24-Volts Automotive Charging System Trainer and Tester Bench

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Abstract— Education is rapidly changing today, and innovations in teaching and learning opportunities are important moves to undertake to keep paced with these changes and challenges. This study aimed to design a 24-volt automotive charging system trainer and tester bench that can be used as learning aid for automotive charging lessons. It also described the process involved in its development. It used descriptive research design. Interview with professionals whose expertise is in line with the project was done to intensify the viability of the study. It was found that 24-volt automotive charging system trainer and tester bench can be made as instructional material to automotive lessons. It can be used as alternator test bench beneficial to automotive electrical shops and research and development practitioners. There were steps to undertake to be able to come up with the trainer and tester bench. The design when developed may be used as trainer and tester bench when undertaking automotive charging lesson. Further studies and testing on the developed product may be done. Research on its effectiveness may likewise be conducted to affirm its use as instructional materials. Innovations on this developed product are encouraged to fully maximize its potential as instructional material, trainer and tester bench.

Keywords— Automotive, 24-Volt Charging System, Trainer and Tester Bench, Developmental.

INTRODUCTION

There have been several researches conducted on the development of instructional materials which are intended to increase the learners' ability to learn the skills and the contents being taught. Teachers exert effort to come up with their own learning materials for their own learners because there are several things to consider in the development which may not have been considered by other instructional materials. Also, the shortage in the instructional materials available is another recurrent problem in the educational system that force teachers to improvise their own instructional materials more than waiting or expecting for to a given one. Most of the time, these given instructional materials may not be appropriate to the teaching principles and practices that teachers opt to implement.

One challenging task for a teacher is to make his students understand intangible ideas in his lessons. It is a basic principle in teaching that students' senses must be involved in their learning process because their senses are their avenues to learning. Dioquino (2011) tells that knowledge is gained through all the senses and when one is engaged in practical work or activity, all these senses are used to perceive the ideas being taught. Taking Dale's statement (1998), he said that the eye as a sensory organ is highly utilized organ in learning compared to other sensory organs. It is quite natural that knowledge to be gained through the sense of sight is more vivid, accurate and permanent. Eighty per cent of the knowledge gained is through the eyes. What one sees, one remembers.

Learning by direct experience is made possible by many channels and it is naturally quick, complete and more accurate. Project method involving creative work provides direct experience in a natural way. It involves a lot of self-activity which make it an ideal method for students to acquire needed knowledge. Effective learning emphasizes the importance of first hand concrete experiences involving sensory contacts as the starting point of learning which later will proceed to building blocks of one's capacity to learn another content or lesson. It is an advantage for students therefore that instruction is within their line of interests and purpose because it makes them involved most especially when instruction is delivered through a well-chosen instructional media that appeal to their different senses. Teachers nowadays have the access and the ability to a wide range of instructional materials which are readily made or are fabricated by teachers themselves to consider every aspect of his instructional activity necessary for a maximum teaching and learning experience.

With the teacher-made instructional materials, the teacher can plan the learning situations and be sure to realize his objectives. They likewise will be able to secure the attention of the learners, motivate and enable the learners to form accurate concepts and ensure permanent retention of that knowledge gained. With the use of appropriate instructional materials, the teacher may even make a difficult concept clear to a below average learner. Taking the situations faced by teachers of automotive where abstract ideas in the lesson almost dominate the learning content. Different concepts in

automotive is tasking and impossible to be learned without the aid of appropriate instructional materials. Explaining concepts would be harder to do if only lectures or even with pictures and illustrations are done in the classroom. Concrete objects must be present to mock the different activities of vehicles. Each and every vehicular activity necessary for a vehicle to function well must have a corresponding instructional material to assist teachers in their teaching activities. With this, the researcher was given the initiative to achieve for the development of another instructional material which is conceptualized from an alternator and starter test bench. It will be a replica of automotive charging system on vehicles. It is the 24-volt Automotive Charging System Trainer and Tester Bench.

