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SURVEY OF THE INDUSTRIAL NEEDS OF ELECTRICITY TO OBTAIN INFORMATION TO BE USED AS A BASIS FOR A CURRICULUM IN ELECTRICITY IN THE HIGH SCHOOL

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SURVEY OF THE INDUSTRIAL NEEDS OF ELECTRICITY TO OBTAIN INFORMATION TO BE USED AS A BASIS FOR A CURRICULUM IN ELECTRICITY IN THE HIGH SCHOOL

A Thesis Submitted to the Graduate Division in
Partial Fulfilment of the Requirements for the Degree
of Master of Science

By
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TABLES OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Purpose of the Study

The purpose of this study was to find what information had been found useful, by one hundred select individuals gainfully employed and interested in the industrial use of electricity, in order to choose items to be used for the construction of a curriculum in electricity for high school pupils.

The writer believes that there is a need for this study, because the regular text books used in the high schools at the present time do not emphasize enough the practical value of electricity. The contents of most of these books emphasize the theoretical and mathematical content. The writer feels confident that, if an instructor knows what information has been found most worthwhile by a select group of individuals, who are actually engaged in some gainful electrical occupation, he will be better able to supplement a course which will give him a sound, interesting and live curriculum for his pupils.

Our schools are being criticized because they do not give to the pupils an opportunity to get the practical training which fits them best for every day life. Many sociologists, economists and curriculum makers have discussed the problem and we have today many schools revising their curricula to fit the aim of education along the lines of a continual

readjustment to life's situations. On this point L. Thomas Hopkins says, "The material should be taught in such a way that the pupil sees the connection between it and the situation where it is to be applied."[1]

Another quotation from L. Thomas Hopkins to show the need of revising the high school curricula in high school physics text-books is as follows:

> An analysis shows that there are approximately 110 different common uses of the principle of the first-class lever, while there are only three or four for polarized light, all of which are vocational. An analysis of physics text-books, however, show that the average amount of space given the latter topic is five times that of the former. Perfectly good for specialists, but 98 per cent of high school pupils in the physics classes want training to be good consumers.[2]

The writer believes that the curriculum in electricity in the high school should contain the items and materials which have been found useful by a select number of persons gainfully employed in the various branches of electricity.

Importance Of The Study

According to the 1929 American Year Book there were 24, 257, 159 customers using electricity in the United States. Of this number 19, 721, 486 or eighty-one and three-tenth per cent are residential. It is estimated that seventy per cent of the homes in the United States are supplied with electricity.

From his contact in Southeastern Kansas, the writer is convinced that the electrical field in that section is very

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1 L. Thomas Hopkins, Curriculum Principles and Practices, P. 26

2 Ibid, P. 27

broad. Electricity is used for everything from residential lighting to electric shovels. There are two large electric power plants in this district. The Empire District Electric Company located at Riverton, Kansas, furnished power throughout the Southeastern part of Kansas. The Kansas Gas and Electric Company has a very large power transmission plant on the Neosho River located at Service, Kansas, about twenty-seven miles southwest of Pittsburg, Kansas.

The writer interviewed the superintendent of the branch of the Kansas Gas and Electric Company at Pittsburg, Kansas, in order to receive first hand information as to the amount of electricity used in kilowatt hours by consumers of electricity. He obtained the following facts and figures as compiled by the Kansas Gas and Electric Company's main office at Wichita, Kansas.

The Wichita power plant generated 87, 724, 510 kilowatt hours of electricity during the year 1930. The Neosho power plant generated 183, 597, 900 kilowatt hours of electricity during the year 1930. The total for the two generating plants was 271, 322, 410 kilowatt hours. The company had as of record July 1, 1931; 60, 630 customers, and 845 employees. The peak of the load for the two plants during the summer months is at 10--12 A.M.; during the winter months from 5--8 P.M.

The Neosho plant has 664 towers which support the transmission lines, and the line is 106 miles in length. The total cost of construction of the Neosho plant and transmission lines

was $1,447,000.00.

The data on the amount of water consumed by the power plants during the year 1930 was: for the Wichita plant 165,000,000,000 gallons; for the Neosho plant, 248,000,000,000 gallons of water.

The foregoing shows the great amount of electricity consumed during the year 1930, and there is everything to show that its use is increasing. Because of the great convenience of electricity and its widespread use there is a need of a course in electricity in the high school to best fit the boy or girl to learn more about the practical and theoretical side of electricity. The course would probably be of value to more pupils if placed in the senior school level, because it may be more easily associated with out of school situations.

In the generation and transmission of this vast power, a wide knowledge of numerous principles governing electrical activity and manipulatory practices should be learned. Some of these principles no doubt are used more frequently than others in electrical activity and manipulatory practices.

CHAPTER II

SIMILAR STUDIES

A study of somewhat similar nature is a thesis entitled, "Survey of Domestic Needs in Electricity," submitted in partial fulfilment of the requirements for the degree of Master of Science in Education by Charles J. Thompson, Kansas State Teachers College, Pittsburg, Kansas. The purpose of this thesis was to find what information people had found useful in order to select items as a basis for a practical course in electricity for high school pupils, preferable the ninth grade.

The check list technique was used to obtain the desired information. The check lists were marked by boys and girls in high school and their parents. A total of eighty items was listed for checking. This seems to be a very good survey for the domestic use of electricity. There is good material which showsa feasibility for the selecting of material for the course in electricity. Some of the information from this thesis and also some of the same items were used for the check list in this study.

The report of the American Vocational Association Committee on "Standards of Attainment in Industrial-Arts Teaching," presented at the meeting of the Industrial Arts section, American Vocational Association, New Orleans, Louisiana, Saturday, December 7, 1929, consisted of a number of tables summarizing the replies to questionnaires sent to forty cities. The purpose of these questionnaires was to determine what a boy

should know and be able to do by the close of the junior high school period in various subjects. The table on electrical construction contained seventy items. Some of the items were used in this study.

Another study[1] of somewhat similar nature was a report by Charles Hayt Watson from a questionnaire answered by parents of Kansas high school students concerning the use made by them of the 174 items appearing in high school physics. The result was that thirty-five of the 174 items were reported by sixty per cent. None of the material in this report was used in the present study.

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[1] Charles Hayt Watson, A Critical Study Of The Content Of High School Physics With Respect To Its Social Value. School Review XXXIV November (1926) 688-697.

CHAPTER III

METHOD OF PROCEDURE

A check list technique was used in this study to obtain information from persons, interested in electricity and gainfully employed in some electrical work, concerning the knowledge of electricity which they had found useful; also concerning information of which they had some interest. The data were secured from one hundred selected individuals.

