SIGNAL AND INTERCOMMÚNICATION SYSTEM TRAINER: A TECHNICAL STUDY

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Electrical Technology

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A P P R O V A L S H E E T

In partial fulfillment of the requirements for the degree of Master of Technician Education (MTE), major in Electrical Technology, this seminar paper entitled **"SIGNAL AND INTERCOMMUNICATION SYSTEM TRAINER: A TECHNICAL STUDY"** has been prepared and submitted by PONCIANO P. MACAPAñAS, who is hereby recommended for the corresponding oral examination.

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P.P.M.

D E D I C A T I O N

TO

I R E N E

My Loving Wife . . .

My Children

MA. ROSARIO

NEIL

and

ANTONIO *(Deceased)*

. . . this study is humbly and lovingly dedicated.

PONS

ABSTRACT

The researcher was motivated to engage in this study to alleviate the pressing problem in the shop which is the scarcity of instructional aids. Many of the technical-vocational institutions in the country today including the Samar State Polytechnic College lack adequate instructional materials. It is economical because this can be made out of local materials and the project utilizes minimal wattage. Safety precautions were then adopted to ensure safety when operating the gadget. These precautions should be emphasized in the development of the effective domain of learning. Together with the safety precautions were the maintenance measures to be followed if the trainer was to last a long time. After the trainer was constructed it was tried for its efficiency. Except for loose connections of binding posts, faulty connection of diode, and humming of the extension speaker, the project was otherwise successful. The study showed that it is feasible to construct a signal and intercom system that can demonstrate low-voltage wiring systems that can perform operations and functions similar to those actual signal and intercom systems installed in hospitals, schools and other office buildings. With this project, the researcher is hopeful that it will contribute to the overall learning process of the student in electricity classes.

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Chapter 1

THE STUDY AND ITS BACKGROUND

Introduction

Electricity is indespensable to modern civilization. Without it life as we know it today would be impossible, for the communities are dependent on electricity in the use of telephones, fire alarm system, illumination, elevators, escalators, computers and automobile starting. Without electricity for illumination and communication in residences, hospitals, industries, schools and other places, life would at least be difficult.

Perry and Schafebook[1] states that industries, hotels, and hospitals are dependent on signal and intercommunication system for communicating and sending messages to their clienteles. They are commonly installed in homes, hotels, schools and hospitals to enable callers to make known their presence at the door and to summon workers from one department to another. Bells are used where a loud sound is required as in homes or in shops. Buzzers are employed in and are sufficient to attract attention without undue disturbance.

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[1]Perry and Schafebook, (Fundamental Jobs in Electricity,) McGraw-Hill Book Company, Inc., New York USA, p. 25.

The many different uses for signaling and intercommunication in homes, schools, and other buildings challenged the instructor to construct the electrical trainer set-up on alarm, signal and intercommunication system, to facilitate learning and understanding in the classroom. It is a common fact that shop teachers are faced with several problems in the classroom. Some of the problems in presenting the concepts in the electricity classes without the electrical trainer set-up are: (1) inadequate instructional training equipment in electricity, (2) Construction of teaching aids and devices for every demonstration class consumes much supplies and electrical materials, (3) There is very limited time for fixing electrical terminal lead connection during the demonstration period, (4) Due to lack of supplies and electrical materials for teaching aids and devices, students' interest is affected. Cabanganan[2] pointed out that many vocational and technical schools in the country do not have the modern tools, equipment and training facilities needed to carry out their programs. Many of these schools are still using the crudest tools and obsolete equipment and

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[2]Dominador Q. Cabanganan, Vocational-Technical Education, Focus on the In-Plant Training Program" (unpublished Doctoral Dissertation, Leyte State College, Tacloban City, March 1982). p. 4.

machineries. Some vehicles that are used for instructional aids like th jeeps and broken cars are of obsolete models with no available spare parts in the local market. He cited further that many schools have already been accused of failure to produce vocational competence among the graduates, because they are not fully equipped with training facilities necessary for the job efficiency. It is not sufficient that the teacher alone will have a general impression in his own mind as to what standard of skill he will expect to his students in a given lesson.

This standard of skill can be clearly taught through the acquisition of improvised equipment that will help understand the concept. Improvised gadget and trainer can be constructed out of local materials so that it will sought to the development of skills of the learners.

Development of skills in electrical work is quiet simple, yet it may be complex if not supplemented by practical application. Through observation the process of learning is the same for all individuals and basically the same for learning skills and information. There are however, significant differences in the mechanics of perfecting skills as compared with the mechanics of mastering information.

A shop teacher should realize that the real reason why

the learner needs to be in position of this information is to give him the tools for forming judgments, so that he can properly apply his skill in every situation which may arise in the practice of the trade. He may know the "how" of the trade, but unless he also understands the "why" he can seldom rise above the operator level in the industry.

The truly skilled teacher or craftsman must be able to choose materials, plan procedures, lay out work, and select methods, tools and equipment to perform any task which falls within the full range of his trade. He must display the necessary degree of skill in the use of such tools and gadget. He must be able to recognize working difficulties when they develop, analyze them to discover their causes, and make necessary changes in techniques or procedures. When choosing methods for presenting information, the teacher has a wider range of choices than when selecting methods for presenting skills.[3]

Skill training in the technical trade suggests some elements of teaching, (1) the teacher himself, making learning meaningful to the learner, (2) the shop talk, designed to provide the learner with a very few key items of

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[3]Donald M. Kidd, "Methods of Teaching Shop and Related Subjects," (New York: Delmar Publishing Inc., 1955) p.81.

information, (3) the learner, the key figure in the trade skills training. In the teaching-learning process the teacher has a big task in the skills training of the learner.

Based on some studies, the teaching of shop subjects should not be limited to textbook as a source of study material, but other types of materials should be used in order to facilitate learning. A good example of these learning materials are instructional trainers or devices that when used and applied strategically, make the teaching-learning process more effective on the part of the learners.

Specifically, this electrical trainer can minimize the problems of an instructor in electricity regarding the practical operations of low-voltage wiring installations. More so, it is locally made hence it is cheaper than the imported one.

Hence, the researcher in his attempt to provide relevant and meaningful experience to the students, plans to construct an electrical gadget which would help the students grasp complex concepts in electricity.

Objectives of the Study

This study sought to pursue the following:

1. To design and construct an electrical trainer set-up on signal and communication system which could be

used in teaching fourteen different lessons in low-voltage wiring installation, and

2. To produce an electrical trainer set-up on signal and intercommunication system made out of local materials which can function and execute the work in low-voltage wiring installation and having the same degree of efficiency and effectiveness like the commercially made signal and intercommunication system, and

3. To limit fixing of wires during actual demonstration classes thus maximizing the number of hours for instruction. The electrical trainer set-up on signal and intercommunication system is simple and economical in meeting the needs of the students in low-voltage wiring installation.

4. To save money, time, effort and materials in classroom instruction in the use of electrical trainer on signal and intercommunication system.

Significance of the Study

This study hopes to enlighten the instructors in electricity on the operations and use of the electrical trainer on signal and intercommunication system in teaching lessons on the following concepts: (1) electric bell connected in series, (2) electric bell connected in series controlled by one push-button switch, (3) electric bell

connected in parallel with indicating lamp, (4) two electric bells connected in parallel controlled by each individual switches, (5) three electric bells connected in parallel controlled by individual switches, (6) buzzer connected in parallel controlled by one push-button switches, (7) two electric bells controlled by two push-button switches with two indicating lamps, (8) burglar alarm circuit wiring, (9) burglar alarm circuit wiring using indicating lamp, (10) alarm circuit wiring with voltmeter connected in parallel, (11) alarm circuit wiring with voltmeter in parallel and ammeter in series, (12) one-call master intercom system, (13) two-call master intercom system, (14) three-call master intercom system. In making wiring connections, safety must always be emphasized and practiced.

Hopefully, this study will help the instructor in electricity facilitate demonstration lesson particularly in the low-voltage wiring system. This will help the learners understand the different operations and applications of electric circuit in the low-voltage wiring installations.

This electrical trainer saves time, effort, and materials used in classroom instructions.

The production of this electrical trainer is within the physical and financial capability of the researcher. Electrical materials and accessories are available in the

locality. This electrical trainer can be constructed by the students in electrical technology. It will serve as a training aid in the concepts of low-voltage wiring installations. This electrical trainer is used in teaching lessons in Electricity classes so that upon finishing the course students are prepared to face such electrical tasks and skills performed in factories and industries upon their employment. The completion of this study is significant to the students, teachers, and school in terms of budget.

Scope and Delimitation of the Study

The study is focused on the design, construction, try-out and revision, and test of efficiency of the electrical trainer. The study includes the following: construction, specification of materials used, operation techniques and the cost of the operation, production of the improvised electrical trainer system. The trainer utilized local materials such as pieces of plywood, wood, and for the frame of the trainer.

The trainer was limited only to demonstrate 14 lessons on the basic concepts of low voltage wiring installations which are as follows: (1) electric bell connected in series, (2) electric bell connected in series controlled by one push-button switch, (3) electric bell connected in parallel with indicating lamp, (4) two electric

bells connected in parallel controlled by each individual switches, (5) three electric bells connected in parallel controlled by each individual switches, (6) buzzer connected in parallel controlled by one push-button switc (7) two electric bells controlled by two push-button switches with two indicating lamps, (8) burglar alarm circuit wiring, (9) burglar alarm circuit wiring using indicating lamp, (10) alarm circuit wiring with voltmeter connected in parallel, (11) alarm circuit wiring with voltmeter in parallel and ammeter in series, (12) one-call master intercom system, (13) two-call master intercom system, (14) three-call master intercom system.

Moreover, this is used only as a device for demonstration purposes in electrical shop classes.

This study is limited to the demonstration of lessons in signal wiring, alarm wiring and intercommunication system installation, including safety practices on these lessons. The functionality of signal and intercommunication system trainer is likewise included in the study. All other operations and technical aspects not mentioned in this study are beyond its scope. The gadget can be improved further to keep the trainer operative in the application of low voltage wiring installation. The gadget can be improved further to keep the trainer operative in the application of low voltage

wiring installation.

Conceptual Framework

According to Grab[4], that to alleviate the burden of using so many teaching devices during demonstration and practical application of operation, electrical gadget will be a worthy alternative. He cited further:

Basic concepts, principles and operations in electrical and industrial technology are best presented by means of demonstration to provide opportunities for the students to experience themselves the actual operation of electrical equipment as current flows in the circuit.

This technical feasibility study was undertaken in order to come up with a model that would provide activities of the learners in the electrical technology classes and even in the laboratory high school electricity classes at the Samar State Polytechnic College at a very low cost.

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[4]Bernard Grob (Electronic Circuits and Application) New York: Mc-Graw Hill Book Company, 1982, p. 16.

The conceptual scheme is illustrated in a paradigm below. The scheme served as the guide during the time of this study.

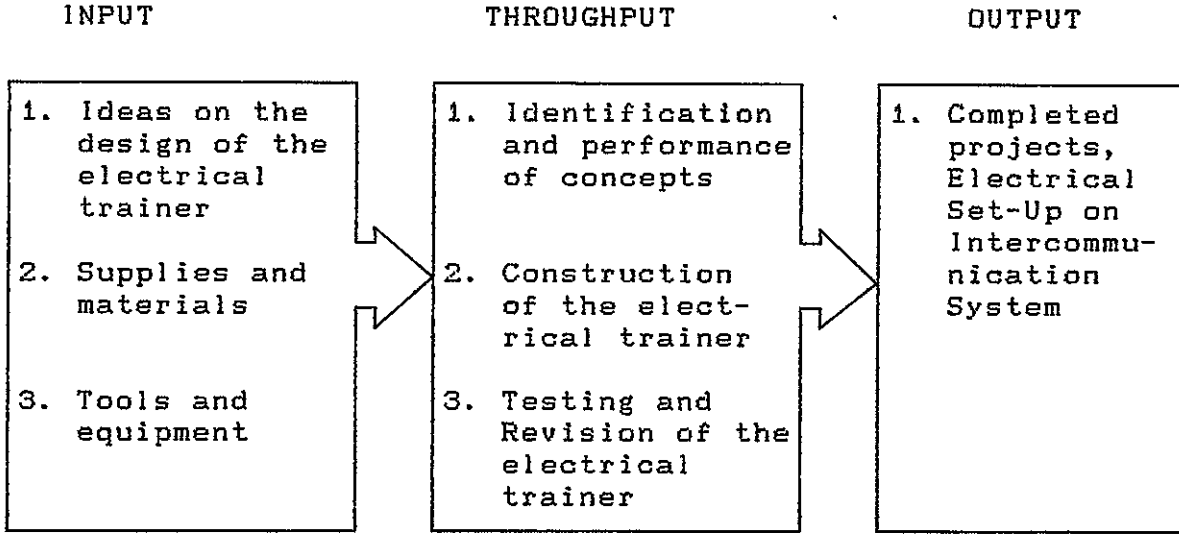

Figure 1. Conceptual Model of the Study

After consulting several books, journals and magazines in electricity, the idea of designing and developing an electrical trainer in low voltage wiring was realized and formed.

Figure 1, shows the three major frames which represent the input-throughput approach to the expected outcome of the study. The first frame represents the input of the study showing the ideas on the design of the electrical trainer, supplies and materials, tools and equipment and labor.

The second frame indicates the throughput of the

study consisting in the identification and performance of the concepts, construction of the electrical trainer, testing and revision of the electrical trainer.

The third frame represents the output of this study which is the completed project.

Definition of Terms

The following terms are operationally defined as used in this study.

Alarm. A device that warns or signals by means of a noise.[5]

Alternating-current. An electrical current in which current flows and reverses from one direction to another direction.

Banana Jack. A piece of round metal at the end of an extension cord used to transmit current by inserting it to its corresponding input jacks.

Bell. A cup-shaped or hollow spherical metallic device that vibrates and gives forth a ringing sound when struck by a clapper or hammer.[6]

Burglar-alarm. A device for automatically giving

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[5]Miriam Webster, "Webster Third International Dictionary" (Massachusettes, G. and L. Miriam Co.) p. 48.

[6]Ibid., p. 63.

an alarm in case of burglary.

Buzzer. An electrical signal device producing a buzzing sound.

Closed circuit. A circuit whose path carries completely around a course or through a cycle without a continuity.[7]

Cord wire. A kind of wire made of several strands of fine conductors. It is the manufactured in single and duplex wire.[8]

Demonstrator. A gadget, device or equipment used to make learning easy and effective.

Direct-current. An electrical current in which the current flows in the same direction.

Equipment. Materials, fitting, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with an electrical installation.

Electric current. Electrons moving throughout conductors by the application of voltage.

Grounded circuit A wire or piece of equipment to be connected to a water pipe, or to an artificial ground as the code call it, grounds are made to promote.

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[7] Ibid., p. 86.

[8] Arthur L. Abbott, National Electrical Code Handbook, (New York: McGraw-Hill Book Co, Inc.), p. 5

Improvise. To make or to modify whatever is at hand usually for the purpose of reducing the cost.

Insulator. A body of electrically non-conducting material for keeping charged conductors from contact.[9]

Intercommunication system. A two-way communication system with microphone and loudespeaker at each station for sending and receiving messages to the clienteles.

Local material. Materials found in the locality and communicating with a limited area.[10] maybe secured for free or can be bought at a very low cost.

Low voltage. Voltage low enough to be considered safe for indoor domestic use, or voltage below that is required for normal operation.

Open circuit. A break in one of the conductors.[11]

Parallel circuit. A multiple circuit, a connection where the current is divided and part flows through each device connected to it.[12]

Rectifier. A device for changing alternating-current

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[9]Ibid., loc. cit. p. 1143.

[10]MERALCO Electric Manual, (Fourth Edition, 1978, Metro Manila). p. 76.

[11]Perry and Schafebook, Fundamental Jobs in Electricity, (New York: McGraw-Hill Book & Co., Inc.) p. 279.

[12]Ibid., loc. cit. p. 281.

to direct-current.[13]

Resistance. The opposition offered by a material to the flow of an electric current.

Relay. An electromagnetic device for remote or automatic control that is actuated by a variation in condition of electric circuit.[14]

Series circuit. A circuit in which the same current flows all the devices.

Signal. A sound of light made to give warning or command.

Short circuit. It is an electric circuit. It maybe caused by inherent defects or by external causes.

Technician. A technician is a worker on a level between the skilled trade, worker and professional electrical engineer, he may design the mechanism, computes the cost, write the specification, organize the procedure, and test the finished product.[15]

Trade skill. The ability to perform the manipulative operation in connection with the given trade.[16]

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[13]Webster, p. 1999.

[14]Ibid.

[15]Webster, p. 1917.

[16]Ibid., p. 1918.

Trainer. An apparatus or device used in training or instruction.

Trainor. A skillful person who trains, directs, and supervises instruction in a course.

Volt. The amount of potential difference or voltage.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter includes relevant information on the different types of low voltage wiring installation, improvisation of machine and electrical apparatus, and electrical trainer invention.

RELATED LITERATURE

Harris[17] revealed that the primary purpose of the laboratory work is to provide the opportunity for learning through participation and observation. All these actual performances in shop classes can be achieved by the students if the school has enough shop facilities necessary for class instruction and demonstration. However, it is sad to note that most vocational and technical institutions in the Philippines today, lack the necessary skills, training facilities, the supplies and materials to satisfy the needs of the students.