This project is composed of four main parts: the frame, alternator clamp, instrument panel and the electrical circuitry. The frame used a rectangular steel to endure the weight load with a ball caster attached at the lower part for easy mobility. The alternator clamp was designed to accommodate any 24-volt alternator. The instrument panel is designed with a detachable module from the instrument panel frame made up of acrylic glass sheet which accommodate the instruments/gadgets. The electrical circuitry is designed to terminate its ending terminals to a binding post which are all installed in the instrument panel. With this project, teacher can readily present to students any lesson concerning vehicular charging system. With the electrical system installed in the car, it would be hard for students to figure them out since its location is not within the convenience and would take time and effort to pull them out of the vehicle. With this improvised instructional material for automotive charging system trainer and tester bench, it will provide students better and wider understanding about charging system and other electrical concerns of vehicle.

With this, the researcher was able to conceptualize the development and construction of an innovated charging system trainer and tester bench, it can be utilized for demonstration, checking, testing and troubleshooting the automotive charging system. It will likewise be a useful alternator test bench to make troubleshooting easier, faster and more convenient.

Automotive charging system as explained by Crouse, et. al. (1975) plays a vital role in the automotive electrical system. According to Meti (2004), the electrical system is the most important support system of a vehicle. Its electricity provides the power needed for the different electrical loads such as starting motor, ignition system, radio and other electrical components and electronics devices while the engine is running. Battery is an important part of automotive Electrical system. It supplies electric current to operate all the electrical and electronic systems in the vehicle. Battery is an electrochemical device. The amount of electricity it can produce is limited. The chemicals – sponge lead, lead oxide and sulfuric acid react chemically to produce flow of current.

Motor vehicles need their own efficient and reliable source of energy that is always available to supply power for the starter, ignition system, fuel injection system, for the ECU to control electronic equipment, lighting system, safety and convenience electronics among others. When the engine is stopped the battery is the source of energy. When the engine is running the, alternator or the dynamo is the electricity generating device supplying power to all electrical loads. Alternators have higher electromagnetic efficiency than DC generators and have much wider rotational speed range. It produces about 1/3 of rated power at idling. It is designed to generate charging voltage of 14V (28V for commercial vehicles). The 3-phase winding is used in the stator and the excitation winding is used in the rotor. A rectifier converts the 3-phase AC in to DC. The alternator output, battery capacity and the starter requirements together with the remaining electrical loads need to be matched to each other as optimally as optimally as possible. These are essential components of a charging system which are included in the prototype that will be made into 24-volt Automotive Charging System Trainer and Tester Bench.

Educational Technology or ET is the efficient organization of any learning system adapting or adopting methods, processes, and products to serve identified educational goals (National Council of Educational Research and Training, 2006). This involves systematic identification of the goals of education, recognition of the diversity of learners' needs, the contexts in which learning will take place, and the range of provisions needed for each of these. The challenge is to design appropriate systems that will provide for and enable appropriate teaching-learning systems that could realise the identified goals. The key to meeting this challenge is an appreciation of the role of ET as an agent of change in the classroom, which includes not only the teacher and the teaching-learning process but also systemic issues like reach, equity, and quality.

The use of educational technology in the classroom can even be maximized with the sensory experience of each and individual student in the classroom. Sensory experience forms the foundation for intellectual activity (Sampath, 1998). Sensory aids affect an economy of

time in learning. For long, the common practice to communicate knowledge has been by means of oral and written language. But language has many limitations that may contribute to learning difficulty. Generally, modern educators recognize in audio-visual materials such basic values as concreteness, enrichment, and dynamic interest. The number of aids for teaching has become so numerous that today a teacher of any subject need not resort to any of the archaic methods of teaching. Even the most abstract object can now be presented to the learner in a concrete and perceivable way through more than one aid.

