRAIN OF THE AUTOMOBILE IN 1953

Source	Number of Charts Published				Availability of Charts for School Use		
	Clutch	Transmission	Propeller Shaft	Differential	Free	Fixed Cost	Not Available
General Motors		1		1	X		
Chrysler Corporation	1		1		X		
Packard Motor Company	1	1	1	2	X		

power train of the automobile. Table 31 is arranged to show the charts available for the various sections of the power train, such as the clutch, transmission, propeller shafts, and the differential. As shown in the table, nine charts are available from three sources that illustrate the power train of the automobile and all are free of charge for school use by the instructor of automobile mechanics.

In Table 32 the charts treated in Table 31 are evaluated by the criteria to ascertain their value or probable worth as instructional aids in teaching automobile mechanics at the secondary school level. As shown in the table, the evaluative criteria for choosing suitable instructional aids for automobile mechanics were listed. The nine charts pertaining to the power train of the automobile were examined with respect to each criterion to determine if the group of aids either did or did not meet the criterion to a moderate or a satisfactory degree. As shown in Table 32, the group of charts as a whole did meet each criterion of measure to a satisfactory degree. As previously stated these charts are available for school use; they are simple, concise, and clear, as well as of a size convenient for school use. (See Table 32 on page 99.)

TABLE 32

AN EVALUATION OF NINE CHARTS PERTAINING TO THE POWER TRAIN OF THE AUTOMOBILE

Criteria	Degree to Which Charts Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?		X	
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?			X
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Presentation of a Chart Concerning the Cooling System of the Automobile

The fourth suggested unit of learning for automobile mechanics involves the cooling system of the automobile. Only one chart was found that was deemed worthy of attention. A chart available from the National Carbon Company illustrated in full color and twenty-three by thirty inches in size shows the cooling system and its features and represents no particular make of car. This chart also shows a cut-away view of the complete cooling system of the automobile which includes the radiator, water pump and hose, water distribution tube, and the action of the cooling process around the valves and cylinder walls. A cut-away of an automobile heater is included as part of the main feature of the cut-away engine. The most common places for leaks in the cooling system are labeled, along with the entire parts of the cooling system. Points of trouble resulting from cooling system neglect are emphasized by pictures of fan belt inspection, air suction test, a close-up view of clogged water tubes, sludge in the crankcase, corroded pistons, blown head gaskets due to defective thermostat, and other common causes.

For a course in automobile mechanics, the chart concerning the cooling system should prove to be extremely valuable as an instructional aid. This chart is accurate in facts and free of exaggeration.

Presentation and Evaluation of a Chart Pertaining to the Fuel System of the Automobile

The fifth unit of learning as suggested for automobile mechanics is the fuel system. A chart concerning the automobile fuel system prepared by the General Motors Corporation gives a very good illustration of the process of the fuel system. This chart is available to instructors of automobile mechanics and is in full color and is twenty-two by thirty-four inches in size. To simplify the automotive fuel system, the following procedure was used. The automotive fuel tank is represented by a water storage pond, and a suction water pump connected to the water storage pond illustrates the automotive fuel pump. To associate the principle of the carburetor with condensation, a fan is shown blowing on water coming from the water pump and in like manner a cut-away view of the carburetor shows a mixture of air and fuel through a low and high throttle. To fully appreciate the content of this chart concerning the automotive fuel system, the proverb that one picture is worth a thousand words would be justified in the presentation and explanation of this chart.

The chart concerning the fuel system of the automobile has been prepared in such a manner as to be an effective instructional aid. The aid has been designed to promote the learner's education rather than sales.

Presentation and Evaluation of Charts Concerning the Electrical System of the Automobile

The sixth unit of learning for automobile mechanics is the electrical system. The principles of battery composition are not given in any one chart; althoughmany types of reference material have been presented in the course of this study that might prove of value in teaching this phase of the electrical system.

Through the courtesy of the Packard Motor Car Company three charts pertaining to the starting and generating systems of the automobile are available to instructors of automobile mechanics. A chart prepared by the Packard Motor Car Company is devoted to the charging circuits of the Packard automobile. Two types of generators are included in this chart and they are the Auto Lite and Delco Remy generators. A second chart included in this group of charts, twenty-five by thirty-six inches in size, shows excellent exploded views of the generator. A third black and white chart prepared by Packard has exploded and sectional views of the starting motor as used on Packard automotive equipment.

The third phase of the study of the automotive electrical system is designated as ignition, lighting, and other electrical accessories. There are seven charts available pertaining to this phase, as follows: A twenty-two by thirty-four inch, fully colored chart published by the General Motors Corporation presents a complete electrical wiring system of

the automotive engine. Included in this chart are views of the distributor, ignition switch, and cut-away coil. The secondary and primary circuits are in different colors to show better the route of travel of electrical power. A second chart on the ignition, lights, and electrical accessories of the automobile is available from the Chrysler Corporation. This black and white, twenty-four by thirty-seven inch chart has pictures of the various adjustments of the distributor such as the internal resistance test with a voltage meter, the breaker arm tension test, and the setting of breaker points with the feeler gauge. In this chart is a double-sized illustration of the distributor including principles of spark advance adjustment. The Packard Motor Car Company has developed five charts devoted to the ignition system, lighting system, and other electrical accessories. These charts, twenty-five by thirty-six inches in size, are produced in black and white color and include diagrams concerning engine compartment wiring, driver's compartment wiring, rear chassis and body wiring. The last two charts referred to show diagrams of the ultramatic and overdrive electrical control as found on the Packard car.

Table 33 presents information pertaining to the charts previously described. The companies from which the charts may be obtained are also listed. From the sources indicated in the table, it was found that there are no charts published that relate directly to the battery as used in the modern

TABLE 33

INFORMATION CONCERNING THE AVAILABILITY OF CHARTS FROM THREE MANUFACTURERS OF AUTOMOBILES PERTAINING TO THE ELECTRICAL SYSTEM OF THE AUTOMOBILE

Source	Number of Charts Published			Availability of Charts for School Use		
	Battery	Starting Generator Systems	Ignition Lighting Electrical Accessories	Free	Fixed Cost	Not Available
General Motors			1	X		
Chrysler Corporation			1	X		
Packard Motor Company		3	5	X		

motor car. While three charts are available to instructors of automobile mechanics concerning the starting and generating systems of the automobile, it was found that seven charts are available for use in courses in automotive mechanics that pertain to the ignition, lighting, and electrical accessories of the automobile. It has been established that ten charts are available free of cost to teachers of automobile mechanics concerning the electrical system of the automobile.

Included in Table 34 are ten evaluative criteria of measure. The group of charts concerning the electrical system of the automobile are evaluated to determine the value or probable value of these aids. As indicated by the data shown in the table, it may be said that the group of ten charts pertaining to the electrical system of the automobile are an improvement over some of the existing types of presentation because a group of students may be shown material illustrated on a chart of ample size throughout the process of a demonstration. It is also true that the charts pertaining to the automotive electrical system are of a size convenient for school use and do present material too recent for available textbooks. Since there is a constant change of theory and an improvement in the construction of automotive electrical systems, such charts are of great value. (See Table 34 on page 106.)

Presentation and Evaluation of Charts Concerning the Lubrication System of the Automobile

The lubricating system of the automobile is adequately illustrated and treated by nine charts obtainable from commercial sources. The Chrysler Corporation has published five charts concerning automotive lubrication. These charts are twenty-four by thirty-six inches in size and are in color. Chart 1 illustrates a complete Chrysler automobile chassis,

TABLE 34

AN EVALUATION OF TEN CHARTS PERTAINING TO THE ELECTRICAL SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Charts Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Does the aid implement student and curricular needs?			X
4. Does the aid have accuracy of facts and freedom from exaggeration?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?		X	
9. Does the aid, or cut-away, give a true picture of the principle or ideato be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

including the frame, front end, engine, transmission, drive shaft, and differential with springs. The various parts requiring lubrication as a result of mileage are labeled. Close-up pictures on this chart illustrate points of lubrication such as the water pump, distributor, generator, steering gear, pedals, gear shift linkage and bell crank. Other points shown that require lubrication are upper and lower control arms, king pin, tie rod, wheel bearings, air cleaners, transmission and universal joints. Miscellaneous lubrication information is also included on this chart.

Chart 2 prepared by the Chrysler Corporation concerns the lubrication of the Dodge automobile. A phantom view of the complete automobile is shown with emphasis placed on the various parts requiring lubrication. Other lubrication parts are pictured in close-up views which are the oil filter air cleaner, carburetor air cleaner, steering gear, steering knuckle king pins, and upper and lower control arms. Also included in the close-up views are the brake and clutch pedals, gear shift and pedal linkage, oil filter, generator, distributor, gear shift rod end and speedometer cable. Additional close-up views of automotive parts requiring lubrication are shown on this chart.

Chart 3 released by the Chrysler Corporation is devoted to lubrication of the Plymouth automobile. Included on this chart are close-up views concerning points of lubrication such

as the hood latch, front seat mechanism, hood hinges, door lock and sticker plates, luggage compartment latch, distributor, generator, speedometer and cable, front wheel bearings, rear wheel bearings, transmission and rear axle, universal joints, carburetor air cleaner, oil filter inlet and outlet, steering gear, and the water pump. There is other information concerning Plymouth lubricating principles included on this chart.

Chart 4 by the Chrysler Corporation presents a phantom view of the V-8 type of engine and has the lubricating system route marked by color that contrasts with the other colors to emphasize the route of engine lubrication. Also included on this chart is the oiling process of the hydraulic valve and rocker arms. This chart is divided into six sections, each section devoted to some special oil retaining seal as used on the automobile. These oil seals are illustrated by use of cut-away pictures and show leather-spring-loaded oil seal, leather with felt washer spring-loaded seal, synthetic rubber steel reinforced seal, leather-plain seal, synthetic rubber spring-loaded seal and synthetic rubber spring-loaded seal as used on the timing case cover. With each of the various type of seals, additional information concerning their purpose on the automobile is included. The International Harvester Company has available a colored, twenty-four by thirty-eight inch chart showing the forced

oiling system of a four cylinder engine. This chart illustrates a phantom view of the engine that adds interest and attention to the oiling system, and it is further emphasized by use of a contrasting color. Although burdened with advertisement, good use can be made of this chart on the engine oiling system. The Ford Motor Company has prepared three charts concerning lubrication of their automobiles, the Ford, Mercury, and Lincoln. These technical publications printed in full color are suitable wall charts being of a size twenty-four by thirty-six inches. Each of these charts contain phantom views of each model of car with the points of lubrication labeled. With the exception of lacking close-up views of various lubrication points, these are good charts for use in teaching automobile mechanics at the secondary school level.

The economy of operation and durability of automotive equipment bear heavily upon proper lubrication at given intervals of time and mileage to which the automobile is subjected. Concerning the unit of learning on lubrication for automobile mechanics, three manufacturers of automotive equipment were questioned through correspondence as to the various charts they had published and made available to instructors of automobile mechanics.

Table 35 lists three sources of commercial instructional aids and the availability of such aids from each source. The

TABLE 35

INFORMATION CONCERNING THE AVAILABILITY OF CHARTS FROM THREE MANUFACTURERS OF AUTOMOTIVE EQUIPMENT PERTAINING TO THE LUBRICATION SYSTEM OF THE AUTOMOBILE

Sources	Number of Charts Published on Lubrication	Availability of Charts for School Use		
		Free	Fixed Cost	Not Available
Chrysler Corporation	5	X		
International Harvester	1	X		
Ford Motor Company	3	X		

availability of charts concerning the lubrication system of the automobile has been indicated as free. Table 35 lists the three sources from which nine charts concerning the lubrication system may be obtained.