Albarracin[18], underscored that teachers should have

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[17]Norman C. Harris, "Experiments in Physics" (New York: McGraw-Hill Book Co., Technical Education Series, 1963), p. 3.

[18]Narciso C. Albarracin, "Science Seminar Workshop," The Philippine Journal of Education, 1978.

the initiative, and imagination in classroom teaching and must possess the skill and know-how in the improvisation of the needed equipment to augment what are already found in the laboratory.

Weaver,[19], expressed his views about electricity as a branch of science and physics, and possibly the greatest benefactor to mankind. He cited further:

> "In its most basic sense, signal and intercommunication is the process of transmitting and receiving messages so that the receiver to the point of destination understands the message the sender (source) sent."

Herman[20] states that the familiarization of electrical symbols used in signal wiring is very necessary for a person who will engaged in electrical works. Electrical symbols specifically in signal wiring and intercommunication are usually done by means of illustrations and drawings which the reader may analyze and interpret. Some of the electrical symbols used in signal wiring are; electrical bells, buzzer, push-button switch, battery, rectifiers, ground, d-c ammeter and voltmeter, and intercommunication system. This

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[19]Warren Weaver, "Science of Electricity and Electronics", The Goodheart-Willcox Company, Inc., 1980.

[20]Duff Herman, "Principles and Appplications of Wiring", McGraw-Hill Book Co., New York, U.S.A., 1976.

means that understanding and analyzing the drawing of electrical symbols used in signal wiring helps the learner to get easier of the task he performs. Ford[21] in his book concludes that an inexperienced electrician performing the low-voltage must be acquainted first with the internal connections of a vibrating bell, converters, ammeter, voltmeter, buzzer and other signal wiring device before the work could be done. He emphasized that a poor work would happen if a learner is not properly coordinated and well-oriented.

Roe[22] cited the connections between series and paraller of electric bells. The series connection of electric bells is commonly done for experiment purposes only in electrical and electronics laboratories. The device is connected in a single line only which in turn is dependent on other device. Parallel connection of electric bells is more advantegeous because each device is connected across the line. They are independent to other device. This is the most common method of wiring.

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[21]Steinberg Ford, "Electricity Made Simple", South-Holland, Illinois, The Goodheart-Willcox Co., Inc.

[22]L.B. Roe, "Electrical Design on Low-Voltage Wiring", American Marketing System, L.A. (California, McGraw-Hill Book Co.

The book of Perry and Schafebook[23] states that some of the low-voltage wiring installation are as follows: (1) electric bells connected in series. This type of connection is not advantegeous because if one of the other device malfunctioned, the whole circuit will be affected. This method is only applicable for the purpose of experiment. (2) Electric bell connected with an indicating lamp. This type of installation is used mostly in our homes. This is more advantegeous than series connection because the device is connected across the lines. There is no interruption in the flow of electric current because each device is connected separately in the circuit. (3) Electric bell connected in series controlled by one push button switch. This method of wiring is used mostly in offices and shop. (4) Two electric bell connected in parallel controlled by each individual push-button switch. This type of wiring is applicable for a two-door apartment rooms. The device is controlled by one push-button each electric bell. (5) Buzzer connected in parallel controlled by one push-button switch. This method of wiring connection is commonly installed in public libraries, and gymnasium where it is necessary. (6) Two-bells connected in parallel controlled by

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[23]Perry, op. cit. p. 29

one push-button switch. This type of low-voltage wiring connection is used when the device is installed in a wider area or space to be controlled immediately. (7) Two electric bells connected in parallel controlled by two push-button switches with the indicating lamp.

This method of wiring installation is used when the device is installed in a two-room apartment houses where, it is necessary to install a signal device or indicating lamp. (8) Alarm circuit using closed circuit relay. This type of connection is used mostly for burglar alarms or in places where the circuit is broken by cutting of wires. The bell will ring continually until the circuit is closed. (9) Burglar alarm wiring using push-button switch with indicating lamp. This method of wiring is installed mostly in offices for emergency purposes. (10) Alarm circuit wiring with voltmeter connected in parallel. This type of wiring is used for experimental purposes only. (11) Alarm circuit wiring with ammeter in series and voltmeter in parallel. This method of wiring is applicable only as in experiments of students measuring d-c voltage and amperes using alarm circuits. This circuit is adaptable to many uses. (12) One call master intercom system. This type of installation is commonly used when person desires to call or listen to one sub-station by pressing the selector switch. (13) Two call

master intercom system. This method of wiring installation is used when a person wants to call or send message to its two sub-station. (14) Three call master intercom system. This type of low-voltage wiring installation specifically on intercom system, is applied when a person desires to call or listen to each three sub-station by merely pressing or rotating the selector switch.

Lush and Engle[24] illustrated in their book another system of low-voltage circuit wiring of signal devices which consists of the following (1) parallel circuit of vibrating bells. Each bell obtains its current directly from the feed wire and returns indirectly to the return wire. The main wires are along side each other. This circuit is also used where several buttons are desired. (2) Series circuit of bells. If an open circuit develops in one bell all the rest will go dead, because the current cannot travel beyond the open place.

Kidd[25] cited that teachers teaching shop subjects must secure and prepare instructional materials and equipments to enhance effective teaching. The types of

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[24]Lush and Engle, "Industrial-Arts Electricity," (Chas; A. Bennet Co., Inc., Publisher, Peoria, Illinois) p. 57.

[25]Donald M. Kidd. "Methods of Teaching Shop and Related Subjects, (New York: Delmar Publishing Inc., 1955) p. 86.

materials used for the shop instructions are: (1) trade journals, which are published for those engaged in the trade occupation and useful for directed study and as sources for additional material which maybe of value, (2) periodicals, of a more general nature dealing with business, industry, and industrial problems. These publications often describes with excellent illustrations, processes and industrial methods and certain useful data in connection with a wide variety of industrial occupation, (3) descriptive material issued by manufacturer of equipment and supplies while some of the material are prepared for advertising and sales use, it remains valuable as descriptive material for teaching purposes.

Manufacturer's information explaining installation maintenance and use of equipment is also available, (4) excellent teaching aids, created lastly for instructional use, (5) instructional sheets in the form of information sheets, where such sheets have been made available for learners they can be used for directed group study, (6) instructional gadgets, assist the instructor in the delivery of subjects matter or concept which arouse interests of the learner in the practical application. These teaching materials and devices therefore, attain great opportunity for improving the teaching and learning process

in the shop.

McGivrey[26] expressed the importance of improvisation of machine for laboratory use. He stressed that in the field of education, experts have concentrated their efforts in making teaching relevant to the demands of industry. As industrial experts and educators, we must continue to experiment using imagination and industrial techniques in our laboratories whenever feasible. One solution to the ever present problem of acquainting the student with realistic commercial shop practice is the time clock approach, which concentrates on such subjects as body mechanics, diagnostic tune-up procedure, wheel alignment, disk brake services, and the use of dynamometer.

The situation here is much like that of an actual auto shop with the aim of improving gadgets and prepare our youth for the world of work.

RELATED STUDIES

After a thorough investigation and review of the different studies and seminar papers made by some researchers, this researcher planned to develop an instructional model in making an electrical trainer on

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[26]William G. McGivrey, "Industrial Skills", London, Sir Isaac and Sons Limited, 1069, p. 30 - 31.

signal and intercommunication system.

Bao[27] in his seminar paper entitled " An Improvised Multi-Purpose Demonstration Gadget: A Technical Feasibility Study" sought to design and construct a multi-purpose demonstration gadget that could be used for shop instruction and can be utilized for wiring different circuits in alternating current systems for the experiment of the students.

Albos'[28] seminar paper entitled "A Multi-Purpose Grinder and Drill Press Machine: A Technical Feasibility Study" was concerned with the design and construction use and functionality of a multi-purpose grinder and drill press machine for instructional purposes. The study was conceived because of the need of the Samar State Polytechnic College Machine Shop for this type of training equipment for instructional purposes. His study attempted to design and construct a multi-purpose grinder and drill press machine for instructional aid out of locally available materials.

The findings of his study were as follows: (1) The

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[27]Clemente C. Bao, Sr. "An Improvised Multi-Purpose Demonstration Gadget: A Technical Feasibility Study" (unpublished Seminar paper, Samar State Polytechnic College, Catbalogan, Samar, April, 1986), p. 23.

[28]Emilio Albos, "A Multi-Purpose Grinder and Drill Press Machine: A Technical Study, MIST, Marikina, M. Manila, 1985.

machine can perform operations similar to that of commercial type; (2) The multi-purpose grinder and drill press machine is used for shop instruction and can be utilized in the making of projects of the students.

Bañez[29] in his seminar paper entitled "Motor Control System Trainer: A Technical Feasibility Study" sought to design and construct a motor control system trainer that could be used for shop instruction and can be utilized in different motor control systems for the experiment of the student. The findings of his study showed that the motor control system can perform and demonstrate different motor the actual motor controllers used in the industries.

Francisco's[30] seminar paper entitled "Instructional Model of an Emergency Lighting: A Technical Feasibility Study" was a study dealing with the design and construction, use and functionality of an emergency lighting as an instructional aid. This instructional aid provides adequate experiences that affect positively the learning process. His study attempted to design and construct an improvised

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[29]Tomas O. Bañez, "Motor Control System Trainer: A Technical Feasibility Study, MIST, Marikina M. Mla., 1986.

[30]Rodrigo R. Francisco, "Instructional Model of an Emergency Lighting: A Technical Feasibility Study, MIST, Marikina, M. Mla., 1986.

emergency lighting as an instructional aid out of locally purchased materials. It was made to test the functionality of an instructional model in order to meet the needs of the technical-vocational schools. The significant findings of his study showed that it is technically feasible to design and construct an instructional emergency lighting out of locally available materials.

The cost of the emergency lighting per unit was P1,768.70 and therefore, its development generated saving not only the school but also for the government.

Merecido's[31] seminar paper entitled "Instructional Direct-Current Circuit Analyzer: A Technical Feasibility Study" was concerned with the design and construction, use and functionality of an improvised direct current motor circuit analyzer as an instructional aid. It was constructed to show and demonstrate electrical troubles of direct current motors.

His study attempted to design and construct an improvised direct current motor circuit analyzer as an instructional aid out of locally purchased materials. The significant findings of his study are the following: (1) Out

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[31]Floro Merecido "Instructional Direct-Current Motor Circuit Analyzer: A Technical Feasibility Study", MIST, Marikina, M. Mla., 1984.

of locally purchased electrical materials available, a demonstrator can be constructed. The lessons that could be demonstrated by his instructional aid are as follows: (a) Overhead troubles, (b) centrifugal switch trouble, (c) shorted or opened capacitor trouble, (d) shortened or opened, and ground motor winding, (e) single-phase trouble, (f) low-voltage trouble. The demonstrator could also be used to determine current and horsepower capacity. The cost of one unit of the improvised demonstrator was P5,828.00 whereas the cost of one unit of its commercial counterpart was P9,100.00 at the time of the completion of the study. The difference of P3,272.00 represents the savings not only of the school but also of the national government.

Mantua[32] developed fourteen units of improvised apparatus in electricity enclosed in a cabinet that measures 115 cm. x 50 cm. - 40 cm. One of the units was electric force model used to show the behavior of the conductor when electric current flows through them and when conductors are parallel to the other. Magnet wire was used to change the wire placed parallel to the other when wire was burnt during experiments. This wire can be used as protective device of

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[32]Fe Mantua, "Improvised Apparatus and Experiments in Basic Electricity: A Technical Feasibility Study", MIST, Marikina, M. Mla. 1978.

the electromagnitizer.

Cabuatan[33] who invented an A.C. portable charcoal stove grills revealed that a cooking stove could be made into a multi-fueled stove at a very low cost. It is portable and durable and easy to operate. Charcoal, firewood or saw dust can be used to make the construction more economical.

Perez[34] seminar paper entitled "Modified Automotive Electrical Tester: A Technical Feasibility Study" attempted to study and develop an apparatus which could be used in teaching automotive technology effectively and efficiently. The improvised apparatus was the modified automotive electrical tester. This modified apparatus could be used in testing the different parts of the alternator and generator, such as the rotor, stator diode, field coils, and armature. The different parts of the modified apparatus could be determined with open and short circuited parts and can test the output voltage and current, resistance of the alternator, and generators, and it may also serve as a battery charger.

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[33]C. I. Cabuatan, "A.C. Portable Charcoal Stove" Handouts, Cabuatan Enterprises, Bacsa, Quezon City, 1984.

[34]Leogardo G. Perez, Modified Automobile Electrical Tester: A Technical Feasibility Study" (unpublished master thesis, MIST, Marikina, M. Mla. 1984)

Relationship with the Present Study

The various types of low-voltage wiring installations of Perry and Schafebook, Lush and Engle, Weaver and Herman, Roe, and McGivrey are closely related to the present study designed and constructed by the researher, in the sense that these are similar wiring installations in the low-voltage wiring system. The principles and its concepts can be performed by this electrical trainer. The studies of Bao, Albos, Bañez, Francisco, Mericido, Mantua, Cabuatan, and Perez enlighted and encouraged the researcher in the improvisation of teaching-learning devices mostly needed in the actual classroom instruction.

These studies are similar to the present study because the project can be used as a training equipment for classroom instruction. It may differ from former studies only on functionality and its uses.

These related literature and studies contributed much to the improvisation of the electrical trainer on signal and intercommunication system.

Chapter 3

DEVELOPMENT OF THE PROJECT

This chapter describes the electrical trainer in details. The discussion includes supplies and materials used, tools and equipment, construction, procedure, schedule of the production, parts of the electrical trainer, safety precautions and production cost of the gadget.

Description of the Electrical Trainer

This electrical trainer was made of an ordinary plywood covered with formica of 75 cm. x 50 cm. for the front board. This is an appropriate size because the accessories and components of the trainer were portable and they could be easily installed in an accessible location. The accessories and components of the trainer were easy to operate. They did not need a wide space because they were all installed at the front panel board. The same size and material also were used for the back cover with 20 cm. x 8 cm. lumber for the frame. The electric bells, buzzer, circuit breaker, bell transformer, intercom system, indicating lamp or pilot lights, converter, and push-button switches were mounted on the board including the d-c voltmeter and ammeter. The wiring connections were supplemented

with the banana jacks in which its input jack or plug was permanently mounted on the board, and wasconnected to the terminal screw whenever the desired connection is being made. The banana jack with a cord wire was directly connected to the input jack by means of plugging-in to the desired connection.

The kind of wire used for the electrical connection was a cord type no. 18 which was a substitute of the intercom wire. To perform the wiring connection using an intercom wire for the low-voltage wiring installation, a single cord wire no. 18 was used. It was used in plugging-in the banana jack to its end. An input jack was coupled to banana jack cord wire to utilize other connection coming from the circuit.

The project adopted the latest method of wiring installation system usually performed in modern buildings and industries. The wire that was used in the electrical trainer was flexible to minimize fixation of wire during the demonstration lesson. The electrical trainer used circuit breakers to protect it from excessive high current and short circuit that occur on the line. The transformer was used to reduce high voltage to low voltage, since signal and intercommunication system uses low voltage power supply.

Supplies and Materials

Table 1 shows the quantity, unit and name and description of the supplies and materials used in the construction of the electrical trainer.

Table 1

Supplies and Materials

Quantity	Unit	Name and Description
1	unit	Circuit breaker, single phase, 100 watts 220 volts
1	Unit	Bell transformer, 12 volts, 60 watts
1	unit	Anunciator, 12 volts, 60 watts
1	unit	D-C Ammeter, 12 volts, 30 amperes
1	unit	D-C Voltmeter, 12 volts, 30 amperes
10	units	Indicating Lamps (Pilot light), 12 volts
4	units	Electric bell, 12 volts
1	unit	Buzzer, 12 volts
5	units	Intercom system, 12 volts
1	unit	Converter power supply, AC-DC, 12 volts
8	units	Push-Button Switch, 12 volts, output
6	doz.	Input and Banana Jack Terminal, one-half meter, (length), no. 18 cord wire type

Table 1 (continued)

1/2	:	roll	: Duplex wire, No. 18
1	:	unit	: Relay, 12 volt
1	:	piece	: Male plug, rubber, heavy duty, two prongs, 10 amperes
50	:	pieces	: Wood screw, 3/4" length
4	:	pieces	: Machine Bolt, 6 mm. x 25 mm.
1	:	roll	: Plastic tape, 8 oz.
12	:	sheets	: Sand paper, waterproof, no. 200
2	:	pieces	: Rubber footing, 10 x 20 mm. x 20 mm
1	:	liter	: Paint, gray, lacquer paint
1	:	liter	: Paint, Red, lacquer paint
1	:	liter	: Paint, White, lacquer paint
1	:	liter	: Paint, Yellow, lacquer paint
1	:	piece	: Paint, brush, nylon bristles, 50 mm
4	:	pieces	: Lumber, 20 mm. x 80 mm.
4	:	pieces	: Lumber, 20 mm. x 50 mm.
4	:	pieces	: Lumber, 20 mm. x 40 mm.
1	:	sheet	: Plywood, 12 mm. x 40 mm. x 940 mm.
1	:	sheet	: Plywood, 12 mm. x 85 mm. x 940 mm.
1	:	sheet	: Plywood, 12 mm. x 130 mm. x 940 mm.
1	:	sheet	: Plywood, 12 mm. x 450 mm. x 510 mm.
1	:	sheet	: Formica, 12 mm. x 450 mm. x 510 mm.
1	:	bot.	: Rubber cement

Table 1 (continued)

1	:	kilo	: Nails, "1" length
1	:	kilo	: Plastic Wood Filler

Tools and Equipment

Table 2 shows the tools and equipment used during the construction of the electrical trainer and their various functions.