Andaya (2002) constructed an AC Machine Circuit Trainer. He used locally available electrical supplies and materials. The trainer is modular in nature, which has an auto transformer, DC regulated power supply and an output lamp circuit. The study revealed that it was technically feasible to facilitate demonstration in laboratory activities. Valera (2008) also designed and constructed a Mechanical Transmission lifter used as instructional equipment for automotive classes principally in power train. It can be utilized in automotive shops to make work safe and convenient. Paat's study (2007) constructed an Enhanced Manual Clutch and Transmission Trainer which were specifically designed as learning aid for automotive students. A portion of the housing of the said trainer was cut away to display or visualize the action or movement of internal parts. Pecaso (2006) constructed an Ignition System Trainer equipped with camshaft that drives the distributor assembly and a pilot light that illuminates showing the sequential order of firing during ignition. The cited studies on devices intended for instruction in an automotive class have given this present study the idea of also coming up with a 24-volt Automotive Charging System Trainer and Tester Bench. It is a concrete teaching material where the teacher can explain the lesson, he wanted to make the students to understand about charging system. The students can likewise explore the ideas being taught with the aid of this instructional material more than just glancing at the board when the teacher do lecture session. It can offer students as well with variety of opportunity to enhance their skills in automotive technology.

This study designed a 24-volt automotive charging system trainer and tester bench that can be used as learning aid for automotive charging lessons. It also described the process involved in its development.

Instruments

This study is a descriptive research design. It This study is a descriptive research design. It designed an instructional material called 24-volt Automotive Charging System Trainer and Tester Bench. It further described the steps in its development such as planning and designing. The planning phase included the formulation of the part by part design of the project such as: studying the research application pertinent to the project developed, working activities and time frame, design, listing of materials and equipment to be used with the project. The design included sketch/layout of the frame, alternator clamp, instrument panel mounting and the schematic diagram of automotive charging system circuitry.

RESULTS AND DISCUSSION

24-volt Automotive Charging System Trainer and Tester Bench

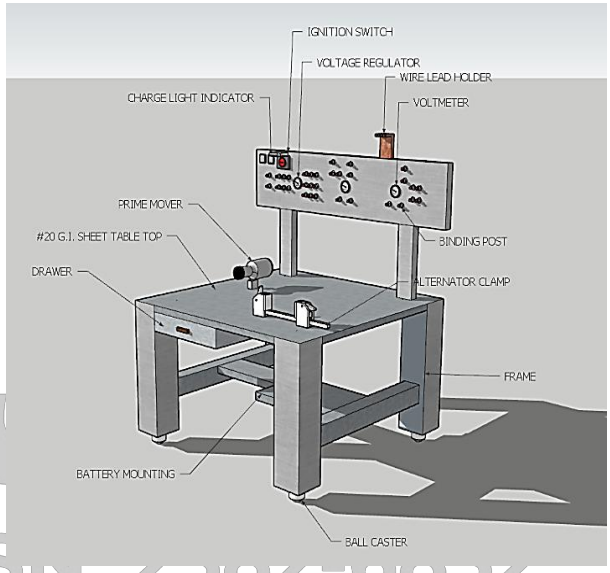

Figure 1: *Pictorial perspective of automotive charging system trainer with parts*

1. ***The Frame –*** It housed the other three parts of the project. It was made of rectangular tubular steel with the purpose of withstanding all the installed loads: alternators, electric motor and instrument panel. It is topped with GI sheet to facilitate the full demonstration of the project during instructions and related activities.