Construction Of Check List

The preparation of the check list was very difficult because there is not much material for this type of work. The list was finally made up of items taken from Black and Davis, Practical Physics Book; Terrell Croft's Practical Electricity, and from a thesis, Survey of Domestic Needs in Electricity by Charles J. Thompson, Kansas State Teachers College, Pittsburg. The items were a sampling of a vocational and of a technical nature, because it was desired to obtain specific information of useful items of a vocational character, and information which might indicate recreational value.

The list was composed of one hundred thirty-three items. There were seventy-nine items concerning very common principles of electricity, thirty items of a higher scientific nature, twelve radio items, and twelve items concerning automobile electricity.

Copies of the list were given to persons interested and gainfully employed in electrical work. These persons were requested to mark with (1) the items a knowledge of which they had found useful and to mark with (2) any other of the items in which they were interested.

Procedure

The lists to be checked were placed in the hands of one hundred individuals by the writer. The writer was fortunate in having the cooperation of the teachers of the Kansas State Teachers College, Pittsburg, Kansas, who instruct classes in electricity in Smith-Hughes Vocational Classes. From this group of teachers he obtained a large part of the one-hundred individuals who checked the list. Other persons checking the list were employees of the Empire District Electric Company at Riverton, Kansas, and individuals from the various electrical concerns in Cherokee and Crawford County, Kansas.

The check list was marked by seventy-three electricians, eight automobile mechanics, nine electric welders, six telephone repairmen, and four automobile battery men. This made a total of one hundred individuals.

CHAPTER IV

FINDINGS OF THE STUDY

The tables on the following pages contain the findings of the study. The data presented show that considerable knowledge of electricity has been found useful by the persons marking the check lists. Since the returns were made by a select group, it was assumed that this information was sufficient to be used in the construction of a curriculum.

Table I, on page 15, gives the data obtained from the lists that were checked by the one hundred individuals. After careful consideration the writer decided to use in the suggested curriculum the items which were checked by fifty to eighty-one individuals. There were sixty items of the one hundred thirty-three that were checked by fifty to eighty-one individuals.

Table II, on page 22, gives the data of the sixty items which were used in the curriculum arranged in descending rank order according to frequency of checking.

A further study of Table I indicates that there were sixty items which were checked by fifty to eighty-one individuals, fifty-nine items which were checked by twenty-five to forty-nine individuals, and fourteen items that were checked by sixteen to twenty-four individuals.

The items checked with number (2) indicating any item in which the individuals were interested ranged from six to thirty-seven. As the number checking each item was not great,

the writer does not believe that a special curriculum should be constructed from these items.

A further analysis of the sixty items used in the curriculum shows the desirable arrangement of the items into seven divisions because of their connection with each other in teaching.

The content of the first division contains the study of the sources of electricity, its generation, and general laws and principles. This division includes ten items. These items deal with the beginning study of electricity as to how it can be generated and the laws and principles governing its use. There are in the second division eight items which indicate the knowledge of the dangers of electricity. These dangers include the loss of life, dangers of overloading a circuit, and the information concerning the knowledge necessary to determine the reasons for these dangers. In the third division there are eight items which stress entirely the knowledge of the various kinds of connections, which are necessary to obtain the best results for common electrical net works. The fourth and fifth division contains fifteen items which are indicative of the information required for house wiring and repairing of household appliances. The foregoing shows the necessary knowledge for common electrical problems which may arise about the home.

The sixth division contains eight items which include a knowledge of the laws of computation and formulas to denote electrical horse power. These items deal with watts, kilowatts, and

reading of the electrical service meter. The seventh division contains eleven items which are entirely concerned with automobile electricity. Since there is at the present time in the United States about one automobile to every five persons, these items should have a place in the curriculum.

By analyzing the sixty items taken for the construction of the curriculum the following arrangement was believed desirable because of their connection with each other in teaching.

Division I

This division includes the following:

Source of electrical current

Principles of magnetism

Laws of magnetic force

Meaning of positive and negative electricity

Methods of generating electrical energy

Materials that will conduct electricity

Materials that will not conduct electricity

What is direct current?

What is alternating current?

Action and principles of an electric motor and generator

Division II

This division includes the following:

Dangers of electricity

How to avoid dangers in electricity

Use of fuses

Testing, finding and replacing fuses

Proper size of fuses to use in circuit

Cause and effect of short circuit

Use of switches

Knowledge of computing size of wire needed in circuit

Division III

This division includes the following:

Principles of connecting dry cells

Connecting dry cells in parallel

Connecting dry cells in series

Making a series connection

Making a parallel connection

Construction of a simple lighting circuit with lamps in series

Construction of a simple lighting circuit with lamps in parallel

Connection of a transformer to 110 volt line

Division IV

This division includes the following:

Common house wire and insulation

Capacity of electric light cords and fixture sockets for carrying current

Making common wire splices

Soldering and taping splices

Making simple repairs of household electrical appliances

Installation of a flush switch

Installation of a snap switch

Division V

This division includes the following:

Repairing an electric light socket

Assembling an electric iron heater or toaster plug

Construction and installation of a drop cord

Construction of an extension cord for 110 volt circuit

Construction of an electro-magnet

Construction of a small transformer

Use and construction of a rheostat

Construction of a simple electric motor

Division VI

This division includes the following:

Knowledge of ampere, volt and resistance

Knowledge of Ohm's law

Meaning of watts and kilowatts

Reading of an electrical service meter

Care of volt meter and ammeter

Computation of voltage, current, and resistance in a series connection

Meaning of electrical horsepower

Computation of electrical horsepower.

Division VII

This division includes the following items in automobile electricity

Construction of automobile storage battery

Care of the automobile storage battery

Use of the automobile storage battery

Testing for automobile battery trouble

Construction of use of spark plug

Locating trouble in automobile ignition system

Adjusting breaker points in the automobile ignition system

Testing for trouble in the automobile lighting system

Locating trouble in automobile horn

Changing the charging rate of the automobile generator

Locating tr uble in the automobile starter

TABLE

One Hundred Thirty-Three Items Checked By One Hundred Individuals. (1) Number Of Persons Checking Items A Knowledge Of Which Was Considered Useful; (2) Number Of Persons Checking Items In Which They Were Interested.