Table 36 contains information showing the degree to which the charts met the criteria used to determine the ultimate usefulness of the instructional aids previously presented concerning the lubrication system of the automobile. It was found after examining this group of charts that they do lend themselves to being excellent instructional aids. As in the case of other charts evaluated in this study, improvements from year to year are made on each car manufactured;

TABLE 36

AN EVALUATION OF NINE CHARTS PERTAINING TO THE LUBRICATION SYSTEM OF THE AUTOMOBILE

Criteria	Degree to Which Charts Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?			X
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

therefore, instructional aids prepared for maintenance and repairmen in the automotive field must be published at given intervals to supply this needed information.

Presentation and Evaluation of Charts Relating to Trouble Shooting and Tune-up of the Automobile

Trouble shooting and tune-up are included in the eighth unit of learning suggested in the course of s tudy for automobile mechanics as a phase of industrial arts; although no charts were secured that are directly related to this phase of automobile mechanics, other charts pertaining to the various units of the automobile could be used to emphasize points of trouble shooting and tune-up. The charts that are included in this study are of a nature that such a substitution could be made.

Presentation and Evaluation of Charts Pertaining to Minor Body Repairs of the Automobile

The ninth unit of learning recommended for automobile mechanics is minor body repair. Seven charts on this subject were found to be available. A twenty-two by thirty-four inch chart available from the General Motors Corporation illustrates an exploded view of an automobile body. Two other views included on this chart have to do with the inner construction of automobile bodies. The Chrysler Corporation has available six charts pertaining to body construction and refinishing. These charts are twenty-four by thirty-seven inches in size and are in black and white color. The first chart concerns body service including sealing points, hood and fender alignment and deck lid fitting. The second chart

has pictures of quarter panels on the 1953 model automobiles manufactured by Chrysler. Another chart concerns the various methods of proper car care and illustrates, in the main, care and maintenance of automotive paint. The fourth chart has pictures of various paint conditions among which are peeling, checking, wrinkling, blistering, fish eyes, and cracking. These paint conditions are presented with suggestions for the prevention of such defects. The last two charts published by the Chrysler Corporation have pictures of windshield construction on the latest models of the Chrysler products, and the latest methods of sealing windshields.

On the secondary school level, much interest will be displayed by students interested in minor body repairs of the automobile. Instructional aids concerning this phase of the maintenance and repair of an automobile must be interesting and informative. Table 37 contains information concerning the value or probable value of this group of charts as instructional aids for use in a secondary school automobile mechanics course. As shown in the table, the charts pertaining to minor body repair of the automobile met each criterion to a moderate degree.

TABLE 37

AN EVALUATION OF SEVEN CHARTS PERTAINING TO MINOR BODY REPAIR OF THE AUTOMOBILE

Criteria	Degree to Which Charts Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available text-books?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?		X	
5. Is the aid available?			X
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

Presentation of Charts Concerning General Related and Technical Information of the Automobile

The first phase of related and technical information concerning the automobile usually taught has to do with general information. Opportunities in the automotive industry are clearly pictured in a chart prepared by the General Motors Corporation. This chart is twenty-two by thirty-four inches in size and emphasizes the opportunities made possible by the automotive industry by using the tree as an example in which the automotive industry represents the main body of the tree, the roots depict the suppliers, and various services and associated businesses are indicated by branches of the tree.

Presentation of Charts Pertaining to Automobile Design and Construction

A second phase of related and technical information usually taught has to do with automobile design and construction. General Motors Corporation through the use of a black and white, twenty-two by thirty-four inch chart, shows the various stopping distances of automobiles traveling at different speeds over various road conditions. The Chrysler Corporation has published numerous twenty-four by thirty-seven inch charts pertaining to automotive design and construction. One chart contains cut-away views of a transmission equipped with overdrive and another chart

published by the Chrysler Corporation gives the wiring diagram as related to automatic overdrive. The various positions of the hydraulic transmission are presented in another chart by Chrysler. A chart concerning torque converters, presented in color, illustrates this system. The Chrysler Corporation also has a chart covering fluid torque drive which has pictures of a cut-away transmission and of the exploded torque converter. Another chart has been prepared concerning the torque converter oil flow. An exploded view of the power steering gear assembly is shown by another chart prepared by the Chrysler Corporation. Other charts published in full color by Chrysler give exploded views of the oil pump assembly for power steering, action of left turn power steering, and a chart concerned with straight ahead position of power steering. Another chart published by Chrysler pertaining to this phase of automobile mechanics involves the oil flow of a right turn by power steering.

Presentation of Charts Concerning Power Plants and Accessories of Automotive Equipment

A third phase of related and technical information of the automobile usually taught concerns power plants and accessories. Six charts have been published that could be used to teach this unit. General Motors Corporation has published these charts and they include a chart illustrating nine varieties of engines; a chart illustrating the difference

in the number of cylinders of an engine as to its effectiveness in comparison with the paddles on a river boat. One cylinder engines versus sixteen cylinder engines are separately illustrated on this chart. A third chart shows the difference in strokes of two and four cycle diesel engines. The fourth chart available from the General Motors Corporation illustrates the percentage of efficiency of various types of engines. The fifth chart presented by the same company illustrates the processes through which parts of the automobile undergo to form a complete automotive unit. The last of this series of charts has pictures of the various type of automotive vehicles manufactured from 1600 to 1949. Sixteen models of automobiles included on this chart show the improvements that have been made through years of experimentation. This is, in actuality, a progress chart of the automotive industry.

Twenty-one charts have been presented that pertain to related and technical information of the automobile. Table 38 contains information as to the number of charts concerning each phase of related and technical information of the automobile that are available to instructors of automobile mechanics. In this table only two commercial sources are listed, and they make available a total of twenty-one charts containing technical and related information. The complete

address of sources listed in Table 38 may be found in the Appendix of the study.

TABLE 38

INFORMATION CONCERNING THE AVAILABILITY OF CHARTS CONCERNING TECHNICAL AND RELATED INFORMATION PERTAINING TO AUTOMOTIVE EQUIPMENT

Source	Number of Charts			Availability of Charts for School Use		
	General Information	Design Construction	Power Plants	Free	Fixed Cost	Not Available
General Motors Corporation	1	1	6	X		
Chrysler Corporation		13		X		

Table 39 shows the extent to which the previously mentioned charts concerning technical and related information pertinent to the automotive equipment met the criteria used to determine their use or probable use as instructional aids. As shown in the table, the twenty-one charts containing technical and related information pertinent to automotive equipment met each criterion of measure to a satisfactory degree. The presentation of information contained in this group of charts would be very difficult for an instructor of automobile mechanics without the use of such aids similar to those presented.

TABLE 39

EVALUATION OF CHARTS PERTAINING TO RELATED AND TECHNICAL INFORMATION OF AUTOMOTIVE EQUIPMENT

Criteria	Degree to Which Charts Met Criteria		
	No	Moderately	Yes
1. Is the material presented too recent for available textbooks?			X
2. Does the aid promote the learner's education rather than sales?			X
3. Is the aid accurate in facts and free from exaggeration?			X
4. Does the aid implement student and curricular needs?		X	
5. Is the aid available?		X	
6. Is the aid simple, concise, and clear?		X	
7. Is the aid of a size convenient for use?			X
8. Does the aid, or cut-away, show working parts of the automobile that cannot be seen unless the machine is torn down?			X
9. Does the aid, or cut-away, give a true picture of the principle or idea to be presented?			X
10. Is the aid an improvement over existing types of presentation?			X

A large number of manuals, brochures, and charts were found to be available and free of charge from commercial sources manufacturing automobiles and accompaniment parts. By use of the criteria previously developed, it is believed that these aids would prove to be indispensable in the teaching-learning process of automotive mechanics at the secondary school level.

CHAPTER V

SUGGESTIONS CONCERNING THE DEVELOPMENT OF AN INSTRUCTIONAL AID NOT AVAILABLE FROM COMMERCIAL SOURCES

After studying and evaluating the various instructional aids for automobile mechanics available from commercial sources, an effort was made to develop additional instructional aids because the average cut-away of an automobile is not available from manufacturers of teaching aids for school use. Usually a course in automobile mechanics includes a study of the various phases of the running system, power system, power train, cooling system, electrical system, and lubrication system of the automobile.

The cut-away aid, to be described later in the study, was developed using a 1940 Plymouth engine, clutch system, differential, and accompanying parts and additional instructional aids were made from these units that could be used in teaching units of learning concerning the braking system, power system, power train, cooling system, electrical system, and fuel system. For the purpose of this study, a color guide was used to denote the several units of the

automobile for which aids were developed and presented. The colors are as follows: red was used to show an actual cut concerning a unit or principle of the automobile; yellow was used to indicate the electrical system; blue was used to illustrate the flow of the cooling system; and black and aluminum paint were used to paint the rest of the portion of the aid.

In planning the development of this aid, consideration was given to the fact that many industrial arts shops would have a limited amount of equipment available to develop cut-away aids showing the various sytems of the automobile. The aid, as presented, was developed by using a power hack saw, a metal band saw, combination welding and cutting equipment, a heavy duty hand grinder equipped with a carborundum wheel, and miscellaneous hand tools. An individual with access to combination welding and cutting equipment, a grinder, and miscellaneous hand tools, could do an adequate job of developing the instructional aid to be presented. The possible use of the various cut-aways presented in this study will be mentioned as related to the units of learning recommended in Chapter II.

Instructional Aids Pertaining to the Braking System of the Automobile

The hydraulic braking system of the automobile is divided into two sections, the master cylinder, and the wheel

cylinder. Figure 1 is a cut-away view of the master cylinder, showing the relation of the various parts which would be impossible to show unless the complete master cylinder was dismantled. Figure 2 is a cut-away view of the second phase of the braking system. This phase includes the wheel cylinder action with the brake shoes against the brake drum. This too would be impossible to show without dismantling.