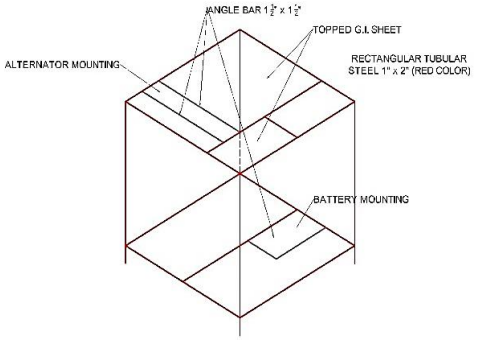

Figure 2: *The Frame*

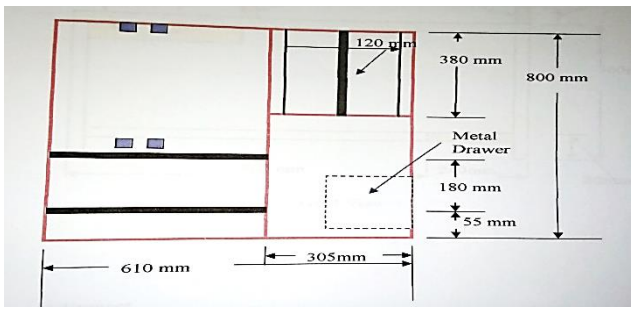

Figure 3: *Top view of the frame*

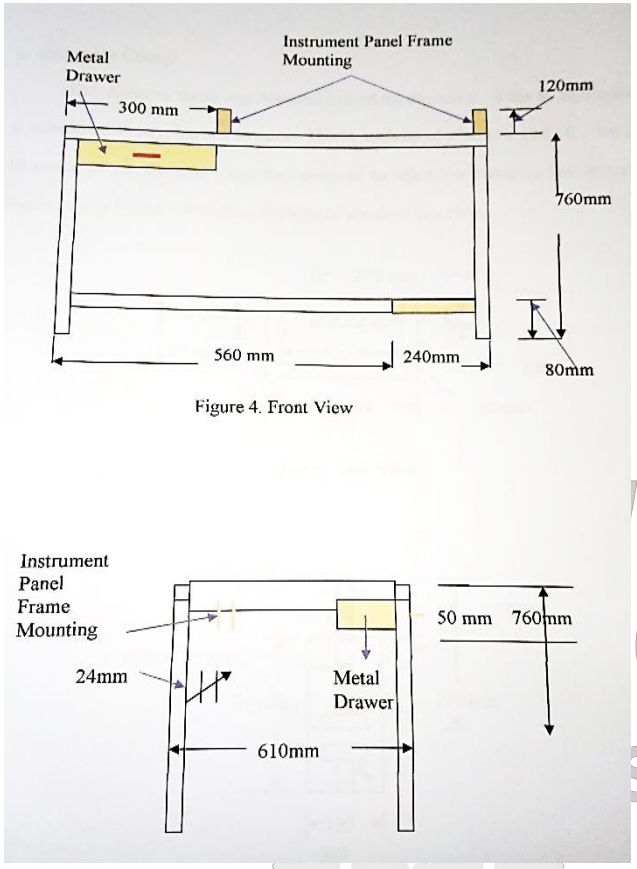

Figure 4: *Front View and side view*

2. ***The Alternator Clamp*** **–** The alternator clamp is designed to hold the alternator. It has an adjustable jaw to accommodate any size of the alternator. This is made up to 2' x 5" x 12.5" C-bar and a 16 mm x 27 mm threaded round bar, designed to adjust the clamping jaw in and out.

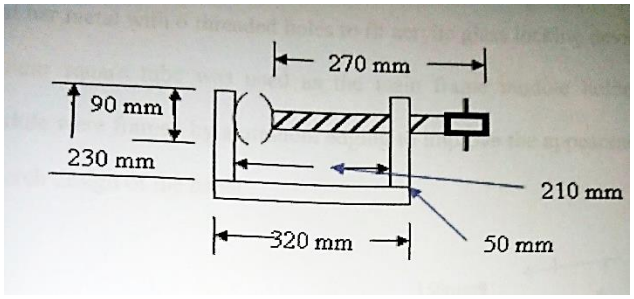

Figure 5: *Side view*

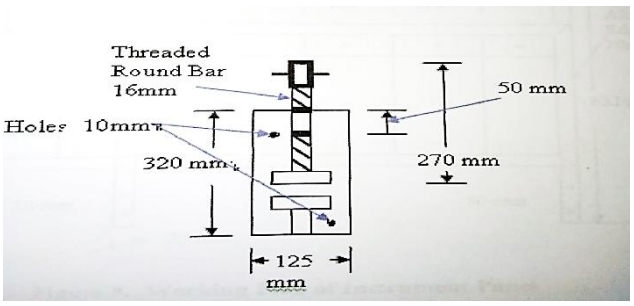

Figure 6: *Top view*

3. ***Instrument Panel*** **–** It served as the holder of the electrical components of the charging system trainer. Instruments/gadgets were mounted into the acrylic glass sheet designed detachable modules from the instrument panel frame. The module holder is made up of flat bar metal with 6 threaded holes to fit acrylic glass locking device. One-by-one aluminum square tube will be used as the main frame module holder and detachable module were framed by aluminum edging to improve the appearance.