Item	(1)	(2)
1. Sources of electrical current-------	79	6
2. Principles of connecting dry cells--	74	4
3. Connecting dry cells in series------	71	6
4. Connecting dry cells in parallel----	72	8
5. Construction of an electromagnet----	58	16
6. Making common wire splices----------	73	12
7. Soldering and taping splices--------	70	12
8. Constructing and wiring bell circuit	40	15
9. Constructing a bell circuit using one button for two bells---------	36	21
10. Constructing a bell circuit using two buttons either of which will operate a single bell-------	33	17
11. Construction of an extension cord for 110 volts---------------	58	8
12. Detection and removal of trouble in a bell circuit-------------------	35	15
13. Assembling electric iron, heater or toaster plug-------------------	50	13
14. Wiring miniature battery lamps------	34	20
15. Construction of a simple lighting-circuit with lamps in parallel---	54	43

Item	(1)	(2)
16. Construction of a simple lighting circuit with lamps in series----	50	16
17. Construction of a simple buzzer----	37	16
18. Construction and installation of a drop-cord----------	50	42
19. Construction of a simple telegraph system----------	23	30
20. Use of switches----------	65	13
21. Installation of a flush switch-----	53	11
22. Installation of a snap switch------	53	14
23. Installation of a flush receptacle-	49	12
24. Construction of a simple electric motor----------	53	25
25. Connection of a transformer to 110-volt line----------	58	17
26. Construction of a small transformer-	50	25
27. Use of fuses----------	81	8
28. Testing, finding and replacing fuses----------	75	7
29. Proper size of fuse to use in a circuit----------	70	17
30. Cause and effect of short circuits--	69	15
31. Reading an electric service meter---	57	18
32. Calculation of light bill from meter reading----------	44	16
33. Action and principles of an electric motor and generator----------	54	20
34. Principles of electromagnetism------	49	16
35. Structure of a push button----------	42	13
36. Structure of an electric bell-------	39	18

Item	(1)	(2)
37. Structure of a dry cell----------	35	17
38. Common house wiring and insulation---	62	14
39. Use of porcela in tubes, knobs, wiring-loom----------	58	11
40. Dangers of electricity----------	73	14
41. How to avoid dangers of electricity--	62	23
42. Construction of electric flatiron----	36	17
43. Construction of lighting-circuit using three-way switches----------	39	24
44. Repairing light socket----------	52	10
45. Farm lighting system----------	22	27
46. Code rules for wiring----------	36	33
47. Construction of an electric pad------	28	20
48. Construction of an electric curling iron----------	26	17
49. Construction of a percolator---------	27	18
50. Electrical toys----------	24	19
51. Construction of weatherproof out-door circuits----------	36	24
52. Use and construction of a rheostat----	52	20
53. Use and construction of a thermostat-	41	18
54. Construction of common electrical household appliances----------	41	24
55. Making simple repairs on household electrical appliances----------	54	17
56. Principles involved in selecting electrically-driven machinery-----	36	26

Item	(1)	(2)
57. Principles of the common incandescent lamp	38	21
58. Electroplating	21	36
59. Construction of a commutator	44	25
60. Magnetic compass	33	23
61. Materials that will conduct electricity	70	11
62. Materials that will not conduct electricity	72	13
63. Care of volt meters and ammeters	54	16
64. Use of pyrometer	22	31
65. Principles of the telephone	41	26
66. Use of automobile storage-battery	58	8
67. Construction of automobile storage-battery	55	18
68. Care of automobile storage-battery	60	16
69. Testing for automobile battery-troubles	53	16
70. Locating troubles in the automobile starter	51	16
71. Locating troubles in the automobile horn	52	11
72. Operation of electric windshield wiper	34	17
73. Testing for trouble in the automobile lighting system	61	14
74. Adjusting breaker points in automobile ignition system	50	21

Item	(1)	(2)
75. Locating trouble in the ignition system----------	52	20
76. Changing the charging rate of the automobile generator----------	60	14
77. Construction and use of spark plug--	51	9
78. Construction and use of ignition coil----------	47	19
79. Capacity of light cords and fixture sockets for carrying current-----	51	23
80. Principles of the electron theory---	31	29
81. Principles magnetism----------	50	21
82. Laws of magnetic force----------	50	25
83. Determing lifting power of magnet---	29	25
84. Knowledge of amperes volt and resistance----------	65	18
85. Knowledge of Ohm's law----------	70	17
86. Meaning of positive and negative current----------	57	12
87. What is direct current?----------	70	12
88. What is an alternating current?-----	71	12
89. Difference between potential and voltage----------	47	19
90. Knowledge of square mils and circular----------	37	20
91. Knowledge of computing size of wire needed for a circuit----------	50	18
92. Skill in using wire table----------	41	25
93. Meaning of electrical horsepower----	60	26
94. Computation of electrical horsepower	53	44

Item	(1)	(2)
95. Meaning of watts, kilowatts---------	70	14
96. Computation of power loss in A.C. or D.C.----------	38	28
97. Computation of the efficiency of electrical apparatus----------	31	29
98. Methods of generating electrical energy----------	50	18
99. Making a series connection----------	62	13
100. Making a parallel connection--------	62	12
101. Computation of voltage, current and resistance in series circuit-----	50	18
102. Computation of voltage, current and resistance in paralled circuit---	47	12
103. Computation of magnetomotive force--	28	24
104. Calculating magnetic winging--------	25	26
105. Applicatons of electromagnetics-----	36	19
106. Determination of capacity of a storage cell or battery----------	27	21
107. Methods of producing induced E M F -	44	49
108. Principles of inductance----------	40	22
109. Factors determiningthevoltage of any generator----------	39	24
110. Principle of a magneto----------	39	18
111. Necessary components of a direct-current generator----------	35	23
112. Radio tube principles----------	21	50
113. Inductance and capacity----------	27	31
114. Resonating circuits----------	19	26

Item	(1)	(2)
115. Radio wave length and frequencies-----	22	35
116. Radio frequency amplification---------	17	37
117. Audio frequency amplification---------	20	30
118. Battery charger----------	33	22
119. B-Battery eliminator----------	27	20
120. Power unit for A. C. sets----------	16	30
121. Types of loud speakers----------	12	25
122. Transformer coupling----------	20	29
123. Resistance coupling----------	19	24
124. The principle of the storage-battery--	38	12
125. The automobile generator principle----	39	18
126. The automobile starting motor---------	42	17
127. Switch arrangements----------	39	14
128. Grounded circuits of automobile-------	38	18
129. Effect of resistance in battery circuit	33	16
130. Why large conductors in battery circuit	44	15
131. Relay cutout----------	36	20
132. Types of automobile lamps----------	30	19
133. Lightingcircuit of automobile----------	43	19

TABLE II

The Sixty Items Used In The Construction Of The Curriculum In Descending Rank Order According To Frequency Of Checking. (N) Number Of Persons Checking Each Item; (RO) Rank Order Of Items Checked.