Table 2

Tools and Equipment and Their Various Functions

Tools and Equipment	Functions
1. Tools	
a. Cross-cut saw	: Cuts lumber and plywood into the required sizes.
b. Smooth place	: Smoothens the flat surface of the lumber and plywood.
c. Electric drill	: Bores holes on the plywood
d. Electrician Plier	: Holds, cuts and splices bigger size of wire.
e. Screwdriver	: Drives and tightens screws and terminal posts.
f. Long-nose plier	: Holds small parts, especially in confined areas, and in adjusting wires.

Table 2 (continued)

g.	Electrician knife	: Cuts and removes the insulation of wire.
h.	Claw hammer	: Drives and pulls nails
i.	Pull-push rule	: Measures the required dimension.
j.	Try-square	: Squares the exact angle of the wood.
k.	Wood chisel	: Cuts plywood and lumber into desired dimension
l.	Tin snip	: Cuts formica into required dimension
2.	Equipment	
a.	Electric Sander	: Smoothens surfaces of wood and plywood
b.	Working bench vise	: Holds lumber, and plywood
c.	Multi-tester	: Checks and tests the continuity of the circuit.

Construction of the Electrical Trainer

Figure 2 shows the full view of the electrical trainer set-up on signal and intercommunication system. Figure 3 shows the orthographic drawing illustrating the dimension of the electrical trainer. Figure 4-12 shows the gadget in full view with the parts labelled and identified.

Construction Procedure:

The electrical trainer on signal and intercommunication system was composed of four main parts, namely: (1) panel board assembly, (2) electrical components, (3) signal devices, and (4) intercom system.

In constructing the different parts of the electrical trainer on signal and intercom system, some basic steps were followed below:

1. Make a plan for the electrical trainer and its accessories.
2. Provide materials needed for the construction of the electrical trainer.
3. Measure the dimension required for the project.
4. Layout the lumber based on the dimension of the project.
5. Layout the plywood based on the dimension of the project.
6. Cut the lumber according to sizes.
7. Cut the plywood according to sizes.
8. Layout the formica based on the dimension of the project.
9. Cut the formica according to sizes.
10. Assemble the wooden frame for the panel, and board following its measurement.

11. Bore a hole on the board using the hand or electric drill with a 0.6 cm. bit for the connection from electric bells, and buzzer.

12. Bore another hole of the same board for wiring connection of circuit breakers, transformer, indicating lamps, d-c measuring instruments, which are to be connected to the input jack according to the plan.

13. Mount all parts and other components of the electrical trainer circuit breaker, electric bell, push-button switches, d-c measuring instruments, buzzer, transformer, intercom system, and relay to the input jacks of the terminal according to the dimension.

14. Make all the necessary connections from the circuit breakers, electric bells, push-button switches, d-c voltmeter and ammeter, relay, buzzer, transformer, and intercom system to the input jacks and solder all the connections.

15. Cut pieces of wire no. 18 as an extension wire for the sub-station of the intercom system.

16. Connect two (2) meters of no. 14 duplex wire for the power supply with a heavy male plug.

17. Apply sandpaper to the front, top, side, and back portion of the electrical trainer.

18. Paint the side, top, and back portion of the electrical trainer.

19. Draw and label each part of the electrical trainer.

20. Put letter symbol and number of the electrical trainer for proper identification.

Schedule of the Production of One Unit of Signal and Intercommunication System Trainer

Table 3

Estimated Construction Procedure Analysis

ACTIVITY	Number of Days																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a. Assembly of the front & back cover																						
b. Assembly of its parts																						
c. Assembly of banana jacks																						
d. Assembly of input jack terminal																						
e. Tryout, testing and revision																						
f. Labelling of its parts																						
g. Painting of the board and its parts																						
Total number of days																						22 days

Table 3 represents the time frame in the production of one unit of signal and intercommunication system trainer, expressed or stated in terms of the number of days to be spent in the production, construction and the connection of the electrical accessories and components. It is estimated that the construction of this electrical trainer can be finished within 22 days.

Parts of the electrical trainer. The component parts of the electrical trainer on signal and intercommunication system as shown in Figure 4 were as follows: (1) board, (2) circuit breaker, 30 amperes, (3) bell transformer, (4) gravity-drop annunciator, (5) d-c ammeter, (6) d-c voltmeter, (7) indicating lamp, (8) four electric bells, (9) buzzer, (10) one-call master station, (11) three-call station, (12) converter, (13) set of push-button switches, (14) input jacks, (15) banana jacks, (16) extension cords, (17) intercom sub-station, 1, 2, and 3, (18) duplex wire, (19) burglar alarm.

Safety precautions. In the application of the concepts on the low-voltage wiring installation, using this electrical system trainer, the teacher or the demonstrator must observe the following safety precautions: (1) Turn "off" the circuit breaker when making some electrical

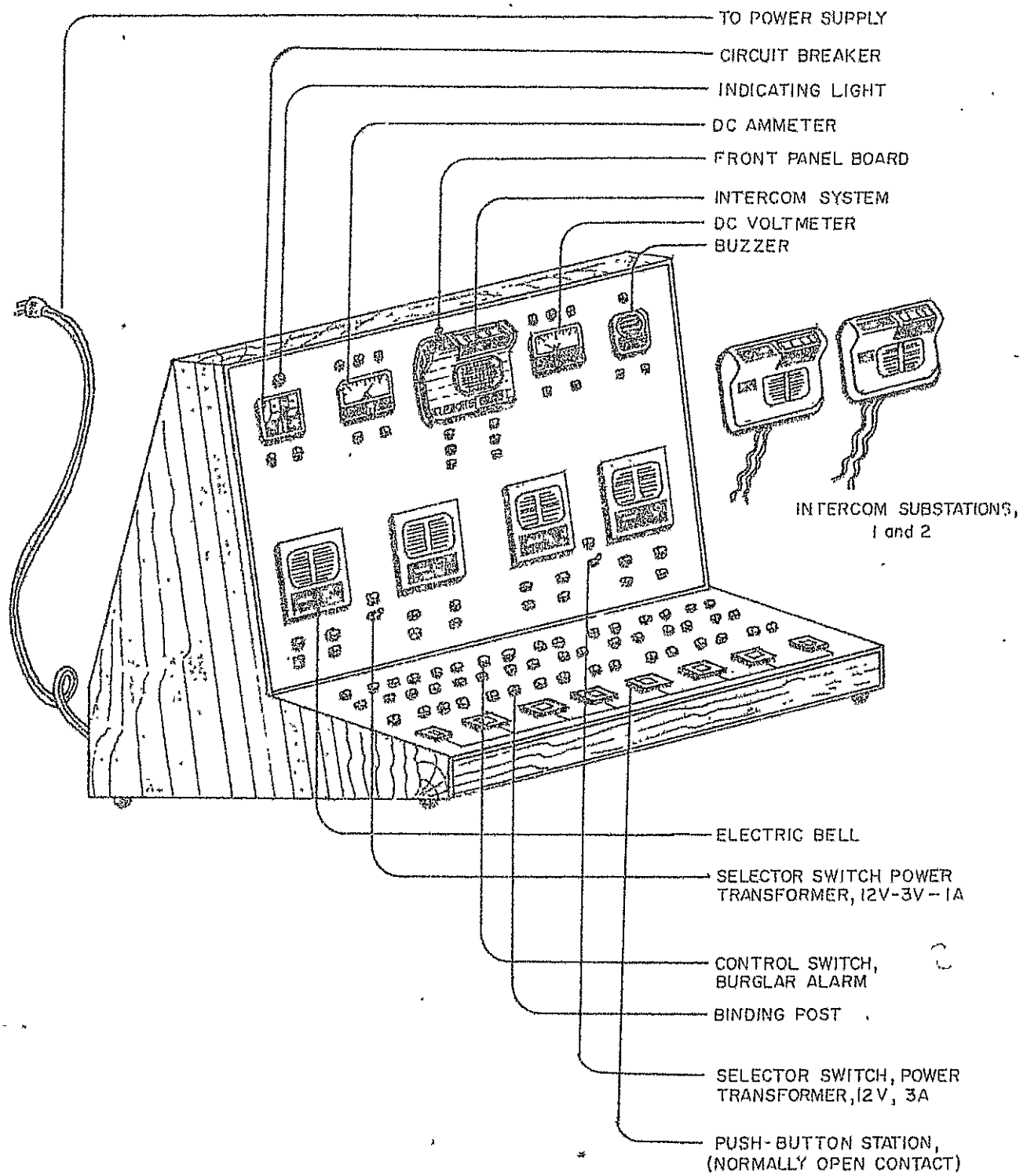


Figure 2. Full View of an Improvised Signal and Intercommunication System Trainer. The accessories and component are described and labelled in detail.

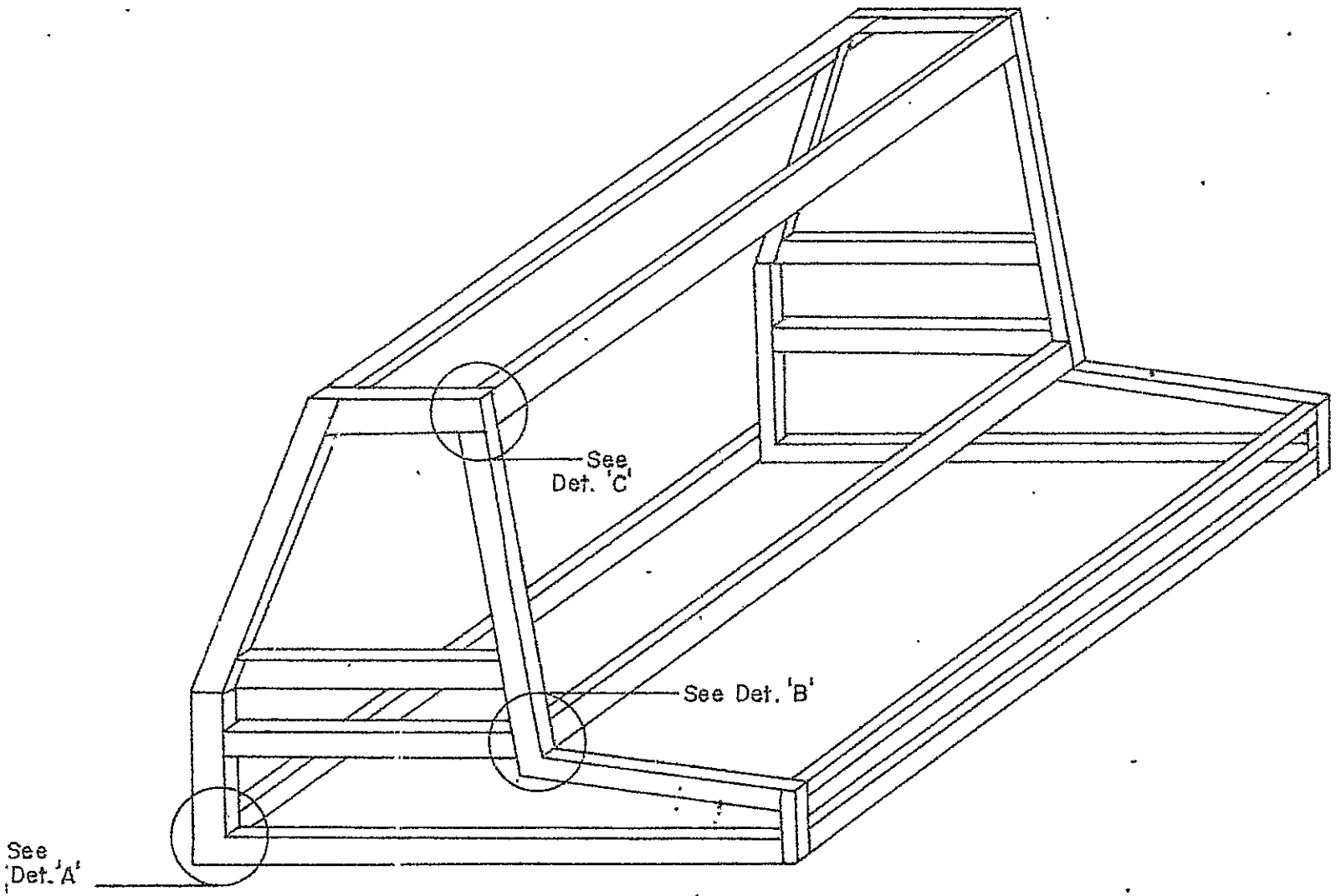


Figure 3. Showing the Panel Frame of the Project.

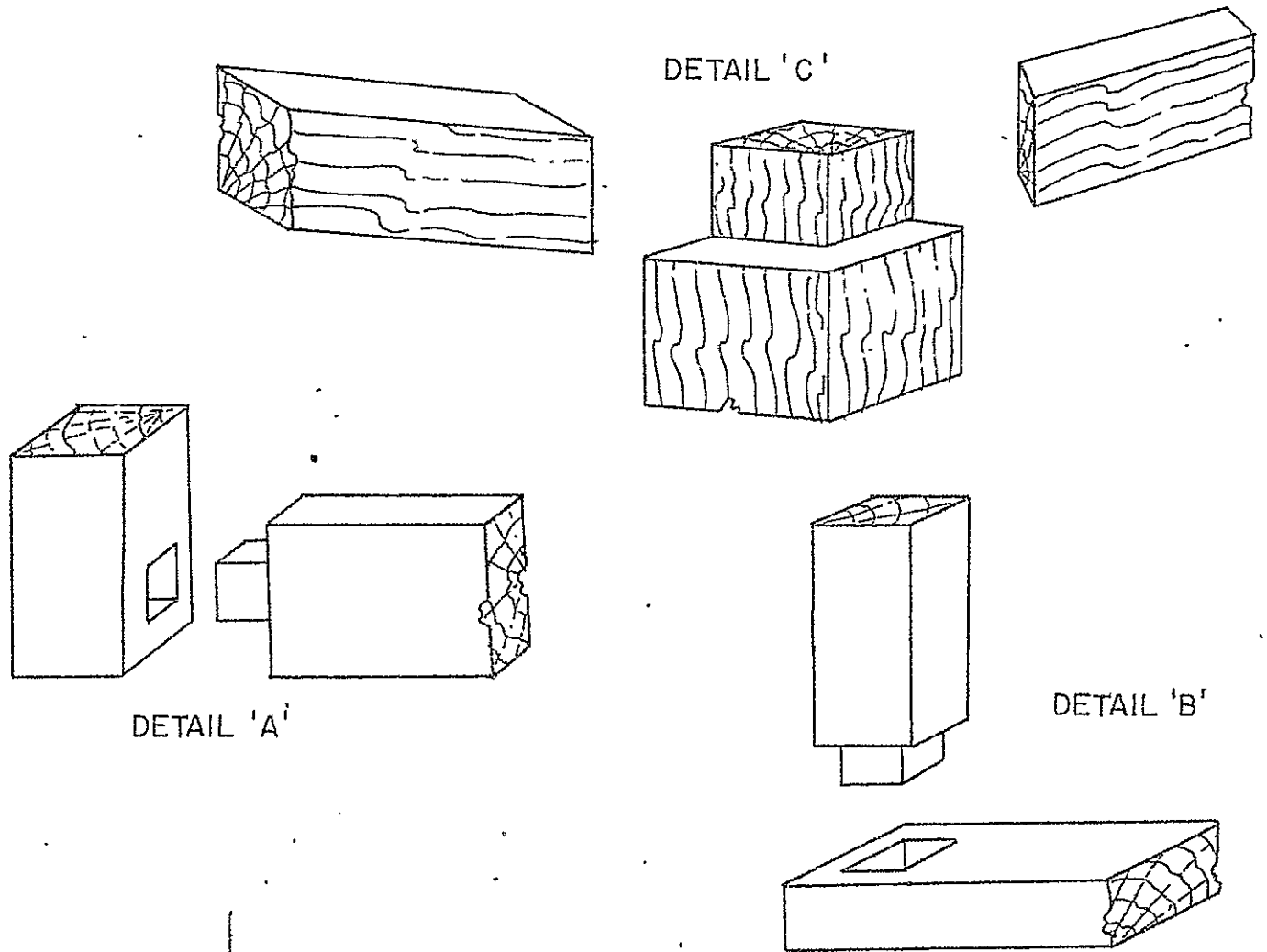


Figure 4. Showing Wood Joints of the Panel Frame.