Instructional Aids Pertaining to the Power System of the Automobile

Engine principles, parts, and functions should be readily seen through the use of the various cut-away sections as shown in Figures 3, 4, 5, and 6. Figure 3 gives a general view of the cut-away engine. This cut-away permits one to see the harmonic balancer, timing chain cover, and manifold. Explaining the firing system is necessary for a complete understanding of the principles of an engine. This may be simplified by cutting the engine head in three sections as shown in Figure 3. The first section of the head is tilted to approximately thirty degrees. The second section rests on one inch spacers, and the third section is flat on the block. A six volt bulb and receptacle are secured to each spark plug and the spark plug wire is replaced on each spark plug with the remaining ends set in the distributor cap. A contact brush made of wire is soldered to the distributor rotor and a six volt battery is connected to the

Fig. 1.--Master cylinder cut in half

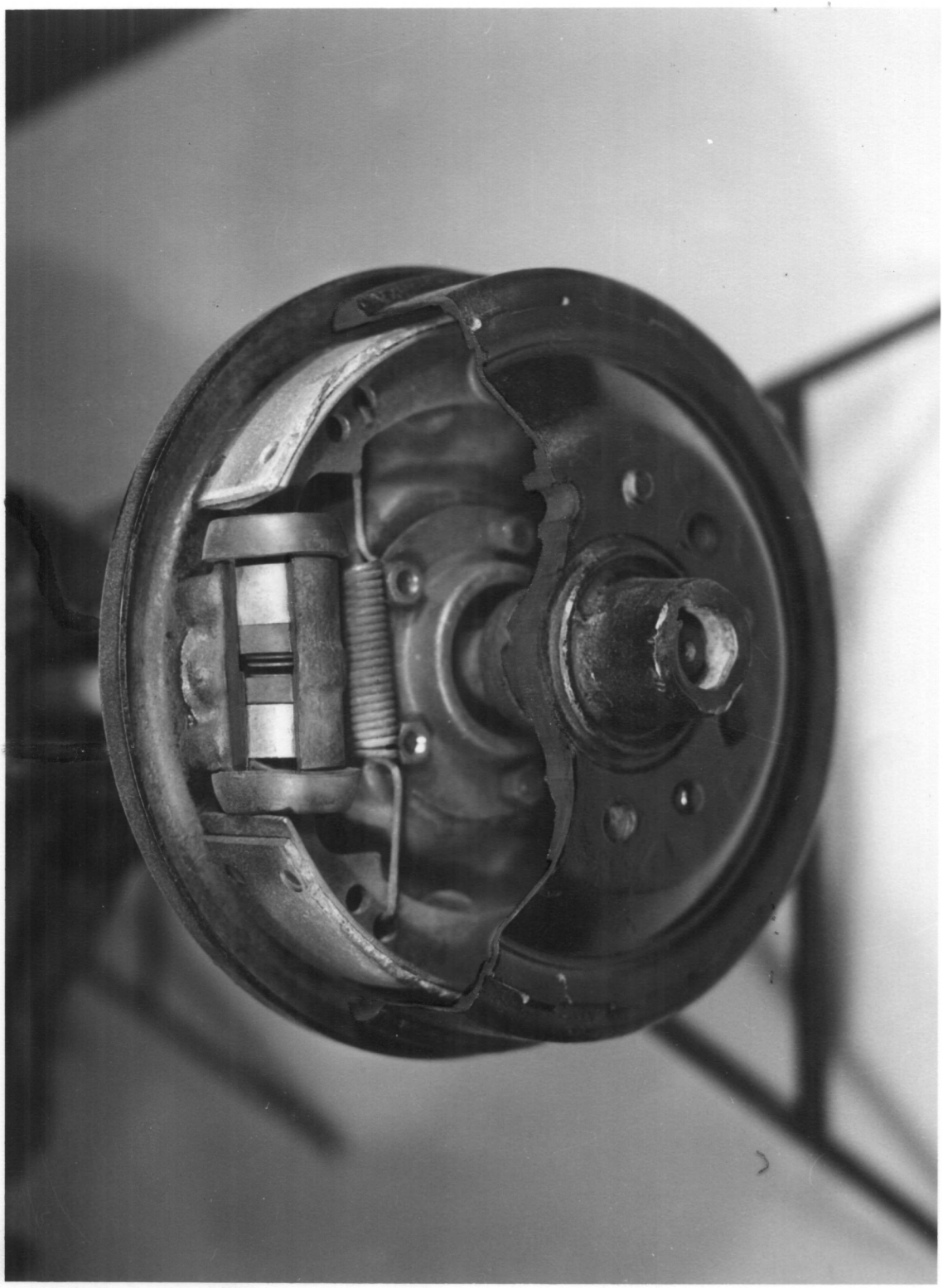

Fig. 2.--Illustration of brake drum and wheel cylinder

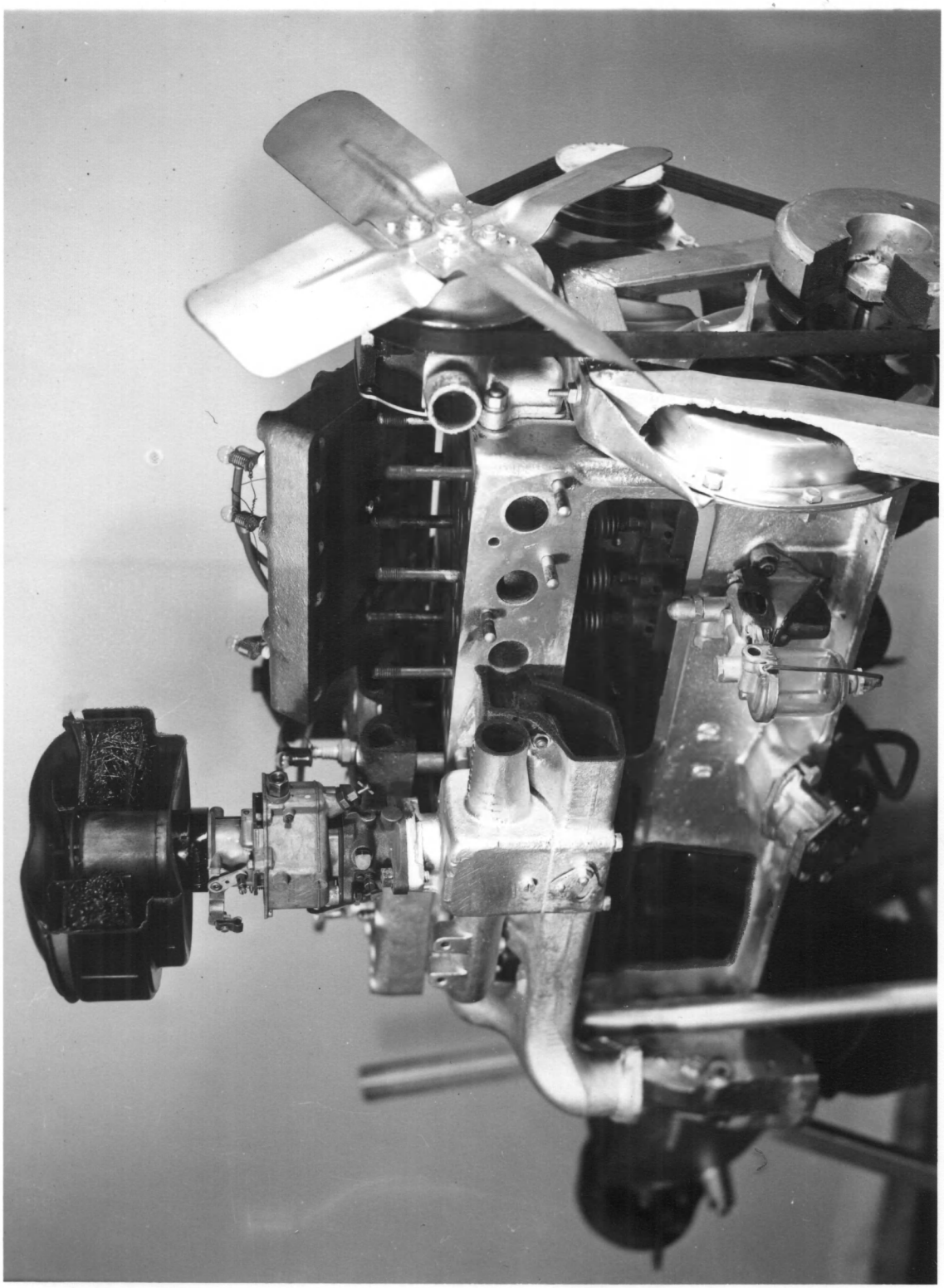

Fig. 3.--Illustration showing firing system of the automobile engine.

coil wire running to the distributor cap. By this method each bulb will light up in the same sequence as each spark plug fires as the engine is rotated.

Figure 4 is a view of the cut-away engine with the head removed. An angle cut of any piston will show the wrist pin action as the engine is rotated. Figure 4 also shows a cut-away of the exhaust valve and exhaust valve chamber.

Figure 5 is a close-up view of the harmonic balancer and the timing chain cover made possible by using a cut-away. This cut-away shows the construction and relationship of this part to the power system. Figure 5 also shows the timing chain cover cut-away and permits a good view of the timing marks and gear ratio.

The principles of the camshaft and valve tappets may be more easily explained by a cut-away similar to the one shown in Figure 6. The oil pump principle may be clearly and easily seen by replacing the metal cover plate with clear plastic. This too may be seen in Figure 6.

Instructional Aids Pertaining to the Power Train of the Automobile

The upper half of the clutch housing may be removed, as illustrated in Figure 7, thus permitting a view of the clutch system. The clutch pressure plate has a section removed to show better the principle of the pressure plate against the clutch disc. Linkage may be connected to the clutch fork,