Item	N.	R.O.
Use of fuses	81	1
Source of electrical current	79	2
Testing, finding and replacing fuses	75	3
Principles of connecting dry cells	74	4
Making common wire splices	73	5
Dangers of electricity	73	6
Connecting dry cells in parallel	72	7
Materials that will not conduct electricity	72	8
Connecting dry cells in series	71	9
What is an alternating current	71	10
Soldering and taping splices	70	11
Proper size of fuse to use in circuit	70	12
Materials that will conduct electricity	70	13
Knowledge of Ohm's Law	70	14
What is direct current?	70	15
Meaning of watts and kilowatts	70	16
Cause and effects of short circuits	69	17

Item	N.	R. O.
Use of switches	65	18
Knowledge of ampere, volt and resistance	65	19
Common house wiring and insulation	62	20
How to avoid dangers of electricity	62	21
Making a series connection	62	22
Making a paralleled connection	62	23
Testing for trouble in the automobile lighting system	61	24
Care of the automobile storage battery	60	25
Changing the charging rate of the automobile generator	60	26
Meaning of electrical horsepower	60	27
Construction of an electromagnet	58	28
Construction of an extension cord for 110 volt's circuit	58	29
Connection of a transformer to 110 volt line	58	30
Use of the automobile storage battery	58	31
Reading an electric service meter	57	32
Meaning of positive and negative current	57	33
Construction of automobile storage battery	55	34
Construction of a simple lighting circuit with lamps in parallel	54	35
Action and principles of an electric motor and generator	54	36
Making simple repairs on household electrical appliances	54	37
Care of volt meters and ammeters	54	38
Installation of a flush switch	53	39

Item	N.	R.O.
Installation of a snap switch----------	53	40
Construction of a simple electric motor-------	53	41
Testing for automobile battery troubles-------	53	42
Computation of electrical horsepower----------	53	43
Repairing an electric light socket----------	52	44
Use and construction of a rheostat----------	52	45
Locating trouble in an automobile horn--------	52	46
Locating trou le in an automobile ignition system----------	52	47
Locating trouble in the automobile starter----	51	48
Construction and use of spark plug----------	51	49
Capacity of electric light cords and fixture sockets for carrying current----------	51	50
Assembling an electric iron heather or toaster plug----------	50	51
Construction of a simple lighting circuit with lamps in series----------	50	52
Construction and installation of a drop cord--	50	53
Construction of a small transformer----------	50	54
Adjusting breaker points in automobile ignition system----------	50	55
Principles of magnetism----------	50	56
Laws of magnetic force----------	50	57
Knowledge of computing size of wire needed for a circuit----------	50	58
Methods of generating electrical energy-------	50	59
Computation of voltage, current and resistance in series circuit----------	50	60

CHAPTER V

THE CURRICULUM

From the study of the book entitled Curriculum Principles and Practices by L. Thomas Hopkins, the writer made use of the following suggested essentials for the construction of the curriculum. There should be some fundamental principles which are used as a basis for curriculum construction; there should be an aim of education clearly defined; and the objectives of the particular course for which the curriculum is constructed should be stated.

The fundamental principles for curriculum construction as suggested by Hopkins are the seven objectives given by the committee on the Reorganization of Secondary Education. These are: health, command of the fundamental processes, worthy home membership, vocation, citizenship, leisure and ethical character.

The writer analyzed various aims of education as suggested by different authors, and finally arrived at the conclusion that the aim of education should be a continual readjustment to the siutations of life.

Having decided to use the fundamental principles for the construction of the curriculum as suggested by Hopkins, and having defined the aim of education, it then became necessary to state the general objectives in science. Since the curriculum of this thesis deals with the teaching of electricity, the following general objectives in science, which were used by the writer, were suggested in the St. Louis Curriculum, Bulletin No. 31 dealing with Physics for the High School.

General Objectives in Science

1. To acquire the ability to use effectively the facts of nature and current scientific problems and practice involved in one's daily life.
2. To acquire the ability to appreciate the lives and works of great scientists and to evaluate their contributions to society.
3. To acquire the ability and the desire to read scientific literature as an indirect mode of observation and a fruitful use of leisure.
4. To acquire the ability to grow in vocational and recreational life through a wide acquaintance with scientific facts and literature.
5. To develop skill in the manipulation of materials in purposeful scientific experimentation.
6. To acquire open mindedness in problem situations and abilities in the use of the scientific method.
7. To appreciate the advantages of further scientific study.
8. To acquire ability to develop one's ethical character through an adequate conception of the truth and a working confidence in the law of cause and effect.

THE CURRICULUM

The content of the Curriculum is as follows:

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
Division I Source of electrical current. To learn the knowledge of the sources.	Review the various sources of electrical current generation, by friction, electrostatics, chemical action in an electric cell, in dynamo, as cutting lines of force.	Diagnostic test to reveal the knowledge the student has of each source. Give the student an opportunity to experiment, to the electrical current produced by each source.	Direct: Renewed, and complete knowledge of the source of electrical current. Indirect: Appreciation of the ways of generating an electric current.
Principles of magnetism. To learn the great commercial importance of the applications of magnetism.	Naming the metals which may acquire peculiar attractive and directive properties, called magnetism. Experiment with iron, nickel and cobalt.	Examination of measuring instruments for electric current, telephone, radio sets and electric generator as to how their action depends on magnetism.	Direct: Complete knowledge of the principles of attraction and repulsion knowledge of magnetic field. Indirect: Utilization of the facts in vocation.
Laws of magnetic force. To learn that the attractive or repulsive forces between the poles vary inversely as the square of the distance between the poles.	Have students use compass to find the force of a magnet. Learning that like poles repel and unlike poles attract.	Student experiment and prove the law of inverse squares.	Direct: learn the laws of magnetic force. Indirect: Learning the commercial value of the laws as magnetism as used by scientists for instruments.

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
Meaning of positive and negative electricity. To learn that there are two kinds of electricity.	Observation of the behavior of frictional electricity. Discover that like charges repel and unlike charges attract. To discover that in a simple cell the copper plate is positive and the zinc is negative.	Have student rub glass with silk this gives positive electricity; rubbing vulcanite with flannel gives negative electricity.	Direct Knowledge of positive and negative electricity both for static and dynamic. Vocational for connection of electrical net works.
Methods of generating electrical energy. To learn the various methods of generation.	Have students see the difference between electrostatic generation and dynamic. Show the generation by cutting lines of force-chemical action-frictional.	Student experiment to get acquainted with the various methods and have them decide which is of the greatest commercial value.	Direct: Knowledge of the various methods. Knowledge that the method of cutting lines of force is of the greatest commercial value. Indirect: Vocational appreciation of the methods.
Materials that will conduct electricity. To learn the materials most commonly used as electrical conductors and the reasons for it.	Use of the various metals to show conductivity. Give names of several good conductors. Use copper, carbon, German silver.	Testing out the various metallic substance to determine the best available material for commercial purposes.	Direct: A knowledge that substances which lead off electric charge quickly are called conductors. Indirect: Learning of the best conductors.