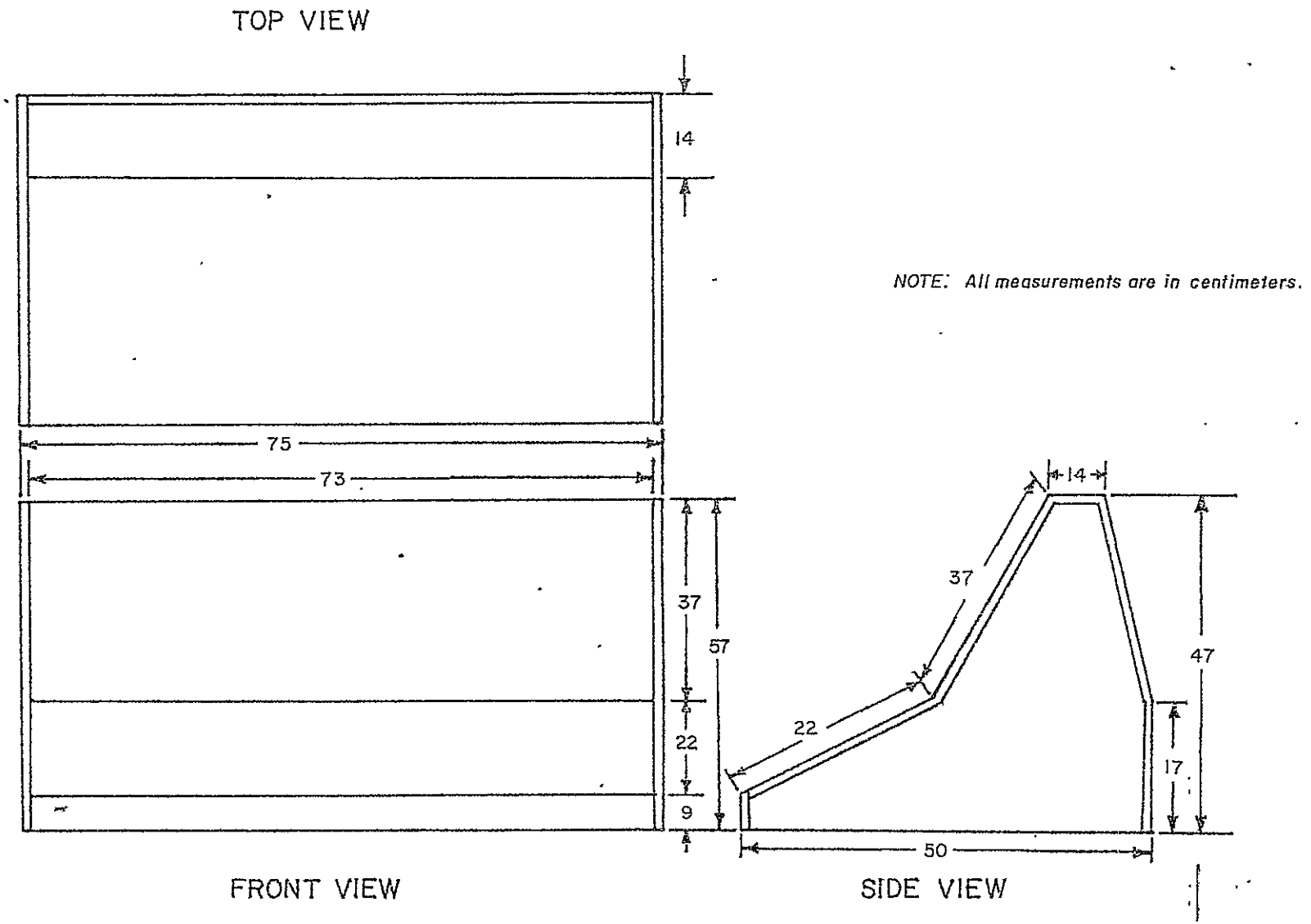


Figure 5. Showing the Orthographic Drawing of the Panel Board

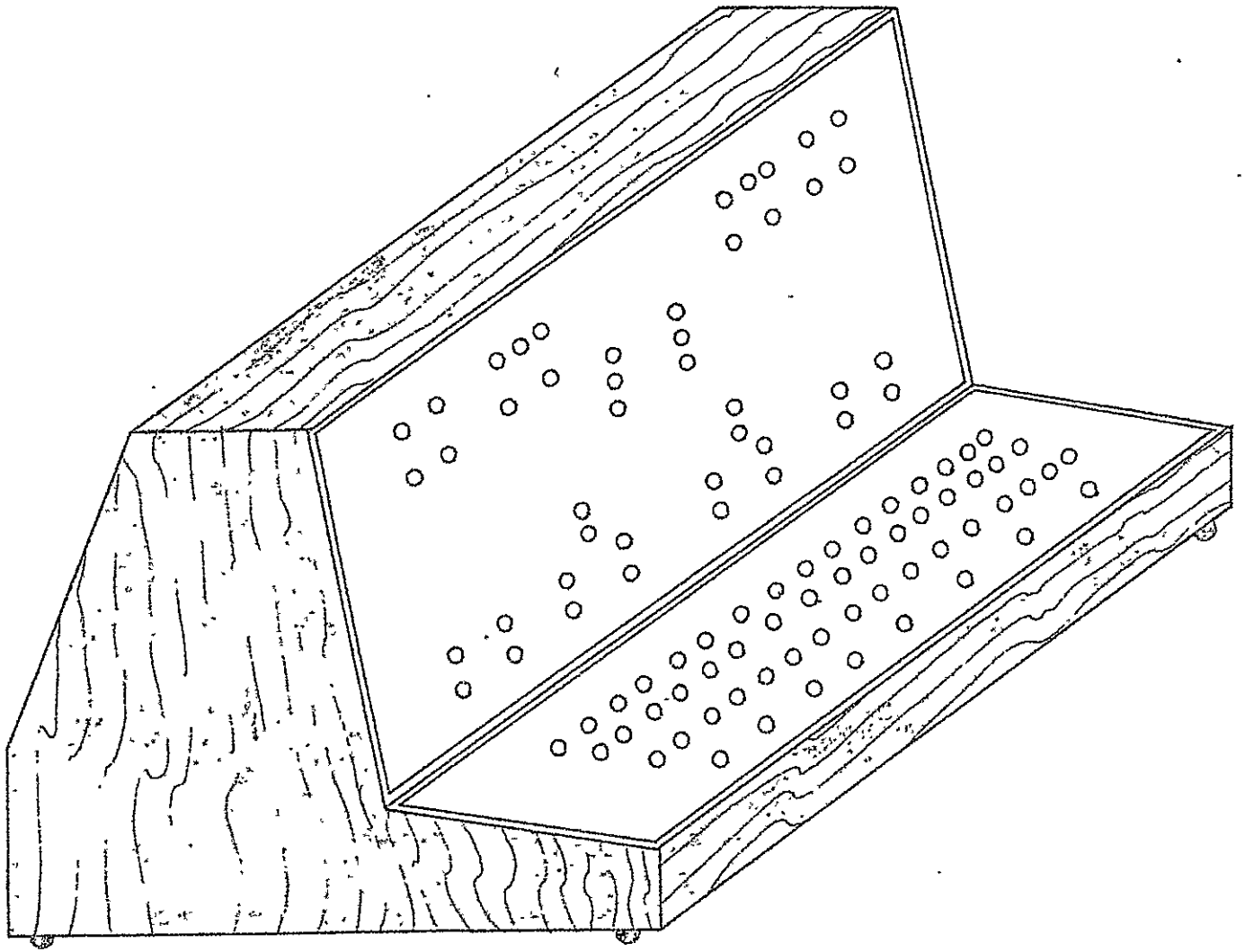


Figure 6. Layout of Holes for the Banana Jacks.

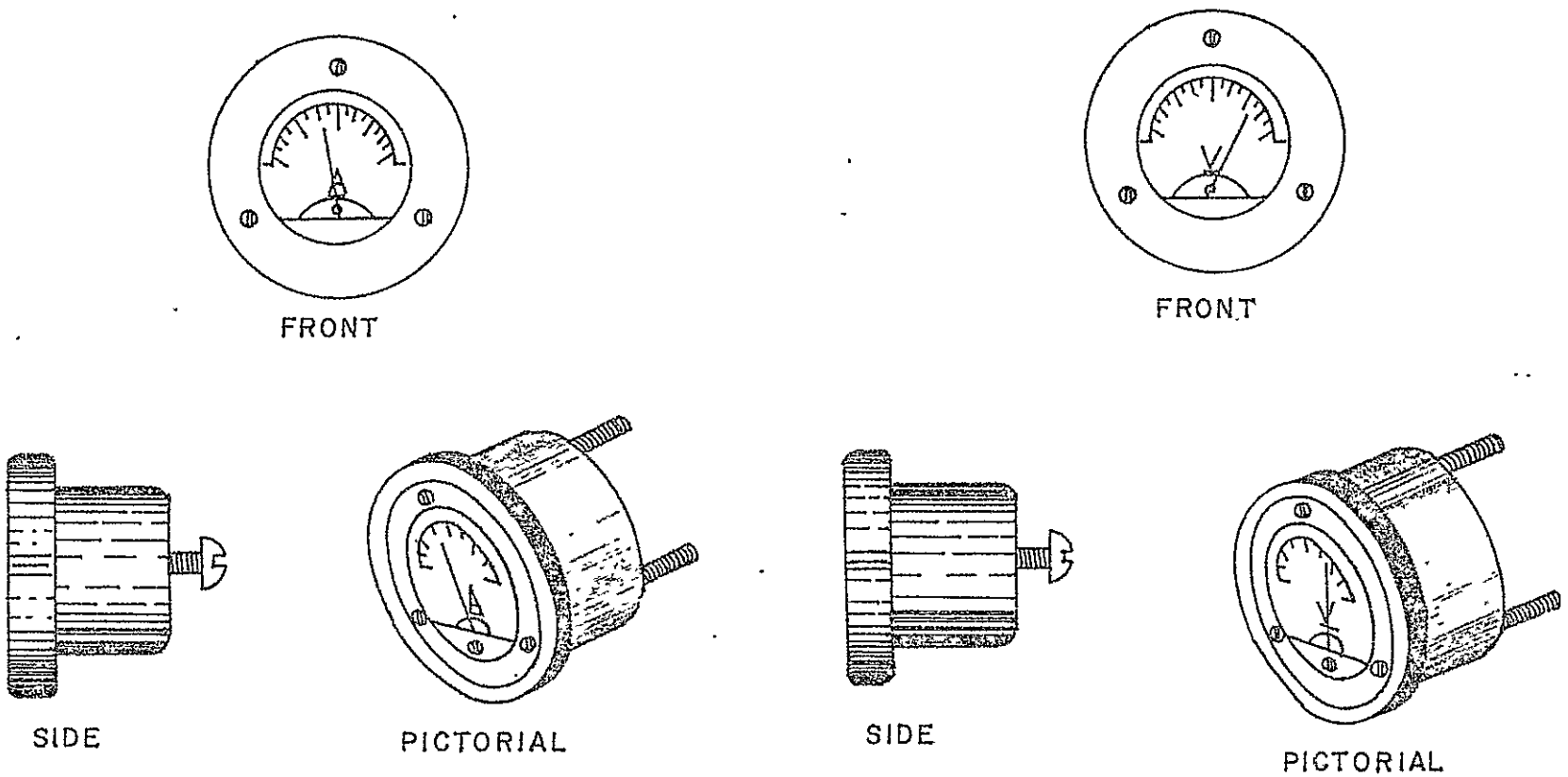


Figure 7. Showing the Panel Type DC Voltmeter and Ammeter.

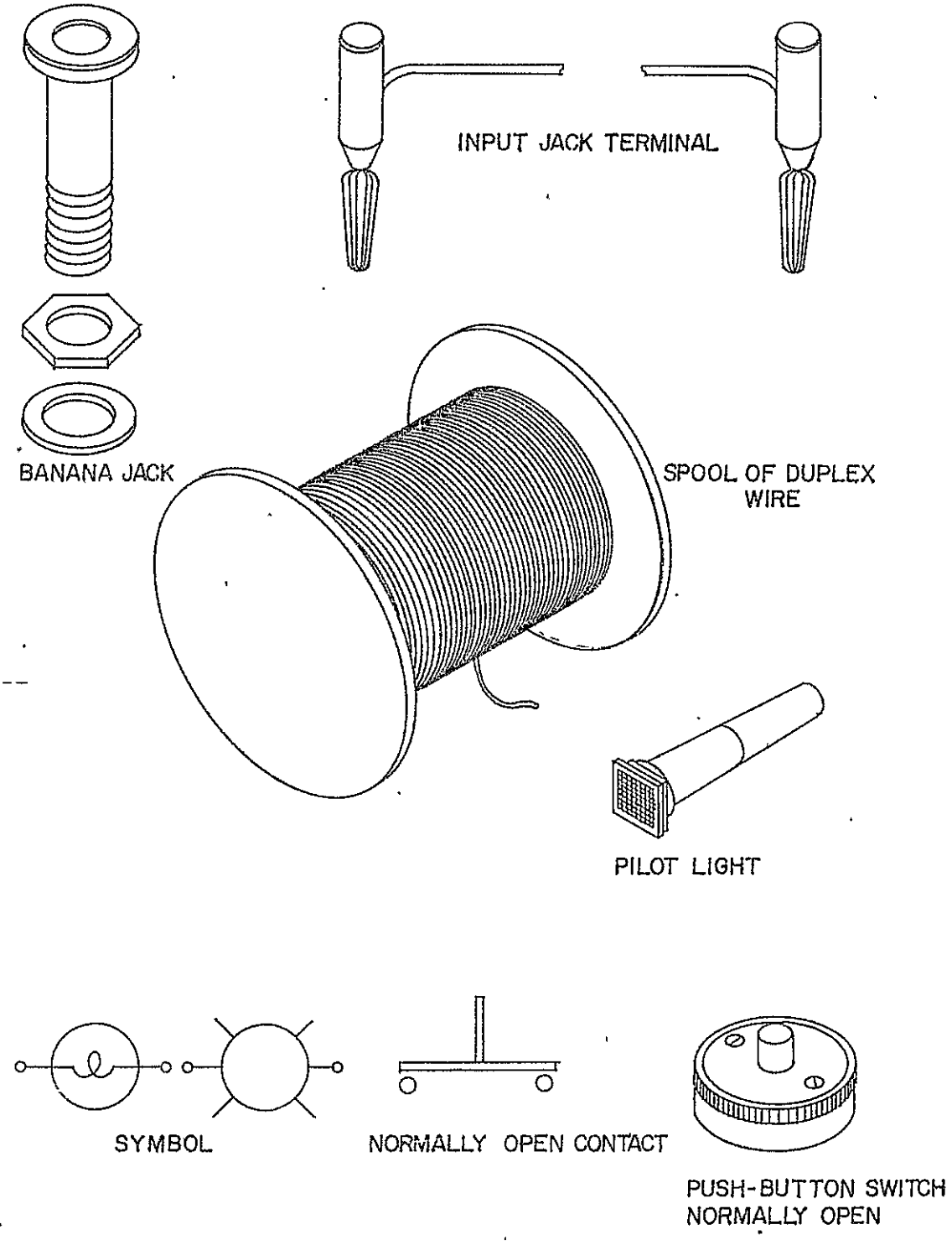
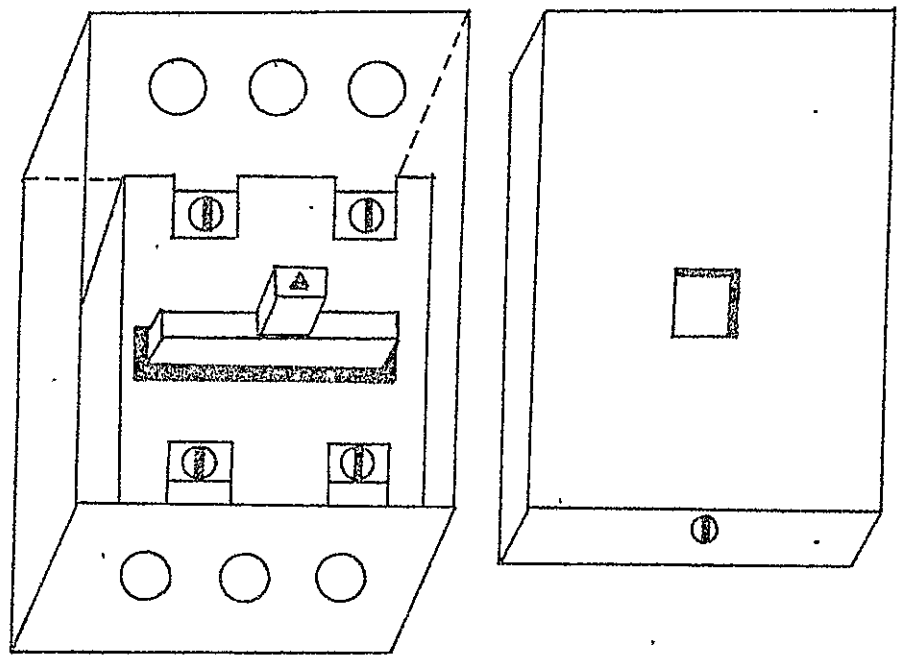


Figure 8. Showing the Electrical components; Banana Jacks, Input Jack Terminal, Duplex Wire, Pilot Light and Push-Button Switch.