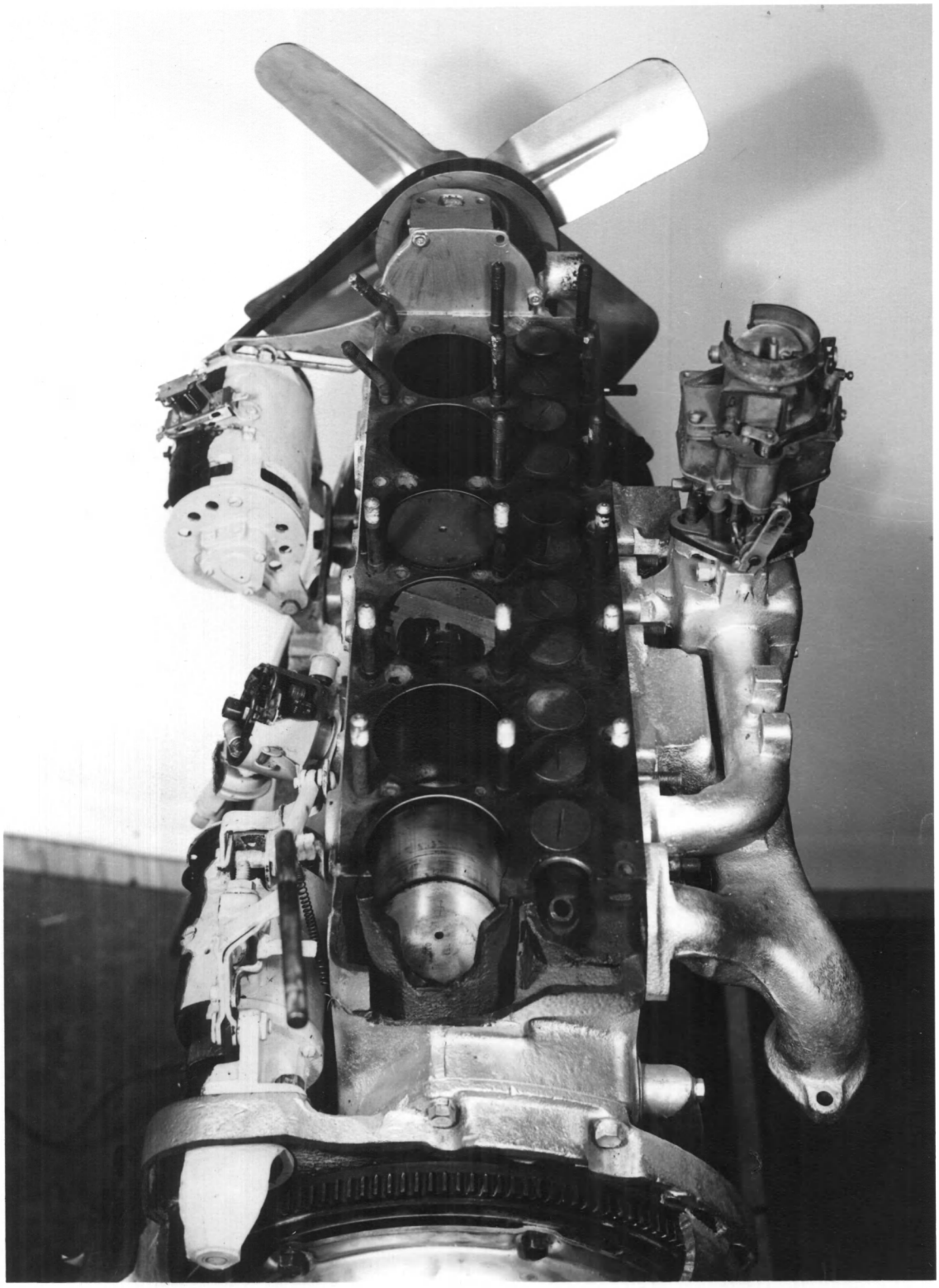

Fig. 4.--Illustration of pistons and exhaust valve chamber

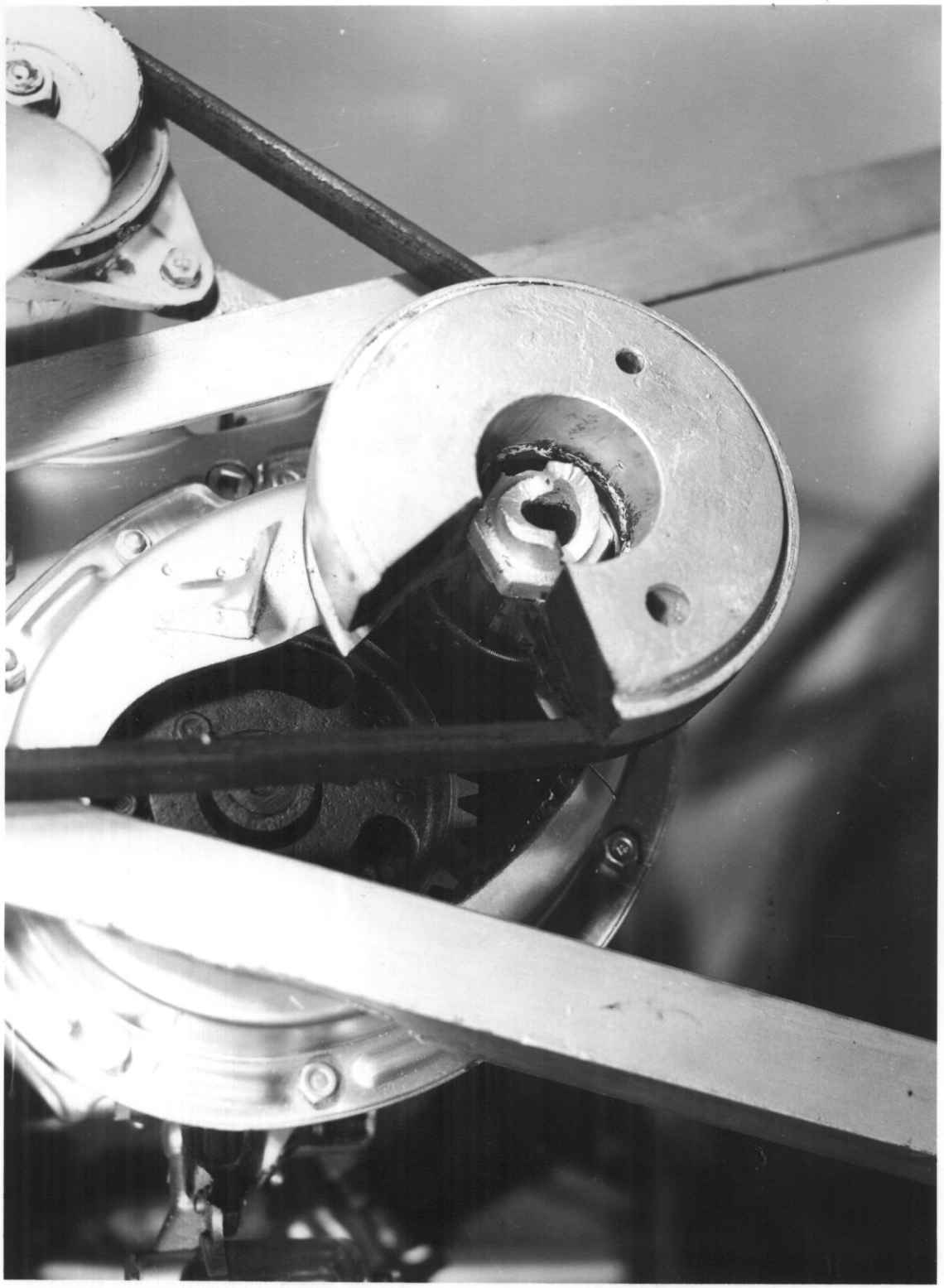

Fig. 5.--Illustration of harmonic balancer and timing chain cover.

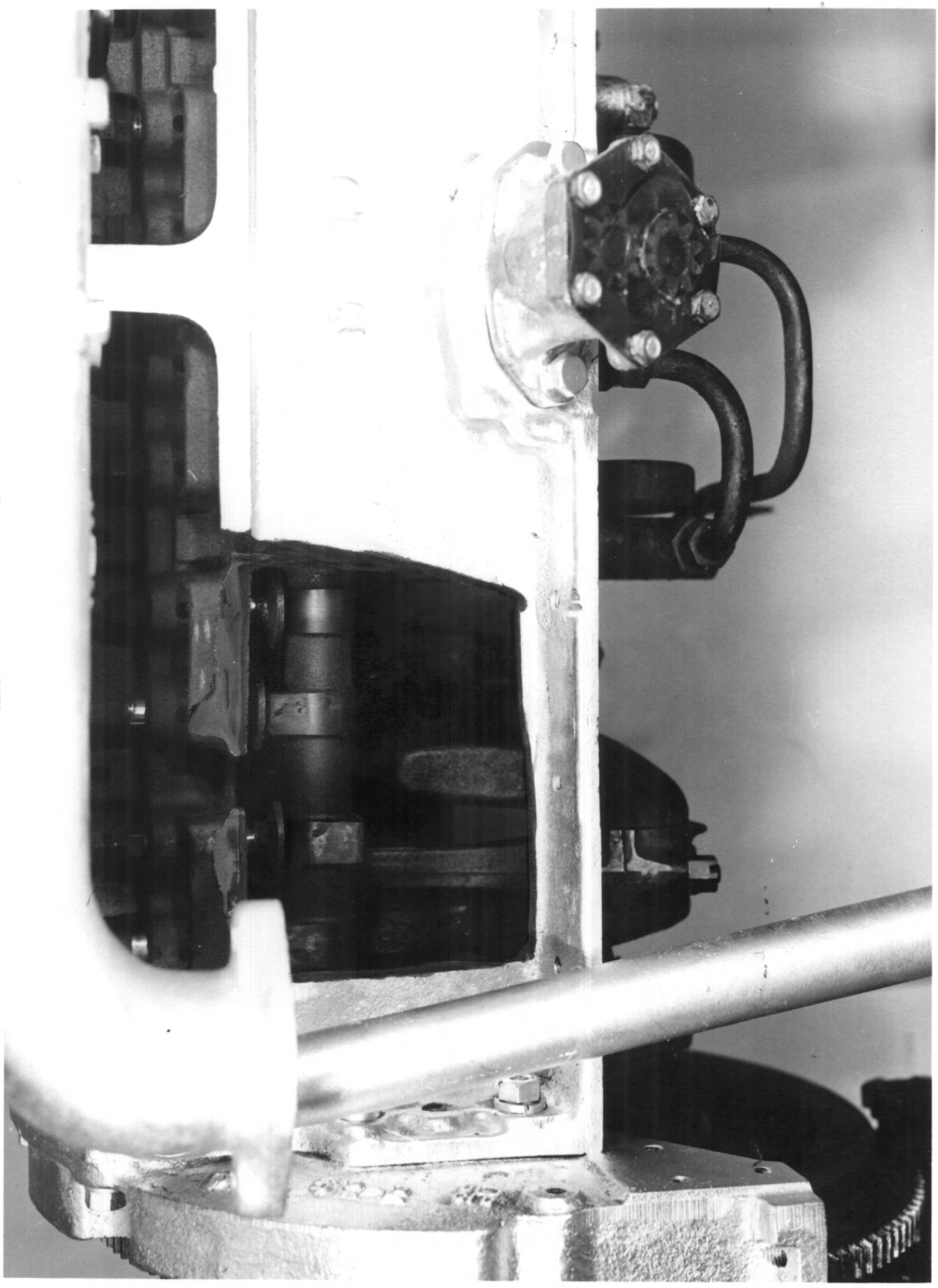

Fig. 6.--Illustration showing suggested cut to expose the engine cam shaft and valve tappets.

Fig. 7.--Illustration showing clutch system and transmission.

as shown in Figure 7 to demonstrate better the clutch system. Figure 7 also shows a view of the transmission cut-away. From the cut made on this transmission, all gear positions may be easily seen.

A cut-away illustrating the differential as shown in Figure 8 is convenient and occupies little classroom space. The entire top section of the differential housing and carrier assembly was removed to permit better visibility of the differential and to show its principles. A section of the wheel bearing housing was also removed to further the understanding of the differential.

Instructional Aids Pertaining to the Cooling System of the Automobile

The flow of the coolent through the various units of the cooling system may be readily seen by using a cut-away as shown in Figure 9, which is a cut-away illustration of the radiator. A cut-away water pump is shown in Figure 10. This cut-away gives an excellent view of the water pump propeller. The engine cooling system is further illustrated in Figure 11. The coolent travel in the engine head may be seen by dividing the head in three sections and elevating the sections at various angles and heights. The engine block cooling circulation, as shown in Figure 11, includes an end view of the water distribution tube, cylinder wall, and valve port cooling circulation.