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
Materials that will not conduct electricity. To learn the value of insulators for electrical insulation.	Explain the value of insulators which prevent the electric charge from escaping. Collect various kinds of insulators and demonstrate their use.	Students use in experimentation hard rubber, paraffin, resin, mica and etc. for the proof of the value of insulation.	Direct: Knowledge of the kinds of insulators and their value for electrical transmission. Indirect: Appreciation of the value of non conductors.
What is direct current. To learn that a direct current always flows in the same direction.	Demonstrate direct current by means of the simple electric cell, flash light battery, storage battery. Discuss the use of the commutator on a generator to give direct current.	Make clear that a direct current flows in one direction only. Have student construct a simple electric cell and trace the direction of flow of current.	Direct: To learn that direct current always flows in the same direction. Vocational as for storage battery-man.
What is an alternating current. To learn that in a revolving loop of wire an electric current is generated which is called an indirect current.	Explaining why in the cutting of lines of force that the loop of wire make a change in the direction of the flow of the current. Explain reasons for slip rings on a generator.	Perform an experiment to demonstrate the use of slip rings for an alternating current. Discussing the reason for alternating current use in the home and factory more so than direct current.	Direct: To learn the value and commercial importance of an alternating current. Indirect: Appreciation of the great electrical work done by the use of alternating current.
Action and principles of an electric motor and	Telling how a simple wire when it is moved across	Student construct a simple electric generator and	Direct: To learn the principles of the generator

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
generator. To learn the principles of a generator. To learn the principles of a motor.	a magnetic field produces an induced e.m.f. The value of speed and the number of lines of force cut per minute to determine the output of the generator. Showing how a motor uses current and voltage produced by the generator to run it.	and electric motor. Have student work with a generator and motor and test its efficiency. Learn what the back e.m.f of a motor means.	and motor and the kinds of motor and generators used in the commercial world. Indirect: Vocational, appreciation of the good done by the generator and motor for mankind in industry.
Division II Dangers of electricity. To learn the dangers of electricity.	Review the various dangers of electricity, danger to the body, overloading, and high voltage on motors.	Student read about dangers of electricity. Experiment on high voltage and its effect on a small wire when carrying heavy current.	Direct: To learn the dangers of electricity. Indirect: Vocation. Health.
How to avoid dangers of electricity. To learn the principles involved in avoiding dangers of electricity.	Demonstrate the use of wire large enough to carry current. Lecture on insulators and safety first.	Testing circuits with large enough size of wire and proper insulation. Proper way of connections.	Direct: To learn how to avoid dangers in electricity. Indirect: Appreciate scientific discoveries to lessen dangers of electricity.
Use of fuses. To learn the uses of fuses.	Explaining the composition of a fuse. Discuss the size of fuses used for	Have student experiment with fuses by loading circuit until fuse is blown. Student should	Direct: To learn that fuses protect from over loading in saving the wiring and do not cause

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
	common electrical purposes.	learn that fuses are for Protection.	fire.
Testing, finding and replacing fuses. To learn how to test, find and replace fuses.	Explaining the use of Ohm's Law in finding the capacity testing fuses with the use of an ammeter. Replacing cartridge fuses.	Give problems involving the use of Ohm's Law in finding the capacity of a circuit, let students replace fuses.	Direct: To learn to find test fuses and replace blown fuses.
To learn. Proper size of fuses to use in circuit.	Discuss Ohm's Law. Use problems directly concerned with various electrical net works to find capacity.	Let students work problems then prove same by using ammeters and fuses in the circuits.	Direct: To learn the proper size of fuses to use in circuit.
To learn the cause and effects of short circuits.	Explaining the cause of overloading, improper insulation, or mechanical defects which cause short circuits.	Experiment with batteries to show the effect of short circuiting. Explanation of the cause of heat, burns, and shock.	Direct: To learn the causes the effects of short circuits. Indirect: Appreciation of safety devices.
To learn. Use of Switches	Discussing the code rules for wiring. Explaining the reason for capacity for the various types of switches and their safety value.	Have students connect switches also work out capacity of circuits to determine the size of switch to be used.	Direct: To learn the use of switches. Indirect: Vocation.
To learn the knowledge of computing size of wire needed in circuit.	Review the use of laws and principles in the computation of size of wire needed.	Perform experiment by using different sizes of wire to show the effect of electrical	Direct: To learn the knowledge of computing size of wire needed in a

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
	discuss the wire table.	efficiency.	circuit.
Division III To learn the principles of connecting dry cells.	Explaining the efficiency of dry cells when connected in series, parallel, or series-parallel.	Show by experiment the connections and discuss the value of each. Have student connect batteries to a telephone.	Direct: To learn the principles of connecting dry cells. Indirect: Vocation. Appreciation of the various methods of connection.
To learn to connect dry cells in parallel.	Reviewing the laws governing parallel circuits. Voltage across several resistances in parallel is the same.	Student connect dry cells in parallel and test voltage and current then prove the laws governing parallel circuits.	Direct: To learn to connect dry cells in parallel.
To learn to connect dry cells in series.	Reviewing the laws governing series circuits explanation of the laws.	Make clear that in a series circuit the amperes will always remain the same-Actual testing by using ammeter in circuit.	Direct: To learn to connect dry cells in parallel Indirect: Vocation.
To learn to make a series connection.	Demonstrate with dry cells in series.	Have student connect dry cell in series.	Direct: To learn to make a series connection.
To learn to make a parallel connection.	Explaining why parallel connection are used in the home on 110 volt circuit.	Have the class report on value of parallel circuits. Have students connect dry cell in parallel.	Direct: To learn to make parallel connections.

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
To learn the construction of a simple lighting circuit with lamps in series.	Explaining the laws governing a series connection. Discussing value of the series lighting circuit for Christmas decorations.	Construction by students of a series lighting system and teaching that if one light burns out all the others will be out because of the broken circuit.	Direct: To learn the construction of a simple lighting circuit with lamps in series.
To learn. Construction of a simple lighting circuit with lamps in parallel.	Review the laws governing parallel circuits.	Give problems on parallel circuits. Explain reasons for house wiring by parallel connection.	Direct: To learn the Construction of a simple lighting circuit with lamps in parallel.
To learn to connect a transformer to 110 volt line.	Demonstrate by diagram the connection of a transformer and discussing the reasons for the transformer.	Students to learn how to make connection from simple diagrams.	Direct: To learn to connect a transformer to 110 volt line. Indirect: Appreciation of the knowledge of connections.
Division IV To learn about common house wiring and insulation.	Discussing the value of the proper wiring and insulations to be used in order to protect homes and the wiring done according to the Code Rules for Wiring.	Draw house plans on the black board and show wiring. Discuss the use of insulation loom, knobs, tubes, and switch boxes.	Direct: To learn about code rules of wiring homes. Indirect: Vocation Appreciation of the inderioriters rules and regulation for wiring.