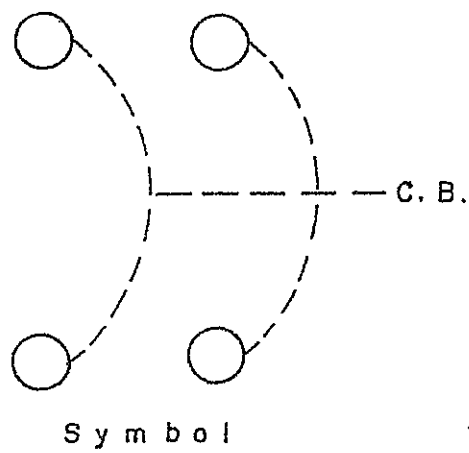
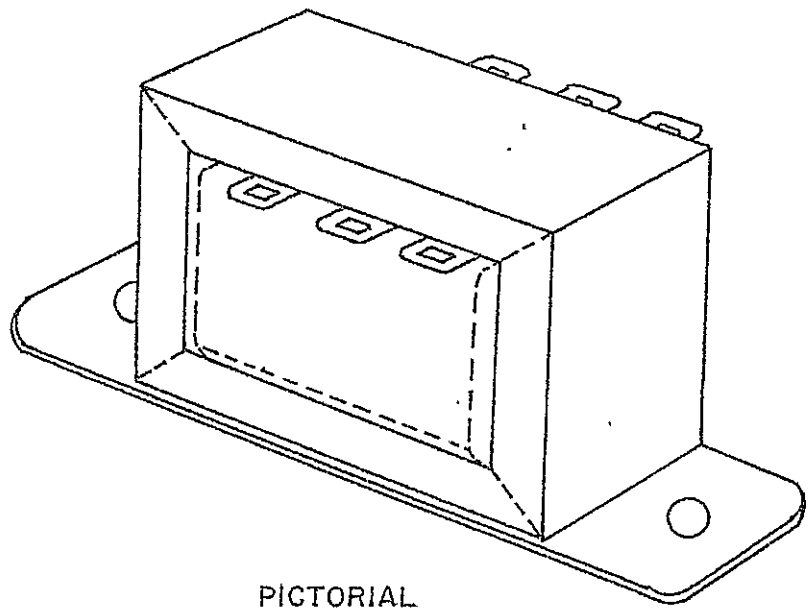
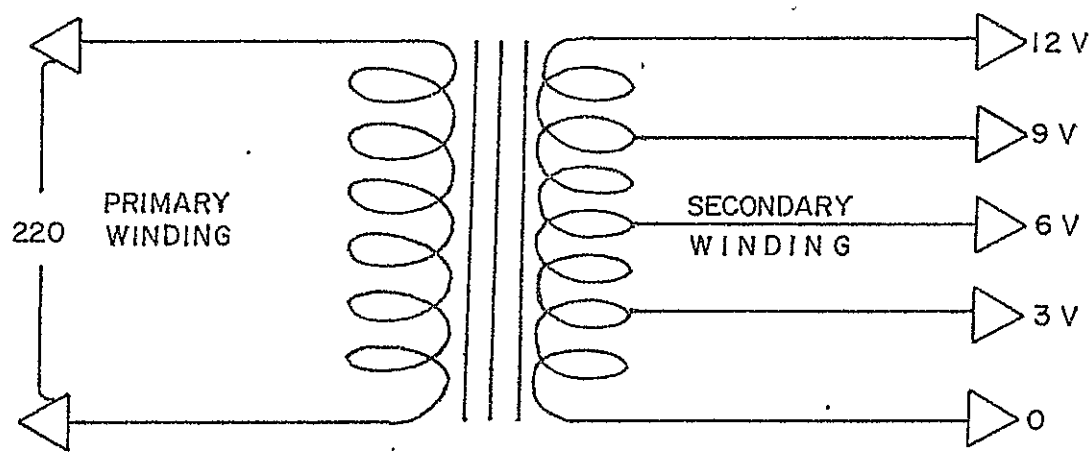


Figure 9. Showing the Front View and Symbol of the Circuit Breaker.



PICTORIAL



SCHEMATIC DIAGRAM

Figure 10. Showing the Pictorial View and Schematic Diagram of the Transformer.

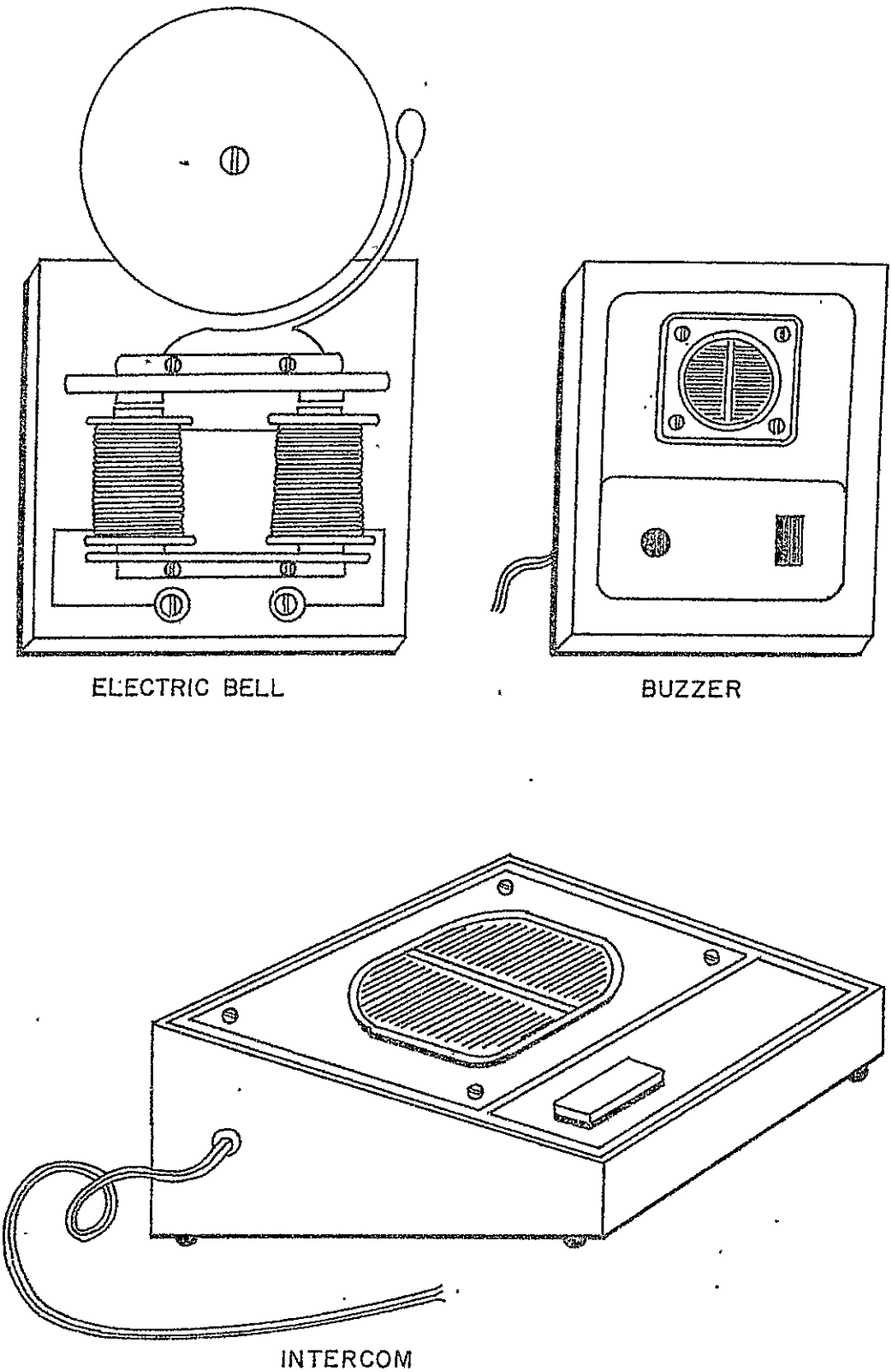


Figure II. Showing the Electric Bell, Buzzer, and Intercom.

connections, (2) Apply electrical tape and insulate all connections before energizing the electrical trainer, (3) Stay on insulating material when operating the electrical trainer, (4) Remove and replace defective core or device for they are hazardous, (5) Be careful with loose connections. This will produce overheating of contacts which destroys the continuity of the device, (6) Use the right kind of tool for your practice task. (7) Check the entire wiring installation before attempting to energize the circuit. (8) Press the switch of the main circuit breaker and apply an extra force for switching on.

Cost

The cost of the electrical trainer is the total cost of the supplies and materials, labor and overhead.

Table 4 shows the quantity, unit, name and description, and the cost of the supplies and materials used in constructing the electrical trainer.

Table 4

Bill of Supplies and Materials

Quantity	Unit	Name and Description	Cost
1	unit	Circuit breaker, single phase, 100 watts 220 volts	150.00
1	Unit	Bell transformer, 12 volts, 60 watts	90.00
1	unit	Anunciator, 12 volts, 60 watts	65.00
1	unit	D-C Ammeter, 12 volts, 30 amperes, panel type	150.00
1	unit	D-C Voltmeter, 12 volts, 30 ampere, Panel type	150.00
10	units	Indicating Lamps (Pilot light), 12 volts, 10 amperes	45.00
4	units	Electric bell, 12 volts	90.00
1	unit	Buzzer, 12 volts, 10 amperes	85.00
5	units	Intercom system, 12 volts	750.00
1	unit	Converter power supply, AC-DC, 12 volts	350.00
8	units	Push-Button Switch, 12 volts, 10 amperes,	3.00
6	doz.	Input and Banana Jack Terminal, one-half meter, in length, no. 18 cord wire type	130.00
1/2	roll	Duplex wire, No. 18	135.00
1	unit	Relay, 12 volts, 10 amperes	85.00
1	piece	Male plug, rubber, heavy duty, two prong, 10 amperes	18.00

Table 4 (continued)

50	:pieces:	Wood screw, 3/4" length	13.00
4	:pieces:	Machine Bolt, 6 mm. x 25 mm.	9.00
1	:roll :	Plastic tape, 8 oz.	13.00
12	:sheets:	Sand paper, waterproof, no. 200	18.00
2	:pieces:	Rubber footing, 10 x 20 mm. x 20 mm.	11.00
1	:liter :	Paint, gray, lacquer paint	60.00
1	:liter :	Paint, Red, lacquer paint	60.00
1	:liter :	Paint, White, lacquer paint	62.00
1	:liter :	Paint, Yellow, lacquer paint	60.00
1	:piece :	Paint, brush, nylon bristles, 50 mm	17.00
4	:pieces:	Lumber, 20 mm. x 80 mm.	68.00
4	:pieces:	Lumber, 20 mm. x 50 mm.	65.00
4	:pieces:	Lumber, 20 mm. x 40 mm.	63.00
1	:sheet :	Plywood, 12 mm. x 40 mm. x 940 mm.	200.00
1	:sheet :	Plywood, 12 mm. x 85 mm. x 940 mm.	210.00
1	:sheet :	Plywood, 12 mm. x 130 mm. x 940 mm.	220.00
1	:sheet :	Plywood, 12 mm. x 450 mm. x 510 mm.	230.00
1	:sheet :	Formica, 12 mm. x 450 mm. x 510 mm.	175.00
1	:bot. :	Rubber cement	25.00
1	:kilo :	Nails, 1" length	12.00

table 4 continued

1	:kilo	: Plastic Wood Filler	40.00
		T o t a l - - - - -	P 8,473.00

The production cost of the electrical trainer was derived from the cost of supplies and materials. The cost of supplies and materials amounted to eight thousand four hundred seventy three pesos (P8,473.00). The supplies and materials used in the construction of the project are available in the locality in electrical and hardware supply stores and in second hand or surplus centers.

Table 5 shows the particulars of cost and the cost per source.

Table 5

Particulars of Cost and Cost per Source

Particulars	:	Cost
1. Supplies and Materials	: P	8,473.00
2. Labor Cost	:	465.00
3. Overhead Cost (3% of the total cost of the supplies and materials	:	254.19

table 5 continued

4.	Operating Cost (3% of the total cost of the supplies and materials	:	254.19
	Total Cost	:P	9,444.38

The minimum labor cost in Catbalogan for a carpenter and an electrician was seventy five pesos a day (P75.00) at the time of the construction. At the a period of five days the carpenter received an amount of three-hundred seventy five pesos (375.00). The electrician received the amount of ninety pesos (90.00) for a period of one and a half days. The overall labor cost amounted to four hundred sixty five pesos (P465.00) for a period of six and a half days. Overhead cost (3% of the total cost of supplies and materials) was P254.00. Operating cost (3% of the total cost of supplies and materials) was P254.00. The total cost of the project was P9,444.38, for the year 1992.

Try-out and Revision

After having been assembled the signal and intercommunication system trainer, and the construction process finished, the project was be subjected to test to find out whether it would operates well according to the expectations. In dealing with the electrical trainer set-up on signal and intercommunication system, extra safety

practices were observed because a faulty connection would result in the destruction of its main parts.

Table 6

Defects Found and Revision Made

Defects	Revisions
1. Loose connection of binding posts. Fault connection of diode causes.	1. Tightened the screw bolt using an electrical plier and fix the wire ends.
2. Humming of the extension speaker	2. Interpret, analyze the type connection of diode and check the polarity between positive and negative terminals.

Construction Time Frame

The time element was one of the most important factor to be considered in constructing an electrical gadget or trainer. This would help the designer to follow his schedule of work to be done in a systematic method in order to save time, money, effort and materials intended for the project.

The activities regarding the construction and development of signal and intercommunication system trainer are shown in Table 1.

Chapter 4

DESCRIPTION OF THE COMPLETED PROJECT

This chapter describes the complete structure of the project, the processes involved in operating, the gadget, and safety and control measures.

A. Structure

The structure of the electrical trainer includes the features, parts and functions, interrelationship, capabilities and limitations.

1. **Features.** The characteristics of the electrical trainer are enumerated and briefly discussed below.

a. **Electrically operated.** The signal and intercommunication system trainer is powered by low-voltage power supply with the use of AC/DC converter from 220 volts AC source to 12 volts - 3 volts. When the electrical trainer is energized, it can perform different operations in the low-voltage wiring system.

The normally open contact push-button switches can be used in controlling the flow of electric current in signal and intercom system.

b. **Economical.** The signal and intercommunication system is economical in terms of:

1. Labor and manpower because this can be made

by students as an instructional facility.

2. Less power consumption compared to other low-voltage wiring system trainer, because it uses only a minimal wattage capacity of signal and intercommunication system equipment.

3. Replaceable parts which are cheap and available in the locality and in surplus center stores.

4. Convenience in operation with the use of a battery in the absence of electric power. The battery is inserted to its positive and negative terminals of each device.

c. Functional. The electrical trainer on signal and intercommunication system is functional. The trainer can function similar to those commercially made trainers installed in hospitals, residence, schools, offices, and other buildings for calling and sending messages.

The electrical trainer can be used for manual control operations in the low-voltage wiring system.

d. Educational. It is valuable on the part of the learners because of its simple, unique design and construction, yet it can perform many operations. The students can understand and learn the basic theories, principles, concepts, techniques and operating procedures as

well as safety measures using the electrical trainer. The lessons covered are as follows:

(1) electric bell connected in series, (2) electric bell connected in series controlled by one push-button switch, (3) electric bell connected in parallel with indicating lamp. (4) two electric bells connected in parallel controlled by each individual switches, (5) three electric bells connected in parallel controlled by each individual switches, (6) buzzer connected in parallel controlled by one push-button switches, (7) two electric bells controlled by two push-button switches with two indicating lamps, (8) burglar alarm circuit wiring, (9) burglar alarm circuit wiring using indicating lamp, (10) alarm circuit wiring with voltmeter connected in parallel, (11) alarm circuit wiring with voltmeter in parallel and ammeter in series, (12) one-call master intercom system, (13) two- call master intercom system, (14) three-call master intercom system. In making wiring connections, safety must always be emphasized and practiced.

c. <u>Produced locally.</u> Because of the simplicity of its design and conctruction, it is believed that this gadget can be produced with the availability of materials in

the locality for instructional purposes in Electricity classes.

2. Parts and Functions. Table 7, shows the major parts of the completed project and the corresponding function of each parts.

Table 7

Part of Completed Project and Their Respective Functions

Parts	Functions
1. Panel board	: Holds the electrical components of the electrical trainer used in various operations.
2. Circuit breaker	: Opens and closes electric current by automatic means in case of short circuit, and excessive high current in the circuit.
3. AC/DC Converter	:Steps down voltages from 220 volts alternating-current to 12 volts - 3 volts pure direct-current.
4. DC Ammeter	: Measures current in direct-current source of supply.
5. DC Voltmeter	: Measures voltage in direct-current source of supply.
6. Indicating Lamp	: Indicates the presence of electromotive force (voltage).
7. Elecrtric bell	: A sound that gives warning or command through electric current.
8. Buzzer	: A low buzzing sound device that gives warning or command through electric current.