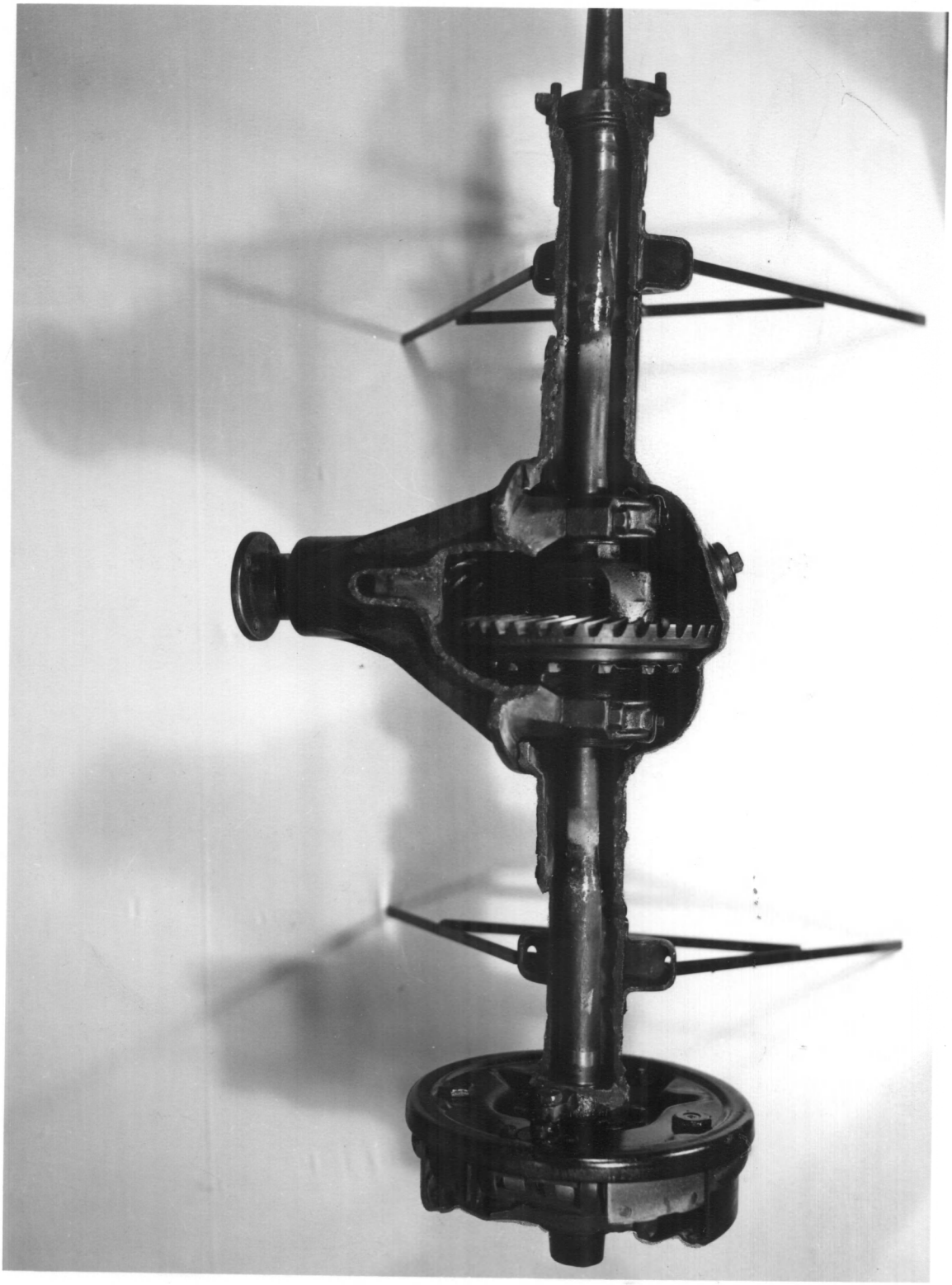

Fig. 8.--Illustration showing differential parts

Fig. 9.--Illustration of automobile radiator

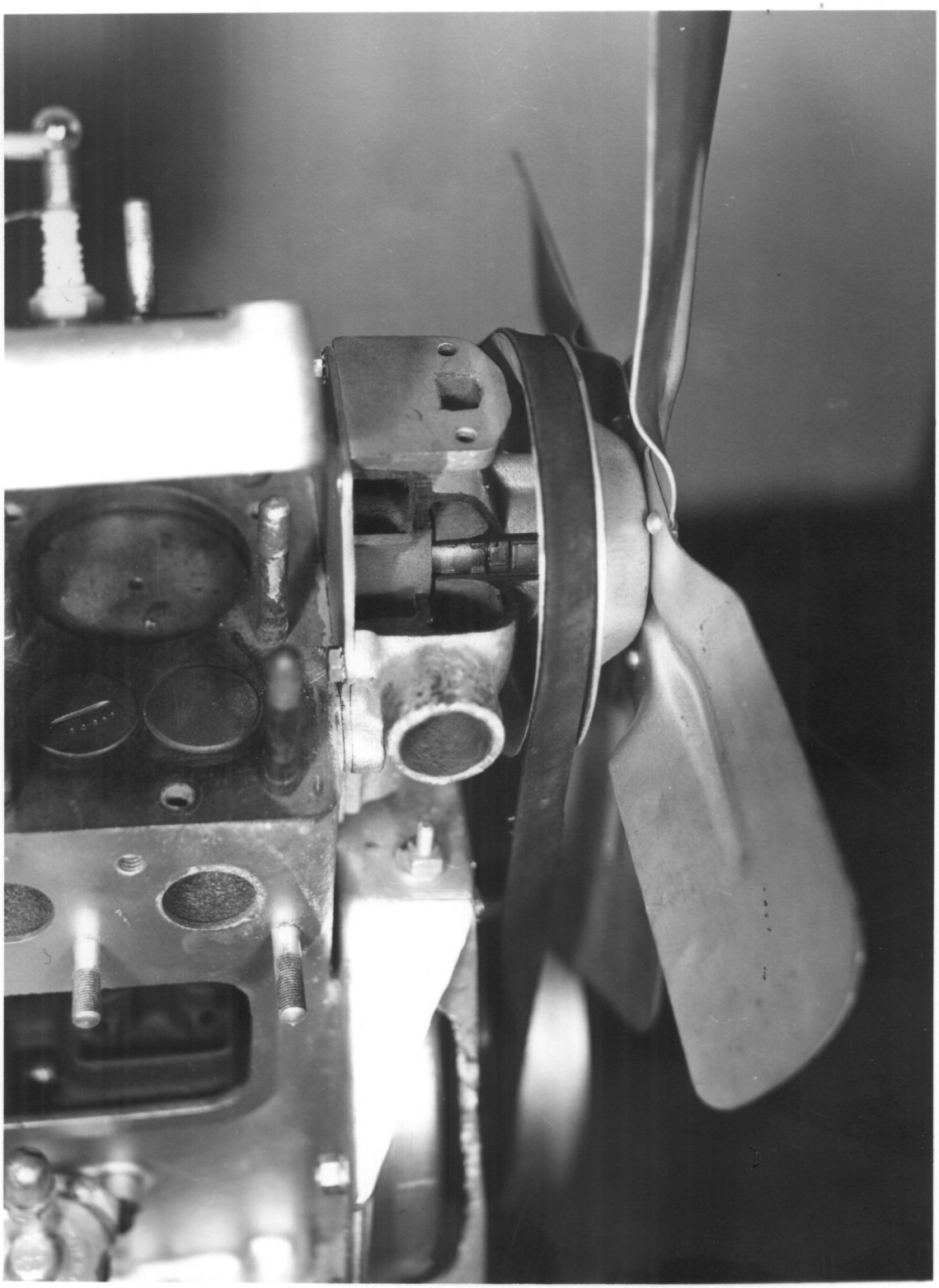

Fig. 10.--Illustration of engine water pump

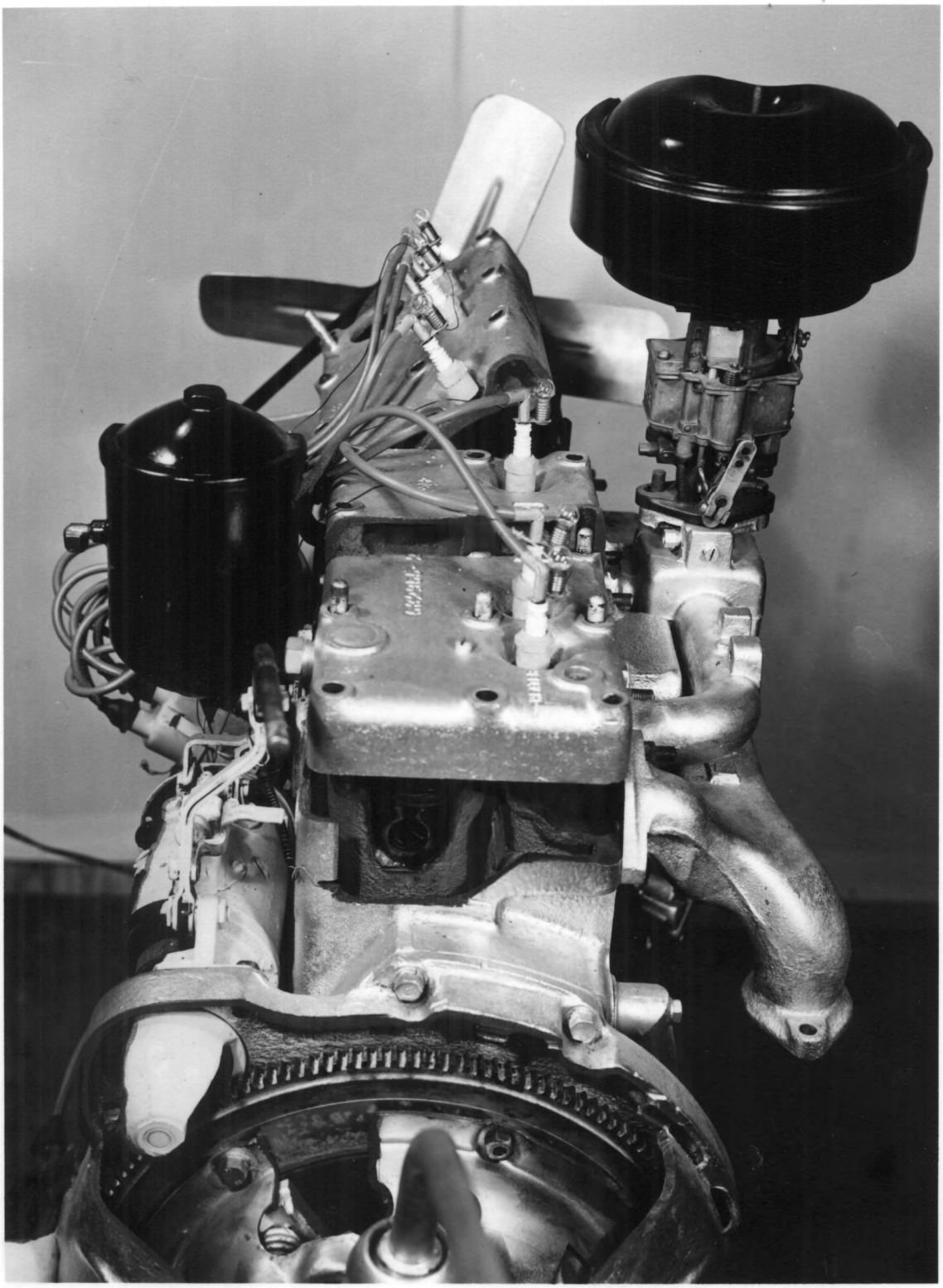

Fig. 11.--Illustration of engine cooling system

Instructional Aids Pertaining to the Fuel System of the Automobile

The fuel system, as shown in Figure 12, includes a cut-away view of the carburetor and air cleaner. The carburetor was cut, with the purpose in mind of introducing a liquid in the carburetor body and thereby have a better demonstration of the actual flow and mixture principles of the carburetor. Also shown in Figure 12, the fuel pump has a vertical cut so as to show the fuel pump diaphragm and diaphragm return springs.

Instructional Aids Pertaining to the Electrical System of the Automobile

The electrical system includes the starter, generator, coil, and distributor. Figure 13 includes a view of a cut-away coil, starter, and starter switch. A cut-away generator and distributor are illustrated in Figure 14. The cut-away distributor as shown in Figures 14 and 15 emphasize the vacuum spark advance unit and condenser. These cuts, as shown in the various figures, are only suggested, although the cuts shown in Figures 13, 14, and 15 will expose all working parts of the electrical system without requiring removal or dismantling of these units.