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
To learn to compute the capacity of electric light cords and fixtures sockets for carrying current.	Reviewing the laws of connection, and Ohm's laws to compute size of wire table.	Examining fixture sockets to find the specifications required by Underwriters. Use of ammeters and volt meter to test circuits. To learn the size of fuses used in circuits.	Direct: To learn to compute the capacity of electric light cords and fixtures sockets for carrying current.
To learn to make common wire splices.	Demonstrate the methods of splices and discussing the value of each.	Have students splice wire and tape each.	Direct: To learn to splice electric wire.
To learn to solder and tape splices	Explaining the need of perfect connections in electricity, and the reasons of taping the splices for protection against short circuits.	Examining wiring that has been spliced and taped, and have student solder and tape wire splices.	Direct: To learn to solder and tape splices.
To learn to make simple repairs of household electrical appliances.	Discussing the value of doing simple repair work which saves money and time and the appreciation derived from the knowledge how to do a thing.	Have students repair electric irons, toaster or curling iron.	Direct: To learn to make simple repairs of household electrical appliances. Indirect: Vocation.
To learn to install a flush switch.	Examining the various types of flush switches Defining the meaning of a flush switch.	Installation of a flush switch.	Direct: To learn to install a flush switch.

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
To learn to install a snap switch.	Explaining the construction of the snap switch and to discuss its capacity.	Installation of a snap switch by students.	Direct: To learn to install a snap switch.
Division V To learn to repair an electric light socket.	Review the construction of the electric light circuit.	Students assemble an electric light socket and repair the same.	Direct: To learn to repair an electric light circuit.
To learn to assemble an electric iron heater or toaster plug.	Discuss and explain the construction of electric iron, explain the reasons for using annealed wire instead of copper wire.	Student assemble electric iron, also toaster plug.	Direct: To learn to assemble an electric iron or toaster plug. Indirect: Vocation.
To learn to construct and install a drop cord.	Review the size of wire used for the construction of drop cords. Explaining the need of proper connections.	Have students construct and install a drop cord.	Direct: To learn to construct a drop cord. Indirect: Vocation.
To learn to construct an extension cord for 110 volt.	Teach the value of insulations size of wire and length of wire used, also code rule for wiring.	Construct extension cord.	Direct: To learn to construct an extension cord for 110 volt circuit.
To learn how to construct an electro-magnet.	Review the study of magnets and induced currents. Discuss the parts of a electro-magnet depends upon strength of current and	Use small battery, soft iron and wire and construct a magnet. Have student report on commercial value of an electro-magnet.	Direct: To learn how to construct an electro-magnet and learn its uses. Indirect: Appreciation

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
	ampere turns of the coil.		of its use commercially.
To learn to construct a small transformer.	Discussing the value of transformers to step up voltage and to step down voltage. Teaching the parts of a transformer use of wire table	Have students construct a transformer. Give problems to find the number of turns of primary and secondary required for a certain voltage.	Direct: To learn to construct a transformer Indirect: Appreciation of the value of transformer for long distance distribution.
To learn the use and construction of a rheostat.	Reviewing the dangers of overloading circuits and the heating effect of electricity. Discussing the value of rheostat to control current of a circuit.	Construct a rheostat in class. Be sure to explain the use of asbestos to protect from fire.	Direct: To learn the use and construction of a rheostat.
To learn to construct a simple electric motor.	Explaining the similarity of a generator and motor. Discussing the parts of a motor such as electro-magnet, armature and commutator with brushes. Report on the automobile motor used for starting.	Experiment by using an electric motor. Then have student construct an electric motor.	Direct: To learn to construct an electric motor and learn the principles involved in its efficiency. Indirect: Vocational.
Division VI To learn the knowledge of amperes volt and	Reviewing units of measure- ampere unit of current per unit time. Volt	Give problems involving definitions of the terms. Have class use voltmeter and	Direct: To learn knowledge of amperes, volts, and resistance.

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
resistance	force needed to drive amperes. Resistance is opposition to flow of electricity by conductors.	ammeter check computations.	Indirect: Appreciation of Ohm's law. Vocational use.
To learn Ohm's Law	Explaining the value of Ohm's law in any electrical circuit. The value of computation for commercial purposes.	Have experiment to prove Ohm's law. Students should discuss value of Ohm's for the building of generators and motors.	Direct: To learn Ohm's law Indirect: Vocation Appreciation of its use in the electrical industry.
To learn the meaning of watts and kilowatts.	Show the value of Ohm's law. Reading of a service meter, Computation of electrical horse power. Explaining the watts of an incadescent lamp.	Examination to test the knowledge of Ohm's law. Work problems involving the finding of horse power and efficiency of electrical motors, generators and other appliances.	Direct: To learn the meaning of watts and kilowatts Indirect: Vocational use.
To learn to read an electrical service meter.	Electricity is measured by the amount of kilowatt hours used. Explain the construction of meter. Checking the meter for the cost of electrical consumption.	Have students read the meter and gives problems involving watts and kilowatts so that a drawing may be made of the meter to show the readings.	Direct: To learn to read an electrical service meter Indirect: Vocation Appreciation
To learn the care of volt meters and ammeters.	Explaining that an ammeter is a low resistance	Use a voltmeter and ammeter to measure volt-	Direct: To learn the care of volt meters

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
	measuring unit, a volt meter is a high resistance galvanometer. Ammeter is in series with circuit and voltmeter is across the line.	age and current of a circuit.	and ammeters.
To learn how to make computation of voltage, current and resistance in a series connection.	Review the laws governing series circuit, also Ohm's law.	Give problems involving computation of series circuit.	Direct: To learn how to make computations of voltage, current and resistance in a series connection. Indirect: Vocational
To learn the meaning of electrical horsepower.	Reviewing of Ohm's law. Compare electrical horsepower with mechanical horsepower 746 watts= 1 horse power.	Students compute horsepower of various net works.	Direct: To learn the meaning of electrical horsepower Indirect: Vocational
Division VII To learn how to construct an automobile storage battery.	Explaining the construction of a storage battery. Discussing value of the battery the automobile ignition and lights.	Have laboratory experiment by having a storage battery taken apart, naming the plates, electrolyte used and voltage and ampere capacity, also the need of insulators.	Direct: To learn how to construct an automobile storage battery. Indirect: Vocation Appreciation of its use for an automobile.