Table 7 (continued)

9. One-call master station	: An electrical device used when a person desires to call or listen messages by pressing the selector switch
10. Three-Call master station	: An electrical device used when a person desires to call or listen three sub-stations by pressing the selector switch.
11. Push-button switch	: Opens and closes manually the operation and flow of electric current.
12. Input Jacks	: Serves as the binding post of all electrical components.
13. Banana Jacks	: Transmit current by inserting it to its corresponding input jack.
14. Extension Cord	: Connects wire from one electrical component to another
15. Intercom Sub-Station	: An extended speaker used to or listen the message given by a person in the master station.
16. Burglar Alarm	: A sound device for automatically giving an alarm in case of emergency.

3. **Interrelationships.** The signal and intercommunication system trainer has various parts. Each part has a vital role in the basic operation of the whole electrical gadget. Figure 12 shows the paradigm of interrelationship of the parts and how each part functions and interrelate to the other parts of the trainer when it is

energized by electric power.

In performing the experiment, one should be careful if he has prepared, read, and analyzed the circuit diagram of the experiment being performed. Circuit should be in "off" position in order to prevent any electric shock and accidential contact with electric current.

The various parts of the electrical trainer functions in relation to the other. The power source which is 220 volts is converted to 12 volts, 9 volts, 6 volts, and 3 volts direct-current voltage, since signal alarm, and intercom system use low-voltage power supply. The whole circuit is protected with the circuit breaker. The d-c ammeter, d-c voltmeter, and indicating lamp show the presence of voltage current in the circuit. The push-button switch closes the circuit that puts signal, alarm, and intercom sustem into operation.

4. <u>Capabilities.</u> The signal and intercom system trainer as an instructional equipment was made to enhance lecture-experimental-demonstration method of shop instruction that will result on actual learning experience of the students.

It helps understands the basic learning theories and concepts of the low-voltage wiring system so that students become skillful with its usefulness of the trainer.

The electrical trainer has a wide and sloping front board to accomodate the different tasks and experiments being performed. The front board is mounted with the electrical components. The measurement of the panel is 22 cm x 37 cm x 73 cm and is made of ordinary plywood.

The electrical trainer can be used also to determine the line voltage and current in direct-current circuit by plugging in the terminal leads into the binding posts of the banana jacks.

5. Limitations. Although the operations, concepts, and set-up that can be performed by this trainer are varied, it has its own limitations. The electrical trainer is limited to perform the following operations only:

a. Signal wiring system

b. Alarm wiring system

c. Intercom system

d. Voltage measurement

e. Current measurement

f. Manual control system

B. Process

1. Operating Procedures. Before the electrical trainer is energized to the source of supply, the following operations are suggested and recommended:

a) The circuit breaker should be OFF before any

operation could be done.

b) Read, analyze the circuit diagram to be performed.

c) Perform all electrical components, accessories needed for the experiment.

d) Install the signal, alarm and intercom system on the circuit.

e) Use the input and banana jacks in wiring the electrical components of the circuit.

f) Connect line terminals of electric bells in series with the normally open contact push-buttons switch.

g) Connect line terminals of electric bells to L_2 of the DC power supply.

h) Connect the remaining terminal lead from push-button switch to L_1 of the DC power supply.

i) Inspect and check all wiring connections to be sure that the connection is correct.

2. <u>Maintenance</u>. Maintenance means the care and repair requirements of various parts of the electrical trainer. In order to minimize wear and tear of the parts of the trainer, proper maintenance is required. To maintain the power output and capabilities of the moving parts of the components, daily check-up is needed. It is important for the student to know the mechanism, function, and operation

of the electrical trainer and exercise the proper maintenance for a longer life span of the trainer.

The following maintenance measures are recommended:

a) Conduct a periodic check-up before the electrical trainer will be used.

b) Make proper adjustment of loose wiring connections to prevent fire hazard and destruction of components.

c) Discuss the importance, and use of the electrical trainer before any task or experiment could be done.

d) Remove all wiring connections immediately after performing the experiment.

3. Safety and Control Measures

All electrical machines, equipments and electrical trainers must be operated carefully to prevent damage to the trainer. Most accidents happen as a result of carelessness, so safety must be consistently be emphasized.

The following safety precautions must be observed in the operation of the electrical trainer in order to avoid accidents and to insure the maximum efficiency and effectiveness of the trainer:

a) Read and analyze the wiring diagram before performing the experiment.

b) Connect the circuit by following the diagram.

c) The circuit breaker must be switched "OFF" when wiring connection is being done.

d) Poor connections should be tightened to minimize sparking and damage to the parts.

e) Inspect and check by using multi-tester to detect short, open circuit before switching "ON" the circuit.

f) Switch ON the electrical trainer when ready.

g) Switch OFF the circuit breaker after the experiment to avoid accident and electricution.

h) Remove all wire connections after the experiment.

i) Return the tools used in the experiment to their proper place.

Chapter 5

SUMMARY, CONCLUSION, FINDINGS OF THE STUDY AND RECOMMENDATIONS

A. Summary

This study was concerned with the design and construction of an electrical trainer on signal and intercommunication system to help solve the problems on inadequacy of training facilities and equipment in electrical technology at Samar State Polytechnic College. The electrical trainer was designed in order to acquire knowledge and skills of students and enhance quality instruction in the field of vocational education, training, and manpower needs of the country.

Moreover, the signal and intercom system was conceived to improve instruction in the electrical technology classes. This type of electrical trainer is mostly needed in the electrical technology shop so that skills of students will be improved and fully developed. The electrical trainer has a sloping design at the front board and constructed out of locally available materials. This study covers basic concepts, principles, and operations of the low-voltage wiring system.

B. Conclusion

Based on the computed project, the researcher is led to the conclusion, that it is technically feasible to construct an electrical trainer set-up on signal and intercommunication system with the following features: (a) it is electrically operated (b) it is economically assembled (c) it is functional (d) it is produced locally (e) it is educational because it can perform the concepts of signal alarm and intercom system involving low voltage wiring system. In conclusion, the application step in the teaching-learning process provides the learner the best opportunity for learning by doing. Significantly, the application step should be also relevant to the skills reinforced by other methods aside from just a mere lecture.

C. Findings of the Study

The findings of this study showed that the signal and intercommunication system trainer can perform various wiring system concepts and can perform tasks similar to the actual signal and intercom devices installed in residences, hospitals, schools, and offices.

This electrical trainer can be made by the electrical technology instructor, and students with the assistance and supervision of the instructors.

D. Recommendation

As a result of this study, the researcher recommends the following:

1. Vocational school administrators should encourage vocational teachers improvise instructional gadget out of locally available materials as a training aid in the shop.
2. Financial support on construction of improvised training equipment be alloted by the administrator to the teacher.
3. Vocational institutions having electricity classes can use and operate this electrical trainer.
4. A study should be conducted to determine whether it is feasible to mass produce the electrical trainer.
5. The electrical trainer should be patented.
6. Expand the dimension of the project to accomodate more number of students.

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A P P E N D I C E S

APPENDIX "A"

Lesson 1

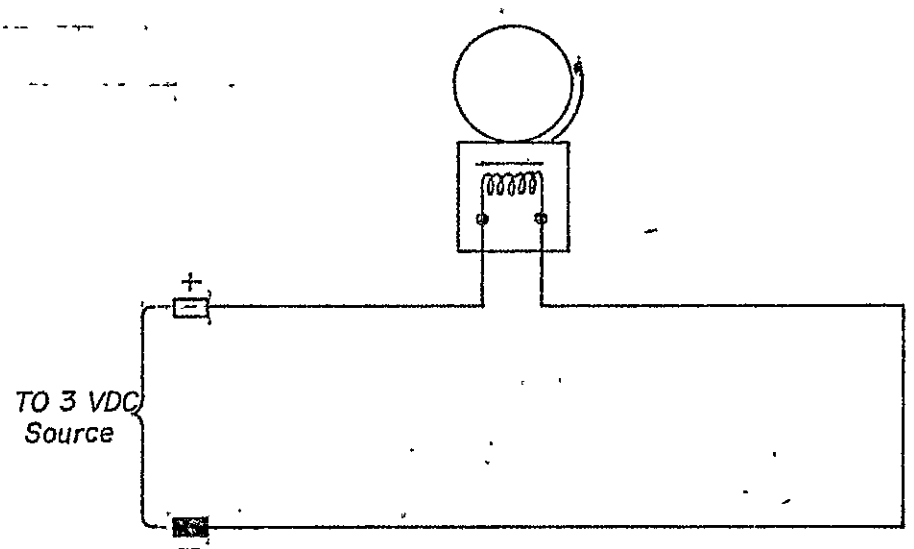
Title: Electric bell connected in Series

Objective: At the end of the lesson the students should be able to gain knowledge and acquire skills in wiring series connection of electric bells.

Introduction:

Series connection is commonly used in wiring electric bells and Christmas lights. Each device is connected in a single wire only. They are dependent on the other device. In case of malfunction; the whole circuit is affected. This type of wiring connection is used for experimental purposes only. Energizing the circuit, the electric bell will ring.

Diagram/Illustration:



Circuit Diagram of Electric bell connected in series within the line.

Steps in Connecting Electric bell in series:

1. Analyze the diagram carefully.
2. Wire the terminals of electric by following the circuit diagram.
3. Follow the polarities between positive and negative.
4. Let the instructor check the circuit connection.
5. Energize the circuit with correct d-c voltage.

APPENDIX "B"

Lesson 2

Title: Electric bell Connected in Series Controlled by One Push-button Switch

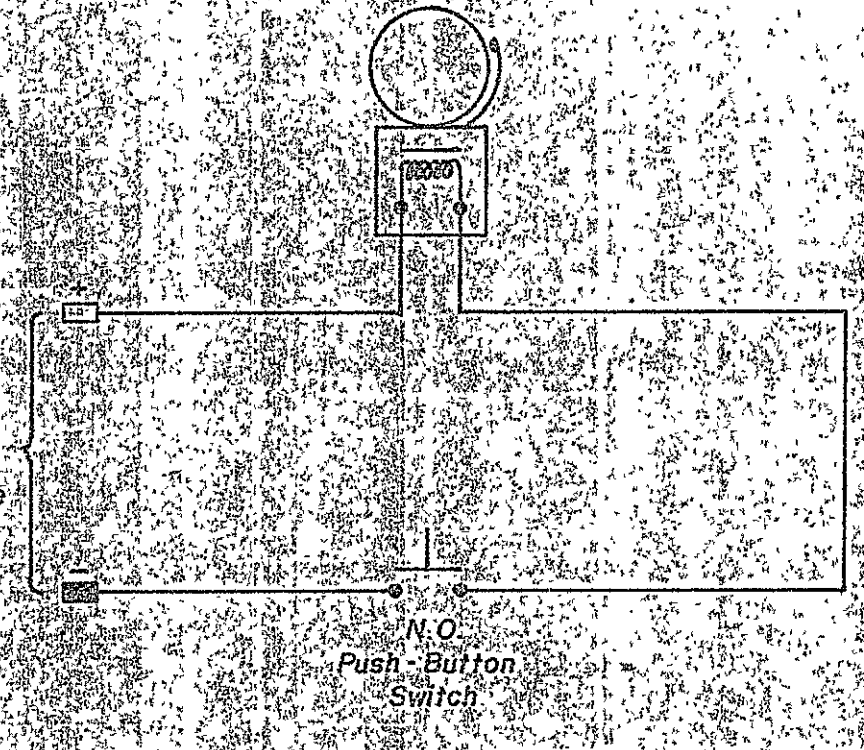
Objectives: At the end of the period, the students will be able to:

1. Define series connection.
2. Perform connection of electric bell in series controlled by push-button switch.
3. Practice safety habits of work in connecting electric bells in series controlled by push-button switch.

Introduction:

This type of wiring installation is used when the device is installed in a room controlled by one push-button switch. However, this method of wiring can be installed for the purpose of laboratory experiment only.

Diagram/Illustration:



Steps in Wiring Electric Bell Connected in Series Controlled by One Push Button Switch

1. Analyze the connection diagram carefully.
2. Wire the terminals of electric bell by following the circuit diagram.
3. Wire the terminals of push-button switch as stated in the circuit diagram.
4. Follow the polarities between positive and negative.
5. Let the instructor check the circuit connection.
6. Energize the circuit with correct d-c voltage.

APPENDIX "C"

Lesson 3

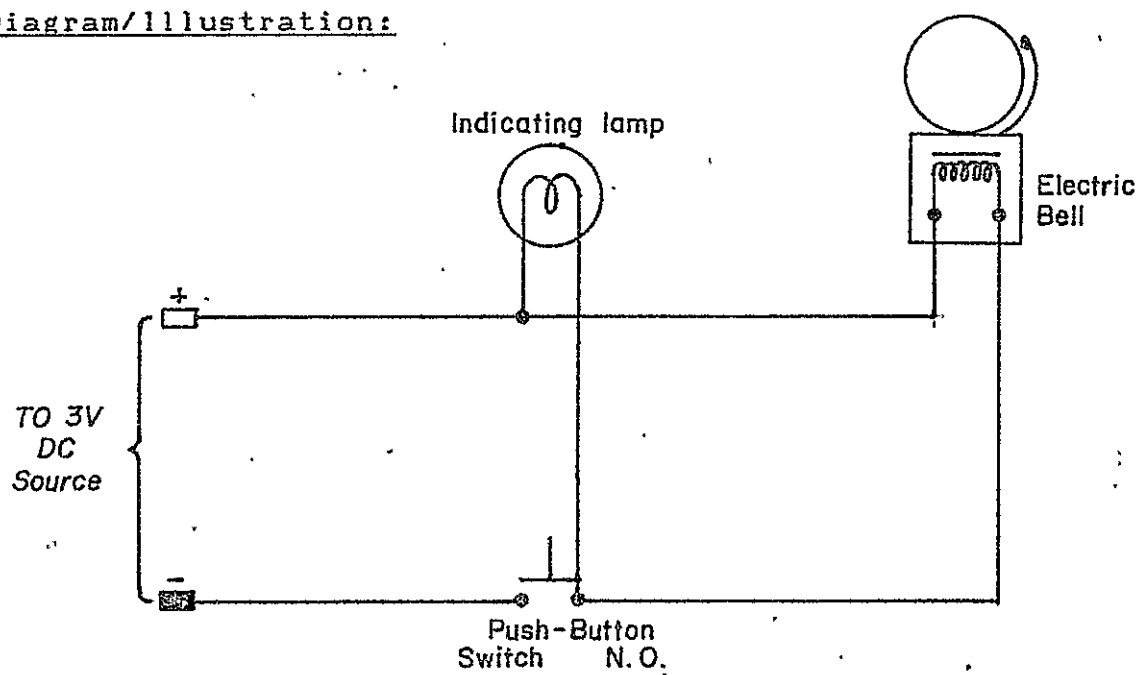
Title: Electric Bell Connected in Parallel with Indicating Lamp Controlled by Push-Button Switch

Objective: At the end of the lesson the student should be able to gain knowledge and acquire skills in wiring parallel connection of electric bell with indicating lamp controlled by push-button switch.

Introduction:

Parallel connection is considered as the most common type of wiring connection. The device is connected across the line in which they are independent to the other device, in case each device will malfunction. When the circuit is energized, the electric bell will automatically ring and electromotive force will pass through the pilot light by pressing the normally open contacts of the push-button switch to "ON" position.

Diagram/Illustration:



Circuit Diagram of Electric Bell in Parallel Controlled by One Push-Button Switch with Indicating Lamp

Steps in Connecting One Electric Bell in Parallel Controlled by One Push-Button with Indicating Lamp

1. Analyze the circuit diagram carefully.

2. Wire the line terminals of indicating lamp and electric bell directly connected to DC source.

3. Wire the other line terminal of indicating lamp and electric bell connecting to the push-button switch, and connect wire to the DC source.

4. Let the instructor check the wire connection.

5. Energize the whole circuit with correct D-C voltage.

APPENDIX "D"

Lesson 4

Title: Two Electric Bells Connected in Parallel Controlled by Two Push-Button Switches with Two Indicating Lamp.

Objectives: At the end of the period the students should be able to:

1. Define and identify the components of an electric bell connected in parallel controlled by push-botton switch.

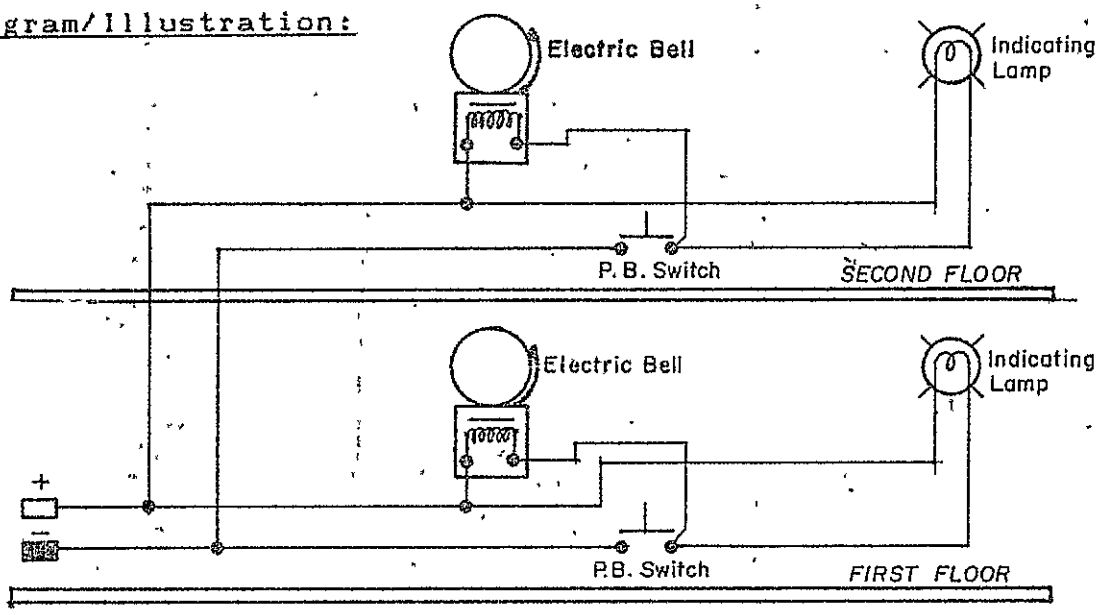
2. Perform connection of two electric bells in parallel controlled by two push-button switches with indicating lamps.