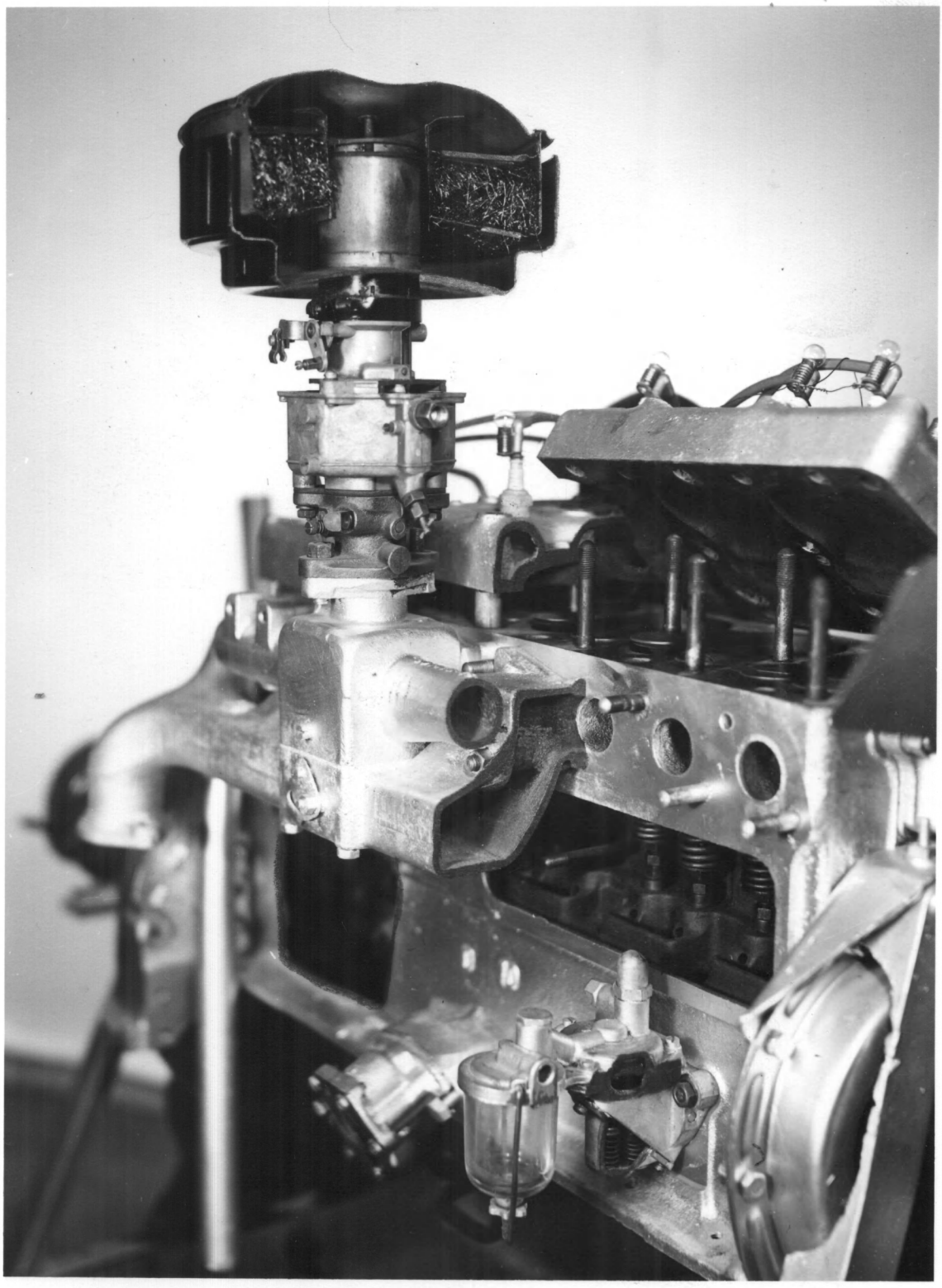

Fig. 12.--Illustration of engine fuel system

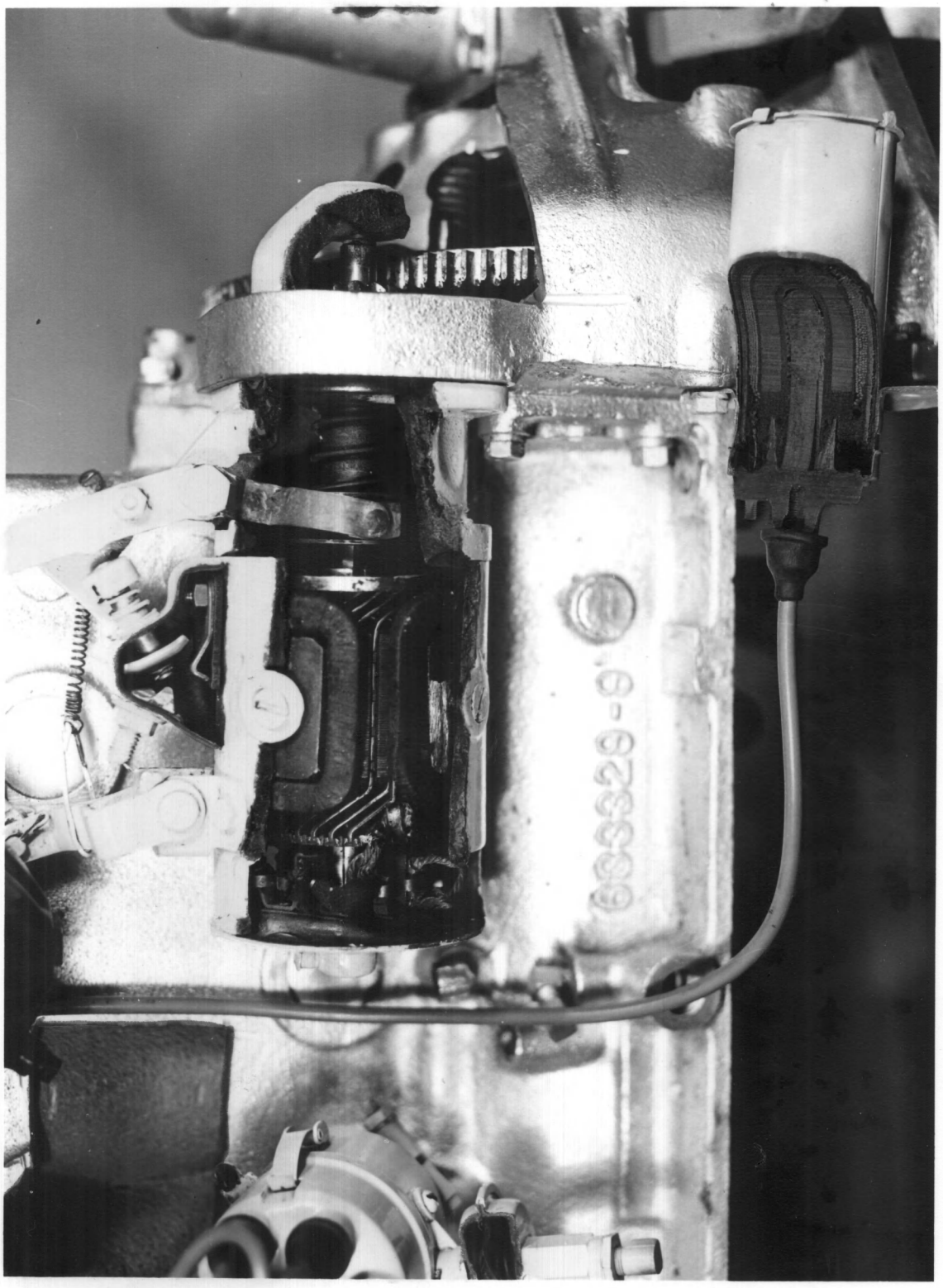

Fig. 13.--Illustration of engine starting system

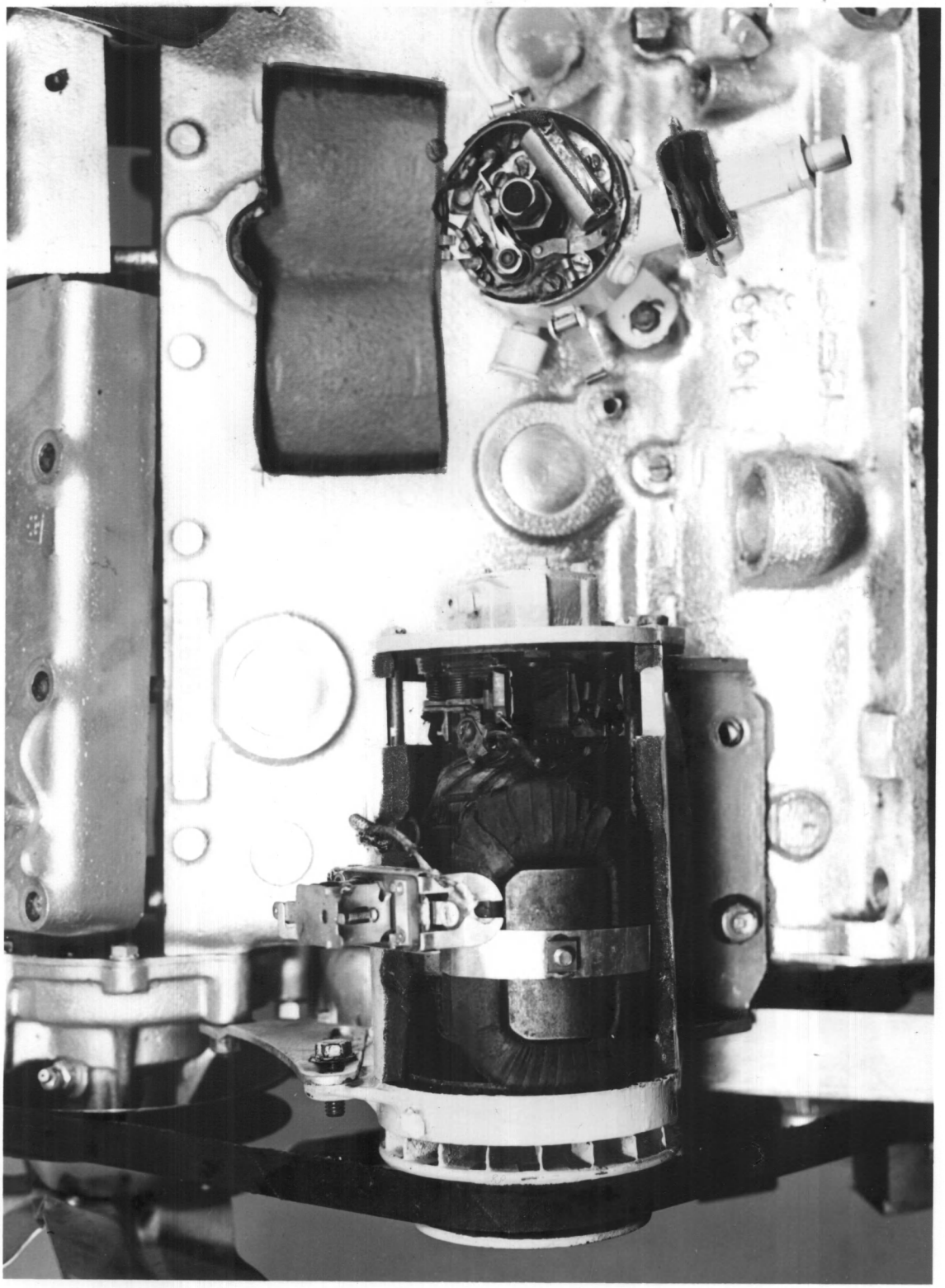

Fig. 14.--Illustration of engine distributor and generator.