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
To learn the care of the automobile storage battery.	Remembering the construction of the battery will help one take care of it. Explaining the use of tight connections addition of pure distilled water every two weeks. Over charging.	Demonstrate the effect on battery which have had proper care as to corrosion of terminals, broken insulators, low specific gravity, broken plates, low voltage and low amperes.	Direct: To learn the care of the automobile storage battery. Indirect: Vocation: Appreciation of the knowledge of the care to increase the efficiency in automobile uses.
To learn the use of the automobile storage battery.	Discussing and explaining the use of the storage battery for starting, ignition, lights and horns.	Experiment with a storage battery and have it run a starter, an electric motor. Show brightness of lights with full charge battery.	Direct: To learn the use of the automobile storage battery. Indirect: Vocation.
To learn how to test for automobile battery trouble.	Reviewing the construction of the battery. Stating the principles involved. Being careful in using ammeter and voltmeter. Explain the corrosion of terminals.	Have students test electrolyte voltage and amperage with proper instruments. Examine all connection and test each cell separately.	Direct: To learn how to test for automobile battery trouble. Indirect: Vocation.
To learn the construction and use of	Explaining the use of the spark plugs for	Examination of a spark plug by students, dis-	Direct: To learn the use and construction

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
spark plugs	ignition purpose, the value of the spark. Why porcelain is used as insulator and give reasons for distance of space gap.	assembling and reassembling, measuring the gap with a dime. Greatest care should be distance of spark gap.	of spark plugs.
To learn to locate trouble in the automobile ignition system.	Reviewing the requirements of tight connection, insulation, care of storage battery, ammeter, and ignition coil.	Trace several ignition system of standard automobiles. Make diagram on black board.	Direct: To learn to locate trouble in the automobile ignition. system. Indirect: Appreciation in case of the stalling of automobile in knowing what to do about ignition.
To learn to adjust points in the automobile ignition system.	Explaining the mechanical feature of timing and the electrical contact required at the same mechanical time. The breaker points are made of tungsten and sometimes need filing.	Show how to repair breaker points. The timing is mechanical.	Direct: To learn to adjust breaker points in the automobile ignition system.
To learn to test for trouble in the automobile lighting system.	Explain the need of knowing the wiring system of particular automobile insulation,	Trace the wiring diagram of an automobile system. Discuss insulation and connections	Direct: To learn to test for trouble in the automobile lighting

Specific Objectives	Suggested Activities	Suggested Procedure	Desirable Outcomes
	burned out lamps, short circuits.	of wiring, also candle power of lamps used. Automatic cut-outs for dim lights.	system. Indirect: Vocation.
To learn to locate trouble in the automobile horn.	Reviewing electro-magnets. Explanation of the use of diaphragm. Different sounding horns.	Have student disassemble and reassemble a horn. Look for short circuits, or tight diaphragm.	Direct: To learn to locate trouble in the automobile horn.
To learn how to change charging rate of the automobile generator.	Reviewing the principles of the electric generator. Explaining use of the brushes and especially the third brush. Keep brushes clean.	Run a generator attached to a motor and move third brush to show the change of rate of charging. Use charging. Use ammeter.	Direct: To learn how to change the charging rate of the automobile generator. Indirect: Vocational.
To learn how to locate trouble in the automobile starter.	Explain the principles of the electric motor. The essential of commutator, insulation, armature and brushes. Good connection.	Take an automobile starter and examine parts. Have students clean brushes and commutator. Look for short circuit in the field or commutator.	Direct: To learn to locate trouble in the automobile starter.

CHAPTER VI

SUMMARY AND CONCLUSION

Summary

The purpose of this study was to find what information had been found useful, by a number of select individuals gainfully employed and interested in the industrial use of electricity, in order to select items to be used for the construction of a curriculum in electricity for high school pupils.

It seems to be a well established fact that electrical service has become an important factor in the determination of the standards of living of the present era, therefore, it should have a place as a subject in the high school curriculum. The course should be so arranged to best meet the situation of actual participation in electrical work.

Two similar studies were reveiwed. One was a thesis, entitled, "Survey Of Domestic Needs In Electricity," submitted in partial fulfilment of the requirement for the Master Of Science Degree in Education, by Charles J. Thompson, Kansas State Teachers College, Pittsburg Kansas. This thesis was based on the check list technique to obtain the information that people had found useful, in order to select items to be used as a basis for a practical course in electricity. The check lists were marked by boys and girls in the high school and their parents. A total of eighty items was listed for checking.

The other study was a report by Charles Hoyt Watson from a questionnaire answered by parents of Kansas high school

students concerning the use made by them of 174 items appearing in the high school physics. The result was that thirty-five of the 174 were reported by sixty per cent. None of the material in this report was used in the present study. The above report was found in School Review XXIV; November 1926. "pp. 688-697."

The check list technique was used to obtain the desired information.

The check lists were marked by one hundred select individuals representing the following occupations: electricians, automobile mechanics, electric welders, telephone repair-men, and automobile storage battery-men.

The check list was based upon personal opinion, and a certain number of items taken from the thesis on "Domestic Needs Of Electricity." The final check list contained one hundred thirty-three items.

This study was carried on in Crawford and Cherokee Counties, in Southeastern Kansas. The check lists were given, under the supervision of the writer, to persons attending the night classes in the Smith-Hughes Vocational classes in electricity, at the Kansas State Teachers College Pittsburg, Kansas, and to the employees of the Empire District Electric Light Company at Riverton, Kansas.

The findings of the study are given in a number of tables containing information concerning the one hundred thirty-three items, which are summarized by the following facts:

(1) There were sixty items of the one hundred thirty-three

that were checked by fifty to eighty-one individuals.

(2) There were fifty-nine items which were checked by twenty-five to forty-nine individuals.

(3) There were only fourteen items out of the one hundred thirty-three that were checked by sixteen to twenty-four individuals.

(4) The items checked with number (2), any item in which they were interested, ranged from six to thirty-seven individuals.

(5) The sixty items used for the curriculum ranged from items of a very general knowledge of electricity to a rather highly scientific character, probably due to the variability of the occupation of the group checking the items.

Conclusion

From the data obtained in this study the following conclusion may be drawn.

First, since a knowledge of electricity has been found useful by one hundred select individuals concerning the general manipulatory practices, and the rather highly scientific, a similar knowledge may probably be found useful by every girl or boy in the high school.