3. Practice safety habits of work in connecting electric bells in parallel controlled by psuh-button switches.

Introduction:

This method of wiring installation is used when the device is installed in a two-room apartment houses where it is necessary to install a signal device or indicating lamp. Each electric bell with indicating lamp will be controlled by one push-button switch for every floor of the apartment house.

Diagram/Illustration:



Steps in Connecting Two Electric Bells Connected in Parallel Controlled by Two Push-Button Switches with Two Indicating Lamp:

1. Analyze the wiring diagram carefully.

2. Wire the line terminals of indicating and electric bell directly connected to D-C source in the first floor.

3. Wire the other line terminal of indicating lamp and electric bell connecting to the push-button switch and connect wire to D-C source in the first floor.

4. Let the instructor check the circuit connection.

5. Energize the whole circuit with correct D-C voltage.

6. Repeat steps 1 to 5 for wiring connection in the second floor.

APPENDIX "E"

Lesson 5

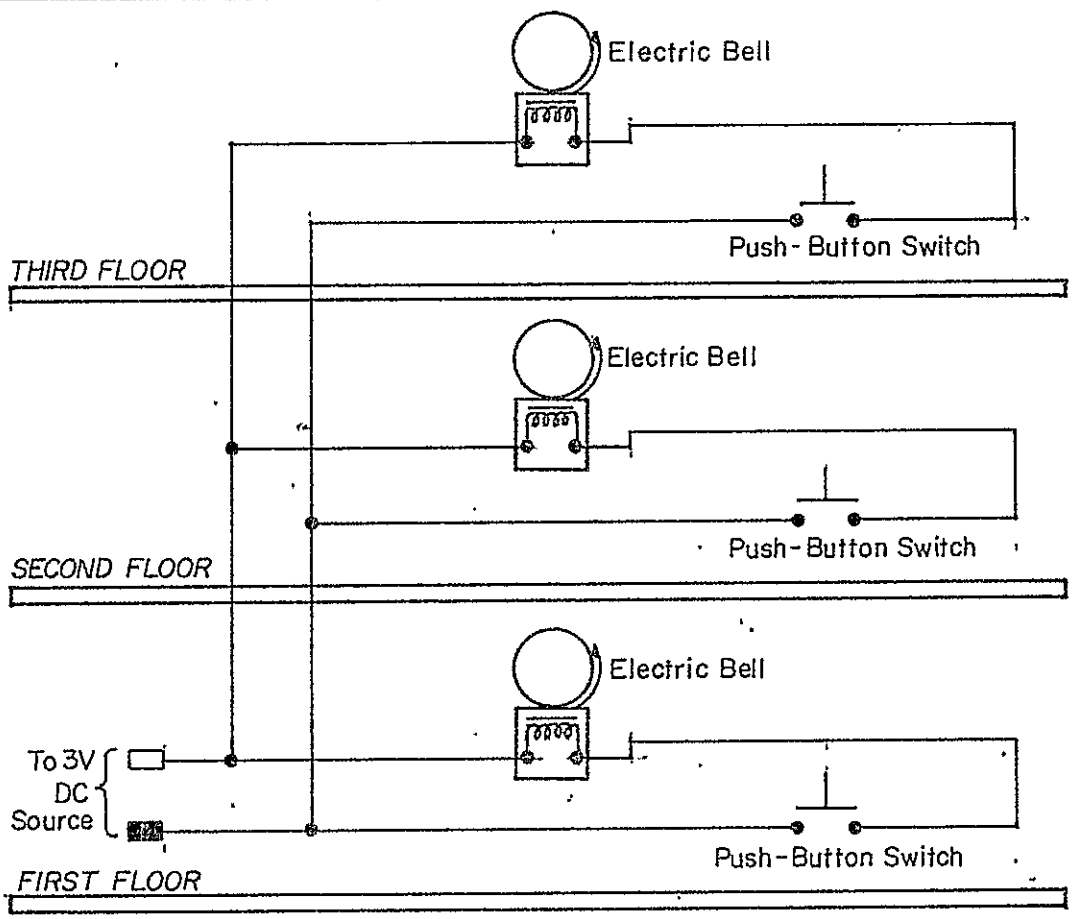
Title: Three Electric Bells Connected in Parallel Controlled by Individual Switches.

Objective: At the end of the lesson, the students should be able to gain knowledge and acquire skills in wiring three electric bells connected in parallel controlled by individual switches.

Introduction:

This type of wiring installation is used when the device is installed in a three-room apartment houses where it is necessary to install a signal device. Each electric bell is controlled by one-push button switch for every floor of the apartment house.

Diagram/Illustration:



Steps in Wiring Three Electric Bells Connected in Parallel Controlled by Individual Switches

1. Analyze the wiring diagram carefully.
2. Wire the line terminals of electric bell connected to D-C source in the first floor.
3. Wire the other line terminals of electric bell connected to the push-button switch and connect wire to D-C source in the first floor.
4. Let the instructor check the circuit connection.
5. Energize the whole circuit with correct D-C voltage.
6. Repeat steps 1 to 5 for wiring connection in the second and third floor.

APPENDIX "F"

Lesson 6

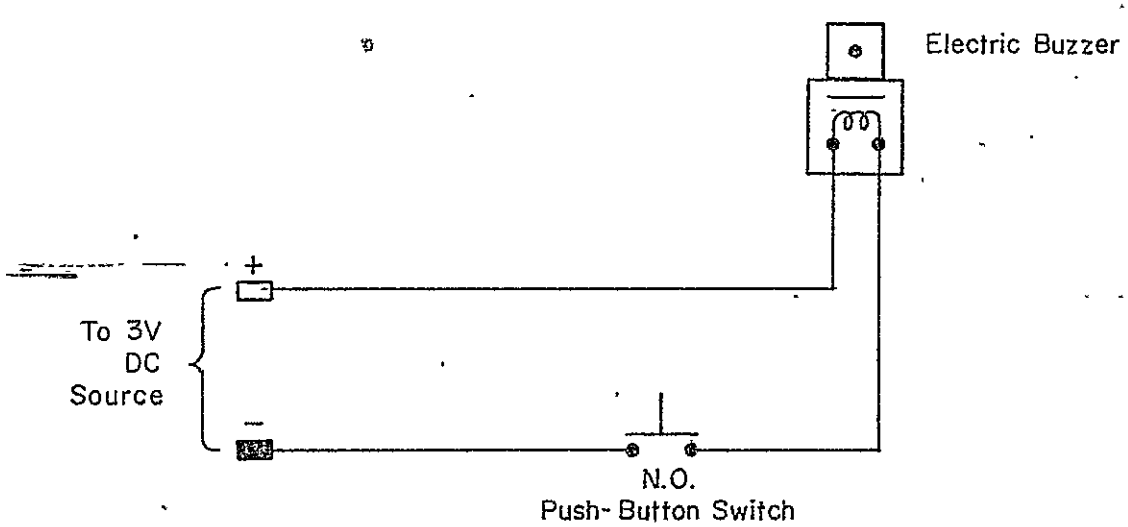
Title: Electric buzzer Connected in Parallel Controlled by One Push-Button Switch.

Objective: At the end of the period, the students should be able to gain knowledge and acquire skills in wiring electric buzzer connected in parallel controlled by one push-button switch.

Introduction:

Signal wiring is commonly installed in homes, schools, offices, gymnasium and ships. Electric buzzer is always used because it produces a very loud sound once it is energized.

Diagram/Illustration:



Steps in Wiring Electric Buzzer Connected in Parallel Controlled by One Push-Button Switch.

1. Analyze the circuit diagram carefully.
2. Wire the terminals of electric buzzer by following the connection diagram.
3. Wire the terminals of push-button switch as indicated in the circuit diagram.
4. Follow the polarities between positive and negative.
5. Let the instructor check the wiring connection.
6. Energize the circuit with correct D-C voltage.

APPENDIX "G"

Lesson 7

Title: Two Electric Bells Connected in Parallel Controlled by Two Individual Switches

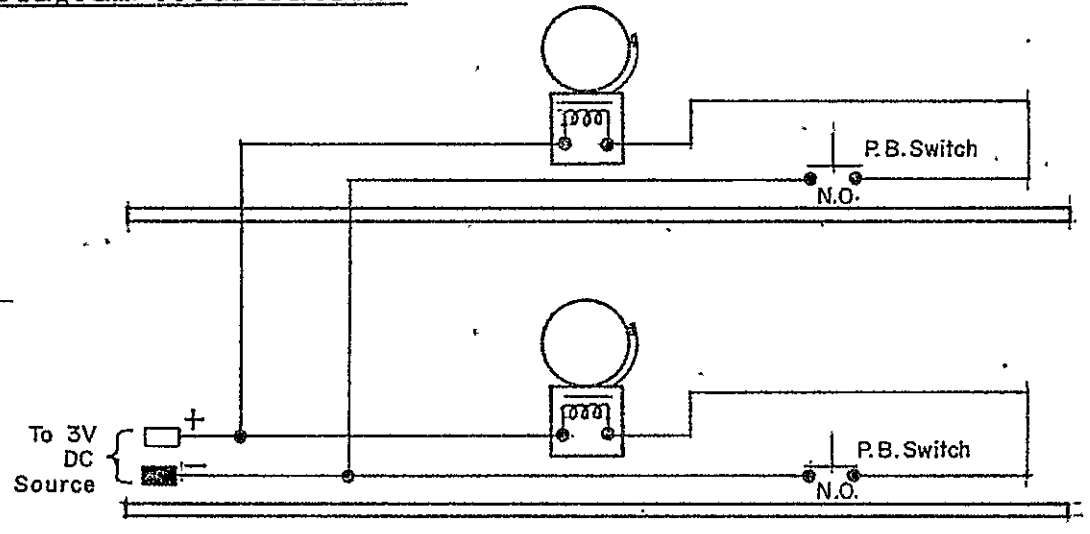
Objectives: At the end of the period, the students should be able to:

1. Identify the parts of electric bells.
2. Define parallel connection.
3. Perform connections of two electric bells in parallel controlled by two push-button switches.
4. Practice safety habits of work in connecting electric bells in parallel controlled by push-button switches.

Introduction:

Parallel connection of two electric bells controlled by two push-button switches is the most common method of installing signal wiring. Parallel connection is more advantageous than the series connection because in parallel circuit the device is independent to the other, there is no interruption in the flow of electric current once each device malfunctions.

Diagram/Illustration:



Steps in Wiring Two Electric Bells Connected in Parallel Controlled by Two Individual Switches

1. Interpret the wiring diagram carefully.

2. Wire the line terminals of electric bell directly connected to D-C source in the first floor.

3. Wire the other line terminal of the push-button switch and connect wire to D-C source in the first floor.

4. Let the instructor check the wiring connection.

5. Energize the whole circuit with correct D-C voltage.

6. Repeat steps 1 to 5 for wiring connection in the second floor.

APPENDIX "H"

Lesson 8

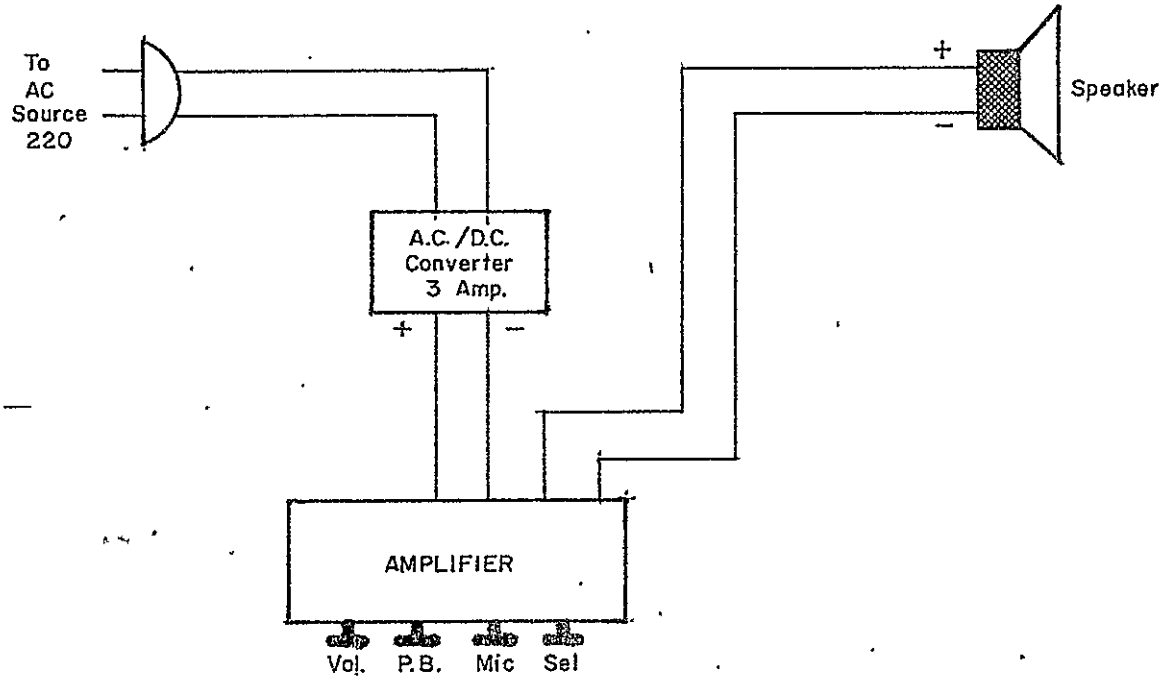
Title: Installing Burglar Alarm System

Objective: At the end of the lesson, the students should be able to gain knowledge and acquire skills in wiring burglar alarm system.

Introduction:

Burglar alarm plays vital role in giving an alarm in case of emergency as in fire, crimes, etc. The burglar alarm system will automatically produce a loud sound of alarm by merely pressing the switch in case of burglary. This is used mostly in big offices, industries, armed forces, and other buildings that need alarm system.

Diagram/Illustration:



APPENDIX "I"

Lesson 9

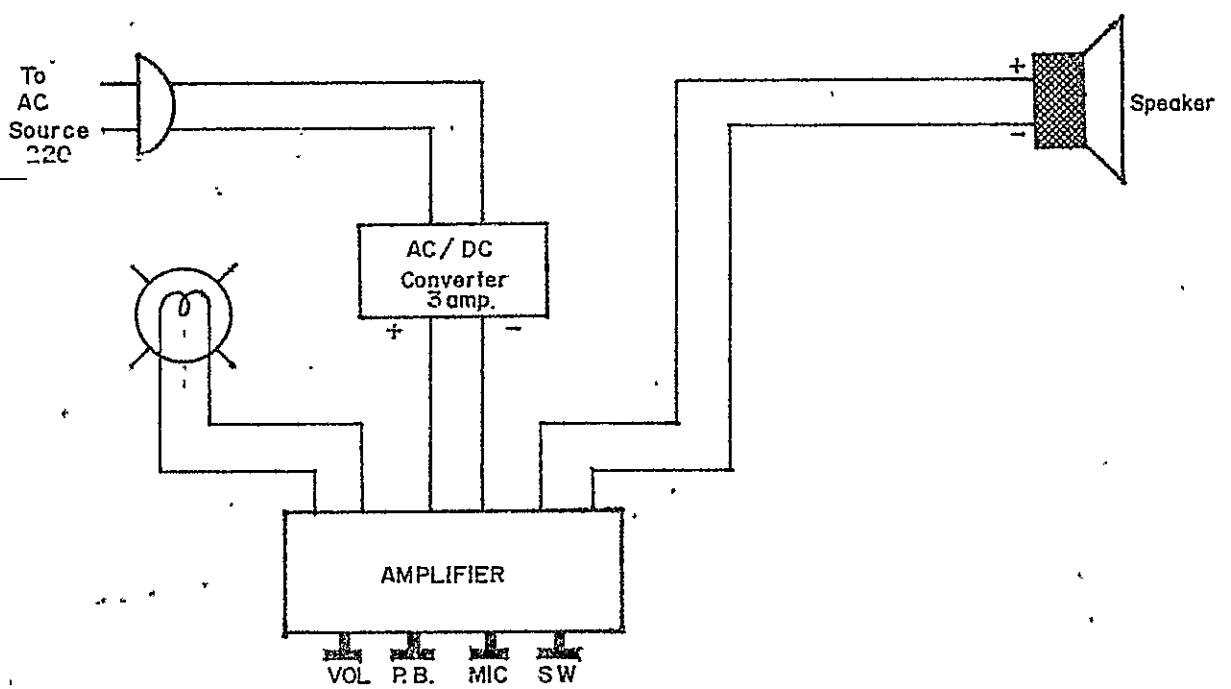
Title: Burglar Alarm Circuit Wiring with Indicating Lamp

Objectives: At the end of the lesson, the students should be able to gain knowledge and acquire skills in wiring burglar alarm system with indicating lamp.