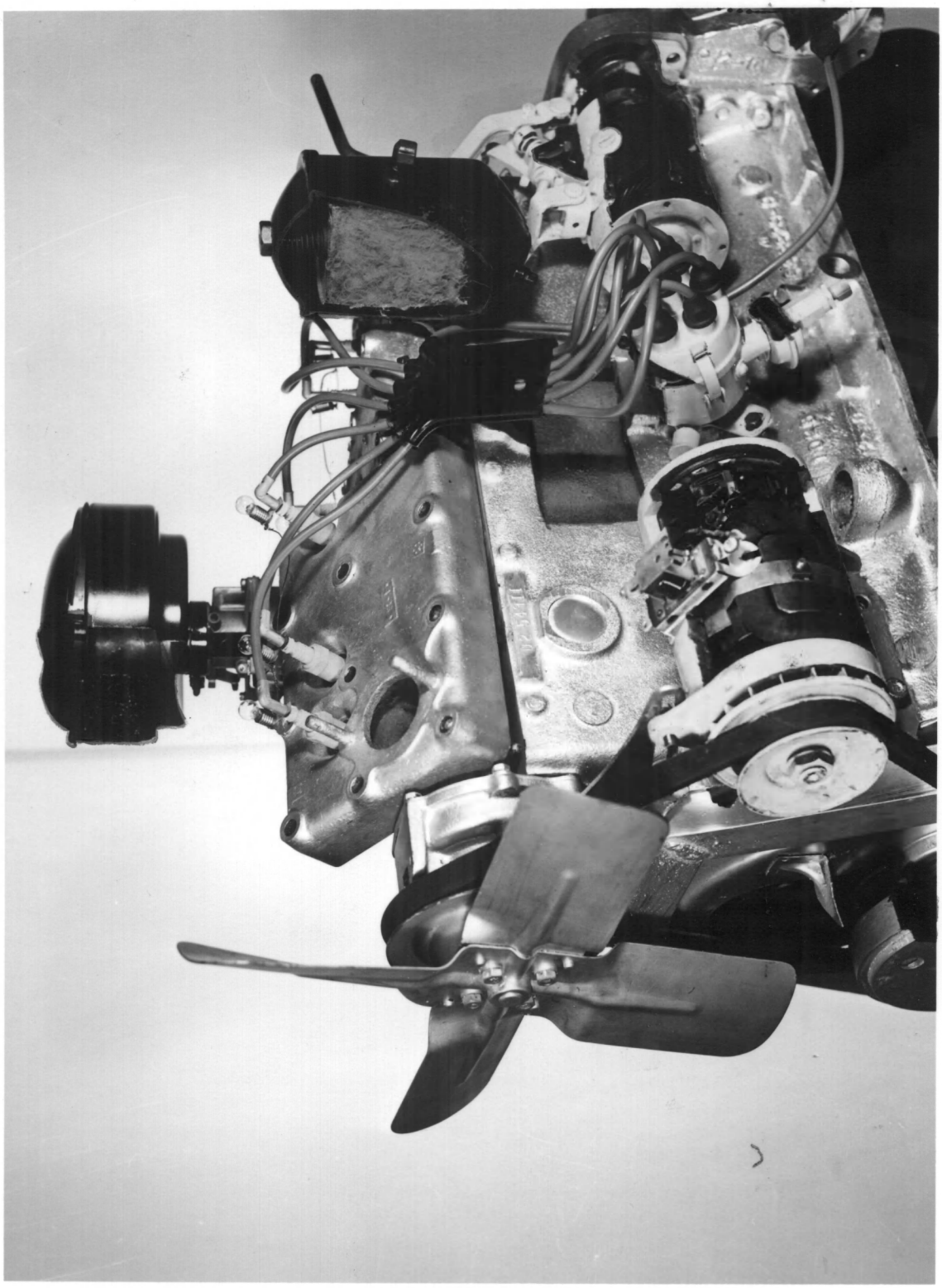

Fig. 15.--Illustration of complete engine electrical system.

Information Concerning Suggested Equipment and Method of Attaching an Electric Motor to Rotate the Cut-away Aid

One of the most common type of motors available that could be used to power the above mentioned cut-away aid would be a one-quarter horse power electric motor with 1,725 revolutions per minute. Figure 16 illustrates the installation of the motor to the fly wheel by the use of a discarded starter engaging gear from the same type of starter as used on the engine.

Sources of units available for reproducing the cut-away mentioned above are numerous. The Plymouth Division of the Chrysler Corporation finds it necessary sometimes to replace a complete engine, transmission, and differential assemblies during the warranty period of new automobiles because of some minor defect. By writing the Plymouth Division, a school will be placed on a list for various units that are replaced by the factory dealer in the surrounding school vicinity. These various units are supplied free of cost to schools for instructional purposes.[1]

A similar program has been offered by Pontiac Motor Division of General Motors. The following units may be purchased for instructional purposes: salvage engine assembly in the six cylinder model may be purchased for $90,

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[1]Letter from H. W. Breemer, Service Department, Plymouth Division, Chrysler Corporation, Detroit, Michigan.

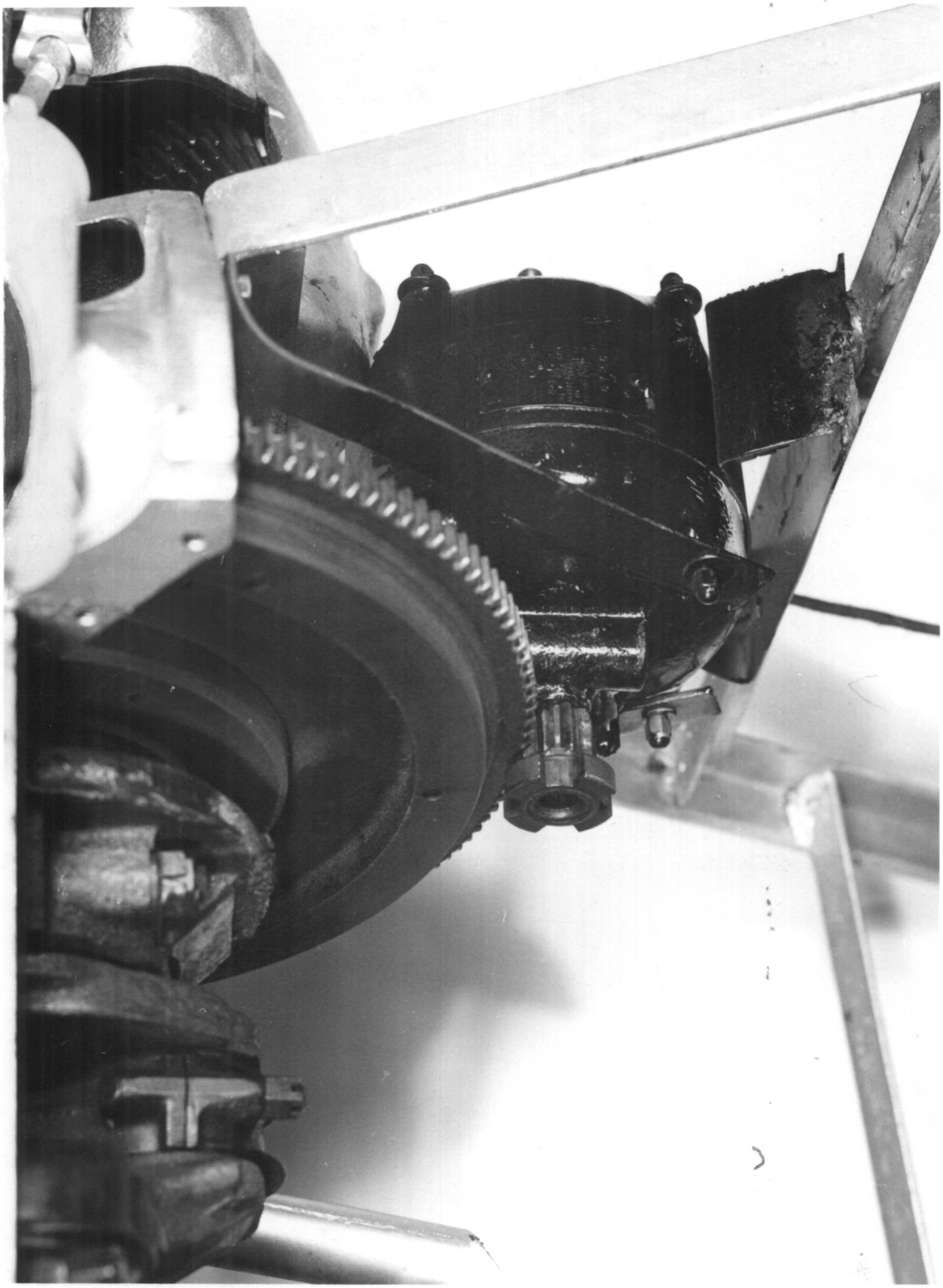

Fig. 16.--Illustration of electric motor installation on instructional aid.

and the eight cylinder engine for $100. Differentials are priced at $15 each, and transmissions are obtainable for $63.20 for the synchromesh which are new; rebuilt hydra-matic transmissions may be purchased for $100 each. Other training aids available from Pontiac Motor Division concern power steering. The steering gear costs $75 and the pump for power steering is priced at $25. These engine units available from Pontiac have failed to pass inspection for one reason or another and could not be used in regular production, but they are suitable for use in the classroom. The engine units are complete with starter, generator, distributor, spark plugs, spark plug wires, coil, fuel pump, carburetor, crankcase inlet and outlet, fan, water pump, and clutch.[2]

A third source of instructional aids suitable for developing cut-away aids and available to instructors throughout the country is a discarded automobile which may be obtained at a nominal cost. From this source an instructional aid covering all phases of the automobile may be developed.

Suggestions for the development of an instructional aid in the form of a cut-away have been presented in this chapter. The suggestions offered were made considering

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[2]Letter from B. R. Sweeney, Service Department, Pontiac Motor Division, General Motors Corporation, Pontiac 11, Michigan.

the amount of time, money, and equipment available for developing such an aid on the part of the instructor of automobile mechanics. Various other sources of instructional aids were presented, and from any one of these sources, a cut-away aid similar to the aid presented in this chapter could be developed.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The youth of this nation have a desire to learn more about the principles of automotive equipment, and in order to satisfy this need more courses in automobile mechanics are being taught as a part of the secondary school curriculum. To stimulate the learning process, instructional aids have proved to be valuable tools of instruction and are currently used in many subject matter areas.

Several studies were reviewed in Chapter I. These studies had an important bearing on this evaluation and the development of instructional aids. Included in one study were suitable phases of automobile mechanics instruction suggested for the secondary school level. Another study approached adequate methods of presenting industrial arts subjects by use of visual aids. The third study concerns the development of instructional aids for elementary electricity in industrial arts.

To satisfy the needs of this study, Chapter II contains a treatment of several suggested courses of study that have

been developed for automobile mechanics at the secondary school level. It was found in this study that units of learning have been developed and recommended to be used in the teaching of automobile mechanics at the secondary level in Texas.

In order to evaluate the instructional aids presented in this study it was necessary to develop criteria that could be used to arrive at the value or probable value of commercial instructional aids available for use in teaching automobile mechanics. Chapter III has a list of the criteria that were used in the evaluation of the aids presented in this study.

Some 290 different pieces of material were secured from manufacturers of automotive equipment and studied to determine if they could be used in teaching automobile mechanics. In Chapter IV they were presented and evaluated to determine their use or probable use as instructional aids for automobile mechanics.

After studying the various instructional aids available, it was apparent that additional instructional aids could be developed by an instructor of automobile mechanics. Included in Chapter V are sixteen illustrations describing the manner in which cut-away aids for automobile mechanics could be developed by a teacher. These aids were developed

with consideration given as to the amount of funds available and the type of equipment that may be found in the average industrial arts shop.

Conclusions

The following conclusions were formulated as a result of the study:

1. A timely unit of learning for automobile mechanics has been prepared and recommended for use in the secondary schools of Texas.

2. Instructional aids from commercial sources are available to teachers of automobile mechanics and most of the aids are free of cost.

3. Instructional cut-away aids may be developed at a nominal cost for use in teaching the principles of the modern motor car.

Recommendations

Based upon the results of this study, the following recommendations are made:

1. That a study be made as to the effectiveness of commercial aids and those developed by instructors in teaching automobile mechanics.

2. That a study be made of other types of commercial aids that could be satisfactorily used for automobile mechanics.

3. That teachers be made more aware of the commercial instructional aids that are available for use in teaching automobile mechanics.