Second, since sixty items were checked by fifty individuals and above, it was decided that these should be used in the construction of the curriculum.

Third, since the present high school text-books in physics

do not stress the teaching of electricity in such a way as to care for the actual situations in life as found by persons actually working in electricity, it is felt that the curriculum giving due consideration to the sixty items listed in this thesis will be most valuable in a course in high school electricity.

The following pages contain a copy of the check list which was given to the one hundred individuals.

Occupation----------Age------Name----------

The purpose of this check list is to help determine the things that should be included in a course in high school electricity.

Mark with (1) the items, a knowledge of which has been useful to you.

Mark with (2) any other item in which you are interested.

1. ( ) Sources of electrical current
2. ( ) Principles of connecting dry cells
3. ( ) Connecting dry cells in series
4. ( ) Connecting dry cells in parallel
5. ( ) Construction of an electromagnet
6. ( ) Making common wire splices
7. ( ) Soldering and taping splices
8. ( ) Constructing and wiring bell circuits
9. ( ) Constructing a bell circuit using one button for two bells
10. ( ) Constructing a bell circuit using two buttons either of which will operate a single bell
11. ( ) Construction of an extension cord for 110 volts
12. ( ) Detection and removal of trouble in a bell circuit
13. ( ) Assembling electric iron, heater or toaster plug
14. ( ) Wiring miniature battery lamps
15. ( ) Construction of a simple lighting-circuit with lamps in parallel
16. ( ) Construction of a simple lighting-circuit with lamps in series
17. ( ) Construction of a simple buzzer
18. ( ) Construction and installation of a drop-cord
19. ( ) Construction of a simple telegraph system
20. ( ) Use of switches
21. ( ) Installation of a flush switch
22. ( ) Installation of a snap switch
23. ( ) Installation of a flush receptacle
24. ( ) Construction of a simple electric motor
25. ( ) Connection of a transformer to 110 volt-line
26. ( ) Construction of a small transformer
27. ( ) Use of fuses
28. ( ) Testing, finding and replacing fuses
29. ( ) Proper size of fuse to use in a circuit
30. ( ) Cause and effect of short circuits
31. ( ) Reading an electric service meter
32. ( ) Calculation of light bill from meter reading
33. ( ) Action and principles of an electric motor and generator
34. ( ) Principles of electromagnetism
35. ( ) Structure of a push button
36. ( ) Structure of an electric bell
37. ( ) Structure of a dry cell
38. ( ) Common house wiring and insulation
39. ( ) Use of porcelain tubes, knobs, wiring-loom
40. ( ) Dangers of electricity
41. ( ) How to avoid dangers of electricity

42. ( ) Construction of electric flatiron
43. ( ) Construction of lighting-circuit using three-way switches
44. ( ) Repairing light socket
45. ( ) Farm lighting system
46. ( ) Code rules for wiring
47. ( ) Construction of electric pad
48. ( ) Construction of an electric curling iron
49. ( ) Use of percolator
50. ( ) Electrical toys
51. ( ) Construction of weatherproof outdoor circuits
52. ( ) Use and construction of a rheostat
53. ( ) Use and construction of a thermostat
54. ( ) Construction of common electrical household appliances
55. ( ) Making simple repairs on household electrical appliances
56. ( ) Principles involved in selecting electrically-driven machinery
57. ( ) Principles of the common incandescent lamp
58. ( ) Electroplating
59. ( ) Construction of a commutator
60. ( ) Magnetic compass
61. ( ) Materials that will conduct electricity
62. ( ) Materials that will not conduct electricity
63. ( ) Care of volt meters and ammeters
64. ( ) Use of pyrometer
65. ( ) Principles of the telephone
66. ( ) Use of automobile storage-battery
67. ( ) Construction of automobile storage-battery
68. ( ) Care of automobile storage-battery
69. ( ) Testing for automobile battery troubles
70. ( ) Locating trouble in the automobile horn
71. ( ) Locating trouble in the automobile starter
72. ( ) Operation of electric windshield wiper
73. ( ) Testing for trouble in the automobile lighting system
74. ( ) Adjusting breaker points in automobile ignition system
75. ( ) Locating trouble in the ignition system
76. ( ) Changing the charging rate of the automobile generator
77. ( ) Construction and use of spark plugs
78. ( ) Construction and use of ignition coil
79. ( ) Capacity of light cords and fixture sockets for carrying current
80. ( ) Principles of the electron theory
81. ( ) Principles of magnetism
82. ( ) Laws of magnetic force
83. ( ) Determining lifting power of magnet
84. ( ) Knowledge of amperes volt and resistance
85. ( ) Knowledge of Ohm's Law
86. ( ) Meaning of positive and negative current?
87. ( ) What is direct current?
88. ( ) What is an alternating current?
89. ( ) Difference between potential and voltage

90. ( ) Knowledge of square mils and circular
91. ( ) Knowledge of computing size of wire needed for a circuit
92. ( ) Skill in using wire table
93. ( ) Meaning of electrical horsepower
94. ( ) Computation of electrical horsepower
95. ( ) Meaning of watts, kilowatts
96. ( ) Computation of power loss in A.C. or D.C.
97. ( ) Computation of the efficiency of electrical apparatus
98. ( ) Methods of generating electrical energy
99. ( ) Making a series connection
100. ( ) Making a parallel connection
101. ( ) Computation of voltage, current and resistance in series circuit
102. ( ) Computation of voltage, current and resistance in parallel circuit
103. ( ) Computation of magnetomotive force
104. ( ) Calculating magnetic winding
105. ( ) Applications of electromagnetics
106. ( ) Determination of capacity of a storage cell or battery
107. ( ) Methods of producing induced E M F
108. ( ) Principles of inductance
109. ( ) Factors determining the voltage of any generator
110. ( ) Principle of magneto
111. ( ) Necessary components of a Direct-current generator
112. ( ) Radio tube principles
113. ( ) Inductance and capacity
114. ( ) Resonating circuits
115. ( ) Radio wave length and frequencies
116. ( ) Radio frequency amplification
117. ( ) Audio frequency amplification
118. ( ) Battery charger
119. ( ) B-Battery eliminator
120. ( ) Power unit for A. C. sets
121. ( ) Types of loud speakers
122. ( ) Transformer coupling
123. ( ) Resistance coupling
124. ( ) The principle of the storage battery
125. ( ) The automobile generator principle
126. ( ) The automobile starting motor
127. ( ) Switch arrangements
128. ( ) Grounded circuits of automobiles
129. ( ) Effect of resistance in battery circuit
130. ( ) Why large conductors in battery circuit
131. ( ) Relay cutout
132. ( ) Types of automobile lamps
133. ( ) Lighting circuit of automobile