Introduction:

Burglar alarm is commonly used in big offices, industries, armed forces and other buildings that needs alarm system. Once the burglar alarm is energized it will automatically produce a loud sound of alarm in case of emergency.

Diagram/Illustration:



Steps in Wiring Burglar Alarm Circuit with Indicating Lamp

1. Analyze the connection diagram carefully.
2. Wire the terminals of burglar alarm system by following the circuit diagram.
3. Wire the terminals of indicating lamp as indicated in the circuit diagram.
4. Follow the polarities between positive and negative.
5. Let the instructor check the circuit connection.
6. Energize the circuit with correct d-c voltage.

APPENDIX "J"

Lesson 10

Title: Alarm Circuit Wiring with Voltmeter Connected in Parallel.

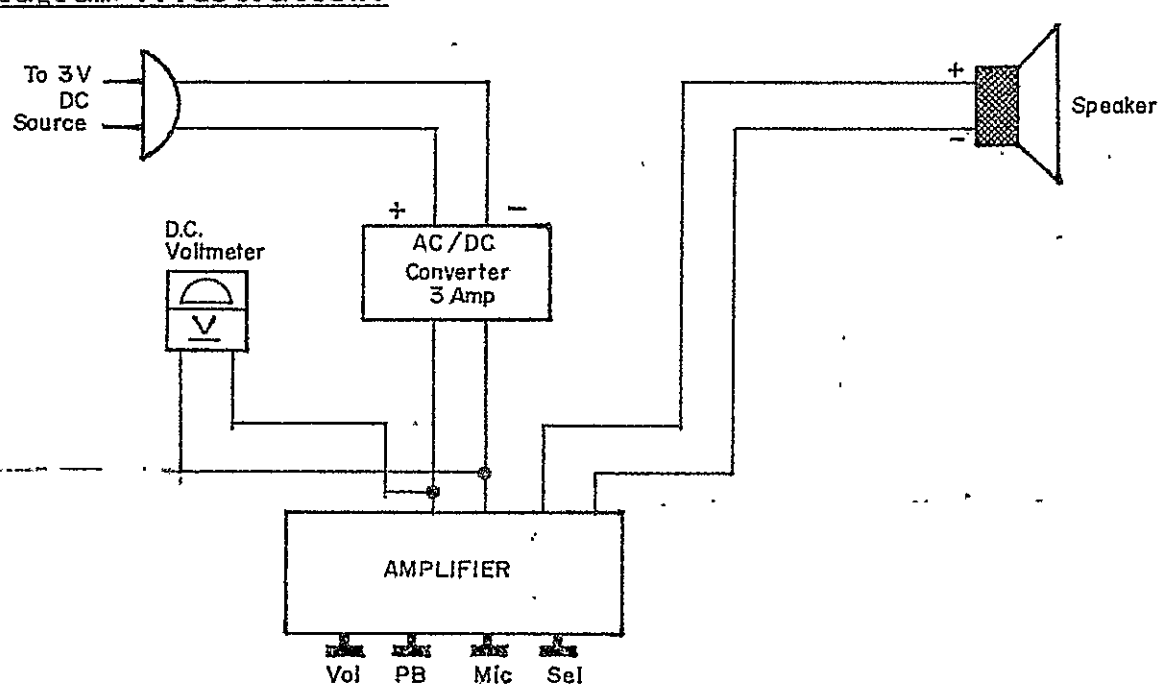
Objectives: At the end of the period, the students should be able to:

1. Identify the parts of burglar alarm, and voltmeter.
2. Perform connection of burglar alarm with voltmeter connected in parallel.
3. Practice safety habits of work in connecting burglar alarm and voltmeter connected in parallel.

Introduction:

Connecting d-c voltmeter in the burglar alarm system is another method of installing signal wiring. The burglar alarm and d-c voltmete are connected in parallel with negative and positive terminal lines. This method of signal wiring is commonly used for the purpose of laboratory experiment only.

Diagram/Illustration:



Steps in Wiring Burglar Alarm System with Voltmeter Connected in Parallel

1. Interpret the circuit connection diagram carefully.
2. Wire the terminals of burglar alarm by following the circuit diagram.
3. Wire the terminals of d-c voltmeter as illustrated in the circuit diagram.
4. Follow the polarities between positive and negative.
5. Let the instructor check the circuit connection.
6. Energize the whole circuit using the correct d-c voltage.

APPENDIX "K"

Lesson 11

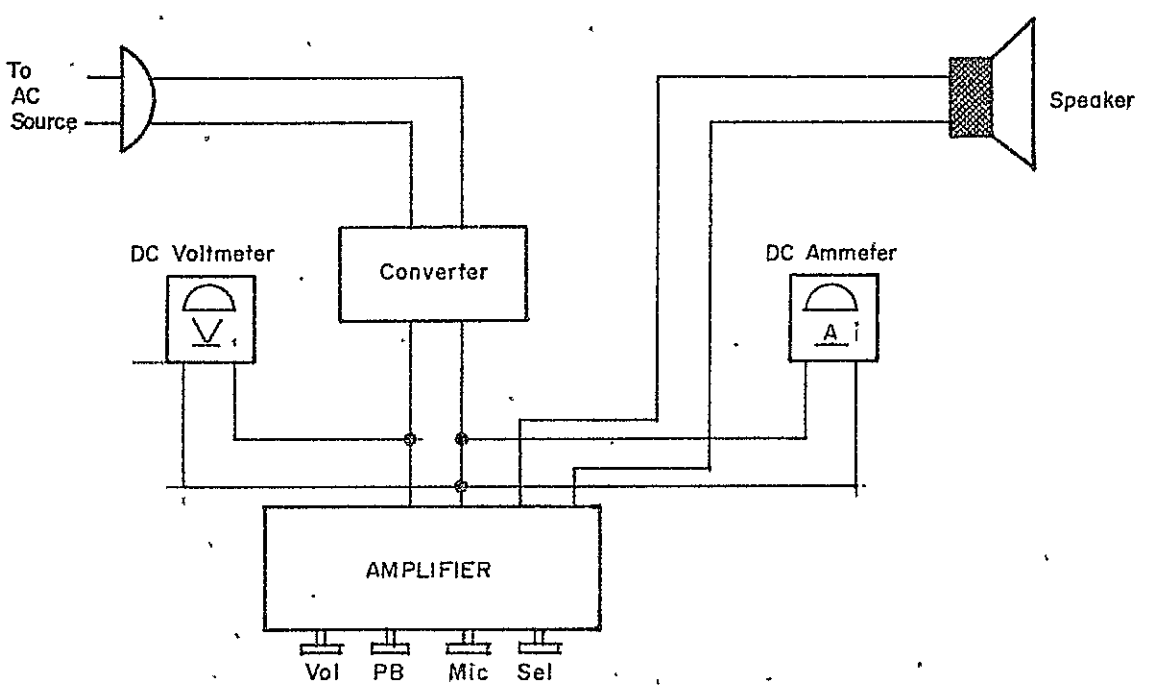
Title: Alarm Circuit Wiring with Voltmeter Parallel and Ammeter in Series.

Objectives: At the end of the lesson, the students should be able to gain knowledge and acquire skills in wiring alarm circuit with d-c voltmeter in parallel and d-c ammeter in series.

Introduction:

This method of wiring of the alarm system with voltmeter in parallel and ammeter in series is commonly done in electrical and electronics laboratories for experiment purposes only.

Diagram/Illustration:



Steps in Wiring Alarm Circuit with Voltmeter in Parallel and Ammeter in Series.

1. Analyze the circuit connection diagram carefully.
2. Wire the terminals of burglar alarm system by following the circuit diagram.
3. Wire the terminals of d-c voltmeter and d-c ammeter as illustrated in the circuit diagram.
4. Follow the polarities between the positive and negative.
5. Wire the terminals of the speaker connected to burglar alarm system, and to d-c source.
6. Let the instructor check the circuit connection.
7. Energize the whole circuit with correct d-c voltage.

APPENDIX "L"

Lesson 12

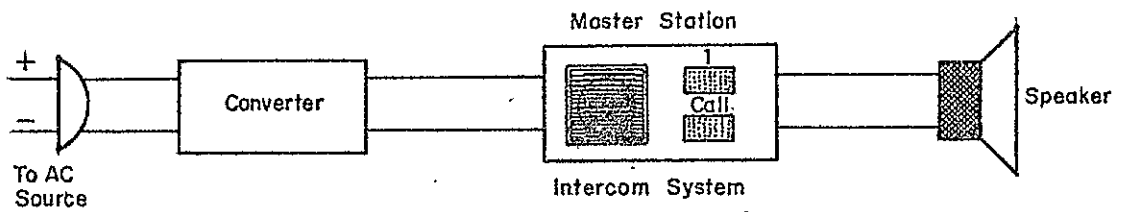
Title: Installing One-Call Master Intercommunication System

Objective: At the end of the lesson, the students should be able to gain knowledge and acquire skills in wiring one-call master intercommunication system.

Introduction:

Intercommunication system is installed mostly in homes, offices, hospitals and other buildings. One-call master intercommunication system is used when a person desires to call or send messages to one sub-station by merely pressing the selector switch.

Diagram/Illustration:



Steps in Connecting a One-Call Master Intercom System

1. Interpret/analyze the circuit diagram carefully.
2. Wire the terminals of one-call master intercom by following the circuit diagram.
3. Follow the polarities between positive and negative.
4. Wire the terminals of one sub-station connecting to the master intercom.
5. Let the instructor check the connection.
6. Energize the circuit with correct d-c voltage.

APPENDIX "M"

Lesson 13

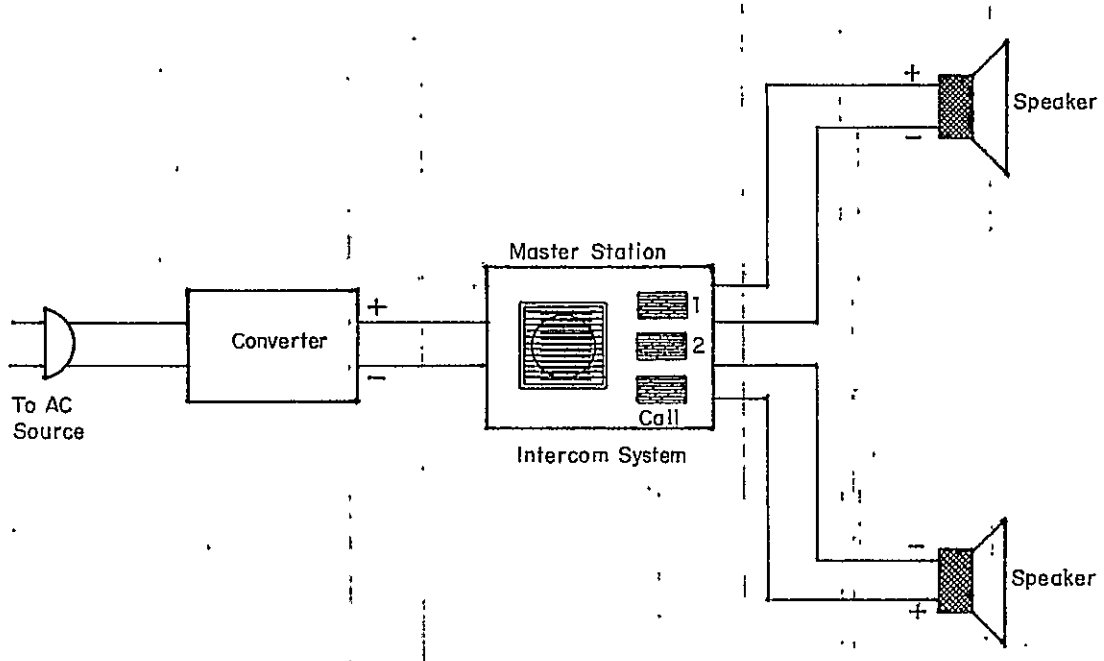
Title: Installing Two-Call Master Intercommunication System

Objective: At the end of the lesson, that students should be able to gain technical knowledge and acquire skills in wiring two-call master intercom system.

Introduction:

Intercommunication system plays a vital role in communicating and sending messages to their clienteles in homes, offices, hospitals, schools and other buildings. Two-Call master intercommunication system is used when a person desires to call or send messages to two sub-stations by only pressing the push-button switch.

Diagram/Illustration:



Steps in Wiring a Two-Call Master Intercom System.

1. Analyze the circuit connection diagram carefully.

2. Wire the terminals of two-call master intercom by following the circuit diagram.

3. Follow the polarities between positive and negative.

4. Wire the terminals of two sub-station connecting the master intercom system.

5. Let the instructor check the circuit connection.

6. Energize the circuit with correct d-c voltage.

APPENDIX "N"

Lesson 14

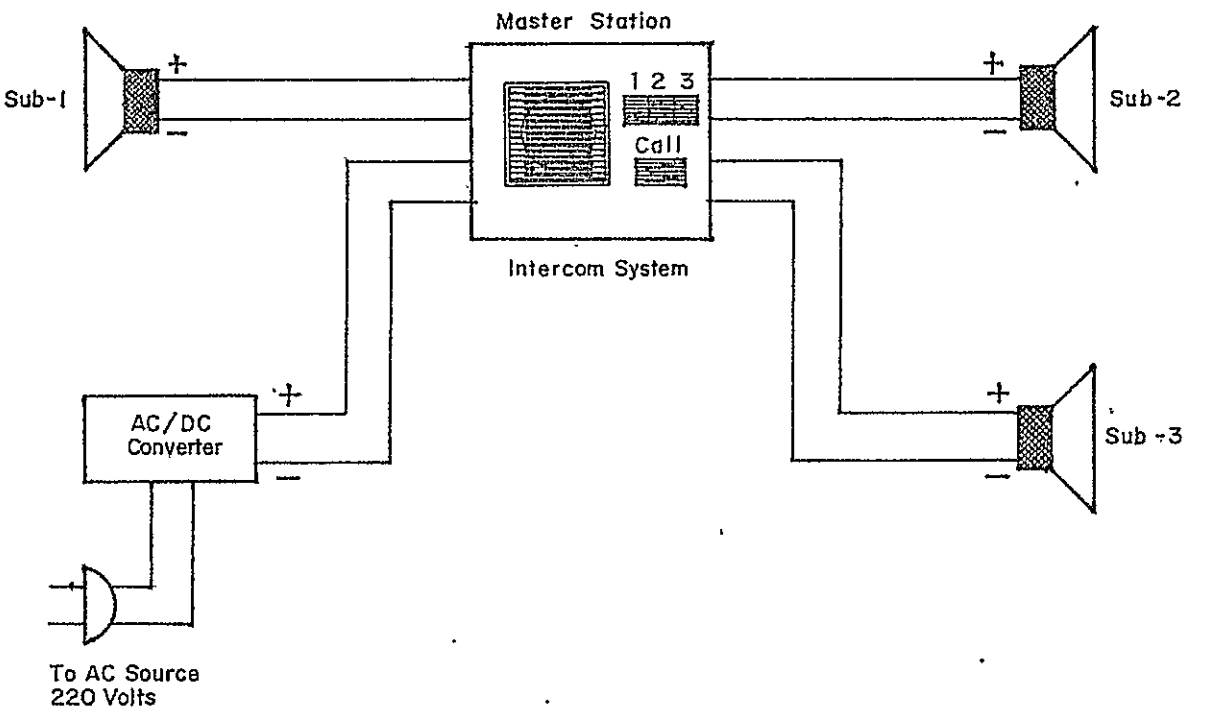
Title: Installing Three-Call Master Intercommunication System

Objective: At the end of the lesson, the students should be able to gain knowledge and acquire skills in wiring Three-Call Master Intercom System.

Introduction:

Intercommunication system is a substitute of a telephone and has a great contribution to human life for the purpose of communicating person to another person whenever he wants to call. Three-Call master intercom system is applied when a person desires to call or listen to each three sub-station by pressing or rotating the selector switch.

Diagram/Illustration:



Steps in Connecting A Three-Call Master Intercom System

1. Analyze the circuit connection diagram carefully.
2. Wire the terminals of three-call master intercom by following the circuit diagram.
3. Follow the polarities between positive and negative.
4. Wire the terminals of three sub-stations connecting the master intercom system.
5. Let the instructor check the circuit connection.
6. Energize the circuit with correct d-c voltage.

APPENDIX "O"

Republic of the Philippines
SAMAR STATE POLYTECHNIC COLLEGE
Catbalogan, Samar

SSPC Masteral Degree Program
Graduate School

THESIS/SEMINAR PAPER APPROVAL SHEET

This proposed thesis/seminar paper entitled "SIGNAL AND INTERCOMMUNICATION SYSTEM TRAINER: A TECHNICAL STUDY" is partial fulfillment of the requirements for the degree of Master of Technician Education, under the masteral degree program is hereby submitted for approval.

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