4. That a study be made concerning the development of additional aids for automobile mechanics.

APPENDIX

List of Sources from Which Instructional Aids May Be Obtained for Use in Teaching Automobile Mechanics

A. Schrader's Son
Manager, Dealer Sales
470 Vanderbilt Avenue
Brooklyn 17, New York

Brochures Available from the Above Source:

McCore's Balancing Tricks, 1953
How to Use the Comparative Air Loss System, 1953
How to Certify Accuracy in All of Air Service Equipment, 1953
What Makes a Steady Customer Steady, 1953
Passenger Car Application, 1947
Every Tire Needs a New Tube, 1953

AC Spark Plug Division
General Motors Corporation
Director of Public Relations
Flint, Michigan

Service Manuals Available from the Above Source:

AC Fuel Pumps, 1953
Spark Plug Manual, 1953

American Petroleum Institute
Oil Industry Information Committee
50 West 50th Street
New York, New York

A Brochure Available from the Above Source:

Oil Serves You

American Society for Testing Materials
1916 Race Street
Philadelphia 3, Pennsylvania

A Brochure Available from the Above Source:

Selection and Use of Engine Antifreezes, August, 1952

Bear Manufacturing Company
Director of Public Relations
Rock Island, Illinois

A Service Manual Available from the Above Source:

Bear Heavy Duty Wheel and Steering Alignment Manual

Charts Available from the Above Source:

Official Standards (Wheel Alignment), 1951
The Wheel Alignment of Your Car--What It Is and How It Works
Tires Must Run Truly and Smoothly, May, 1942

Chrysler Corporation
Plymouth Division
Service Department
6334 Lynch Road
Detroit 31, Michigan

(All materials from Chrysler are available in a Technical Literature Kit, which is free to instructors of automobile mechanics from the Plymouth Division.)

Shop Manuals Available from the Above Source:

Chrysler Shop Manual, Models C51, C52, C53, C54, and C55
Chrysler Preliminary Shop Manual, 1953
Parts List for Chrysler Automobiles, 1952
DeSoto Shop Manual, Models S13, S14, and S15
DeSoto Shop Manual, Models S11, S13, and S14
DeSoto Shop Manual, Model S17, 1953
Dodge Shop Manual, Models D46, D44, D47, and D48
Plymouth Shop Manual, Models 46-53

Miscellaneous Service Manuals Available from the Above Source:

The NewPlymouth, 1953
Information about the New DeSoto, 1953
What You Should Know about the New Dodge, Models D33 and D34
Information about the New DeSoto
Facts about the New Chrysler, Code C-39
Chrysler Industrial Engines, 1953
The New Chrysler, 1953, Code C-45
Plymouth Hy-Drive Service Manual, 1953
Fuel Economy through Planned Driving, 1949
Body and Sheet Metal Reference List, 1949
Lubrication, 1950, Vol. 3, No. 5

Brake Shoe Adjustment, Vol. 3, No. 6
Gauges, 1950, Vol. 3, No. 7
Convertible Tops, 1950, Vol. 3, No. 8
Unusual Cases, 1950, Vol. 3, No. 9
All in a Day's Work, 1950, Vol. 3, No. 10
Fixin' Facts, Vol. 3, No. 11
Ignition System Servicing, 1950, Vol. 3, No. 12
Hydraulic Transmission Maintenance, Vol. 4, No. 1
A Close Look at the 51's, Vol. 4, No. 3
Windshield Service, Vol. 4, No. 4
Windshield Wipers, Vol. 4, No. 5
The Paint Story, Vol. 4, No. 6
Automotive Radio Service, Vol. 4, No. 8
Fire Power Engine Facts, Vol. 4, No. 8
Fire Power Carburetor Adjustments, Vol. 4, No. 9
Chrysler V-8 Engine Distributor, Vol. 4, No. 10
Body Service Adjustments, Vol. 4, No. 11
Transmission, Brakes and Shock Absorbers, Vol. 4, No. 12
Fluid-Torque Drive, Vol. 5, No. 1
Hydraulic Power Steering, Vol. 5, No. 2
Hydraulic Power Steering, Vol. 5, No. 3
Servicing Tips, Vol. 5, No. 4
Automatic Overdrive (Operation), Vol. 5, No. 5
Automatic Overdrive (Maintenance), Vol. 5, No. 7
Automatic Overdrive (Controls), Vol. 5, No. 6
Universal Joints and Propeller Shafts, Vol. 5, No. 8
Fluid Torque Drive, Vol. 5, No. 9
Up-to-the-minute Service Tips, Vol. 5, No. 10
The Red Ram V-Eight Engine, 1952, Vol. 5, No. 11
Windshield and Rear Window Service, 1950, Vol. 5, No. 12
Hydraulic Tappets--Battery Performance, Session 64, 1953, Vol. 6, No. 4
The Story of Combustion, Session 65, 1953, Vol. 6, No. 5
The Plymouth Hy-Drive, 1953, Session 66

Brochures Available from the Above Source:

The Tech Story, 1952
A Visit to the Plymouth Motor Plant
Plymouth in 53
Good Going in the New Plymouth
Good Driving Practices, 1949
True Stories of Young Men Who Have Been Successful in the Retail Automobile Business
Some Facts about the Chrysler Corporation
The Years of Progress (Chrysler)

Charts Available from the Above Source:

Plymouth Lubrication
Dodge Lubrication, D-41, D-42
Chrysler Lubrication, C-45, C-46, C-47
Hydraulic Tappets V-8 Engines, Session No. 64
Hydraulically Operated Transmission and Internal Expanding Parking Brake, Vol. 4, No. 1
Tech Sez, Vol. 4, No. 2
Integral Type Automatic Choke, Vol. 4, No. 1
Oriflow Shock Absorbers, Vol. 4, No. 3
Hydraulically Operated Transmission, Vol. 4, No. 3
1951 Windshield Seals, Vol. 4, No. 4
Windshield Wipers, Vol. 4, No. 5
Common Paint Conditions, Vol. 4, No. 6
Take Care of Your Car, Vol. 4, No. 6
Radio First Aid, Vol. 4, No. 7
Chrysler Fire Power V-8 Engine, Vol. 4, No. 8, Chart 1
Chrysler Fire Power V-8 Engine, Vol. 4, No. 8, Chart 2
Chrysler V-8 Firepower Engine Carburetor Adjustments, Vol. 4, No. 9
Chrysler Firepower Engine Distributor, Vol. 4, No. 10
Body Service, Vol. 4, No. 11
Fluid-Torque Drive, Vol. 5, No. 1
Torque Converter Oil Flow, Vol. 5, No. 1
Hydraulic Power Steering, Vol. 5, No. 2, Chart 1
Hydraulic Power Steering, Vol. 5, No. 2, Chart 2
Hydraulic Power Steering, Vol. 5, No. 2, Chart 3
Hydraulic Power Steering, Vol. 5, No. 3, Chart 1
Hydraulic Power Steering, Vol. 5, No. 3, Chart 2
Windshield Wiper Motors and Linkage; Follow-through Starter Drive; Clutch Disc; V-8 Engine Manifold Heat Control, Vol. 5, No. 4
Automatic Overdrive, Vol. 5, No. 5
Automatic Overdrive, Vol. 5, No. 6
Automatic Overdrive, Vol. 5, No. 7
Propeller Shaft and Universal Joints, Vol. 5, No. 8
Engine Torque Converter, Vol. 5, No. 9
V-8 Engine Lubrication System, Vol. 5, No. 11
1953 Windshield Construction, Vol. 5, No. 12
1953 Quarter Panels, Chart No. 2, Vol. 6, No. 1, Session 61
Oil and Grease Seal Types, Session 62, Vol. 6, No. 2
Conventional Steering Gear Alignment Adjustments, Chart 2, Session 63, Vol. 6, No. 3

Champion Spark Plug Company
Sales Promotion Manager
Toledo 1, Ohio

Service Manuals Available from the Above Source:

Spark Plugs, 1952
Spark Plug Engineering Manual, 3d Edition, 1953

A Brochure Available from the Above Source:

The Spark Plug Is Your Thermometer of Engine Performance, 1951

Defiance Spark Plug Company
Toledo, Ohio

A Service Manual Available from the Above Source:

Defiance Spark Plugs--Supplement No. 53

Ethyl Corporation
Southern Region, National Bank of Tulsa Building
Tulsa 3, Oklahoma

Service Manuals Available from the Above Source:

Brief Passenger Car Data, 1953
Ethyl Technical Notes, 1953

Brochures Available from the Above Source:

Practical Pointers on Engine Maintenance, 1950
A Good Valve Job Pays, 53

Ford Motor Company
Manager, Educational Relations Department
3000 Schaefer Road
Dearborn, Michigan

Service Manuals Available from the Above Source:

Ford Service Specifications, 1953
1953 Ford Owner's Manual

Brochures Available from the Above Source:

Deft Driving, 1952
The Human Bridge, 1953

Charts Available from the Above Source:

Merccmatic Transmission
1953 Ford Lubrication
1952 Mercury Lubrication
1952 Lincoln Lubrication

Friction Materials Standards Institute, Inc.
370 Lexington Avenue
New York 17, New York

A Service Manual Available from the Above Source:

1953 Automotive Brake Lining and Clutch Facing Data Book

Gatke Corporation
Sales Service Manager
Automotive Division
228 North LaSalle Street
Chicago 1, Illinois

Service Manuals Available from the Above Source:

1953 Suggested List Prices Form No. LP-53
1953 Revised Condensed Specifications Catalog

A Chart Available from the Above Source:

Can You Stop Safely, Form No. A840, 1939

General Motors Corporation
Educational Service
Department of Public Relations
3044 West Gray Boulevard
Detroit 2, Michigan

Brochures Available from the Above Source:

How the Wheels Revolve (Engine Principles), 1952
Power Goes to Work, 1945
A Power Primer, 1944
Chemistry and Wheels, 1950
Electricity and Wheels, 1939
Optics and Wheels, 1940
Good Housekeeping in your Car
Opportunities in the Automotive Business, 1953
ABC's of Hand Tools, 1945
Metallurgy and Wheels, 1950

Charts Available from the Above Source:

Automobile Chassis, 1940
Steering Systems, 1940
Brake Systems, 1940
Four-stroke Cycle and Flame Travel, 1939
Three-speed Gear Transmission, 1941
Rear Axle Assembly
Automobile Fuel System
Automobile Ignition System
Body Construction
Diesel Cycle Diagram
Engine Types
Cylinders and Paddle Wheels
Engine Efficiency
From Start to Finished Automobile
Automobile Progress
Automobile Stopping Distances for Different Road Conditions
9,000,000 Jobs (in the Automobile Industry)

The Goodyear Tire and Rubber Company, Inc.
Service Department
Akron 16, Ohio

A Brochure Available from the Above Source:

The Story of the Tire, 1953

Hudson Motor Car Company
Technical Service Department
Detroit 15, Michigan

Service Manuals Available from the Above Source:

Hudson Shop Manual, 1952, price $2
Hudson Shop Manual, 1953, price $1
Hudson Body Service Manual, Models 480-490, Series,
price 75¢
Hudson Hydra-matic Transmission Service Manual, price $1
Body Service Manual, 1950-1951 Supplement

International Harvester Company, Inc.
606 South Michigan Avenue
Chicago, Illinois

Charts Available from the Above Source:

Four Stroke Cycle
Insure Your Engine's Life

Johns-Manville
Industrial Products Division
3115 Blodgett Avenue
Houston 1, Texas

Service Manuals Available from the Above Source:

1951 Brake Reliner's Manual, Eleventh Edition
Guide to Better Automotive Refinishing, 1951, price 35¢

The Martin-Senour Company
Automotive Division
Automotive Sales Promotion Manager
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