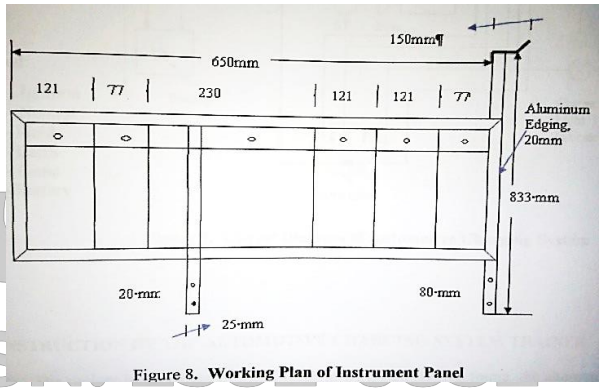

Figure 7: *Working plan of instrument panel*

4. ***Wiring Circuitry*** **–** The wiring circuitry of the project demonstrates the complete path of the electric current flow into the charging system. All terminals of the instruments used were connected to binding post for easy connection. A flexible connecting leads with banana plug will be used as wiring connectors.

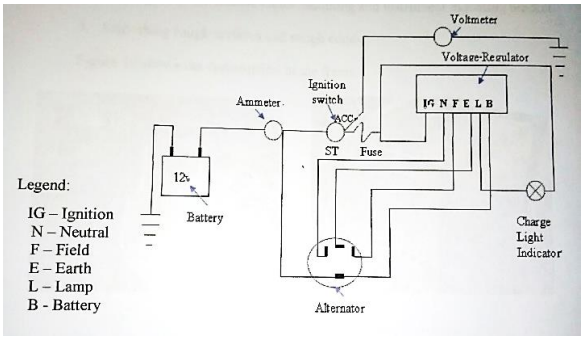

Figure 8: *Circuit diagram of automotive charging system*

Steps in the construction of the 24-volt Automotive Charging System and Tester Bench

This project is composed of four major parts: the frame, the alternator clamp, the instrument panel and the wiring circuitry. The construction of this project will follow several steps and procedures and is done by component.

The Frame

1. Lay out the dimension of the frame into the materials.
2. Cut the laid-out materials.
3. Assemble by welding.
4. Drill holes for electrical motor mounting and instrument mounting bracket.
5. Smoothen rough surfaces and rough edges.

The Alternator Clamp

1. Make the working drawing.
2. Prepare the materials
3. Lay out measurement into the materials.
4. Fabricate the adjusting clamp device.
5. Fit into the frame for proper alignment.
6. Drill holes for bolts to mount the parts.
7. Assemble.

The Instrument Panel

1. Make the working drawing.
2. Prepare the materials.
3. Lay out dimensions into the materials.
4. Cut the laid out materials.
5. Drill holes for module mountings on the panel frame and holes for the binding posts into the acrylic glass sheet.
6. Thread the holes with 6 mm hand tap.
7. Trial assembly into the panel frame.

The Wiring Circuitry

1. Draw the circuit diagram.
2. Install wirings of the different instruments mounted.
3. Solder wires that are permanently installed.
4. Test the circuit for proper operation.

CONCLUSIONS AND RECOMMENDATIONS

The 24-Volt Automotive Charging System and Tester Bench is designed to be used as instructional material for Automotive Technology class. It has four main components: the frame, the alternator clamp, the instrument panel and the wiring circuitry. The frame is a rectangular steel tube to withstand the load and has ball caster on the legs for easy mobility. The instrument panel is designed with detachable modules from the instrument panel made up of the acrylic glass sheet which accommodate the instrument/gadget. The electrical circuitry is designed to terminate its ending terminals to a binding post all installed in the instrument panel modules.

Implementation of this project may be done through a research funding agency to finance the needed materials for its built. Study on its development and evaluation may be done. The output project may be used as instructional material in automotive electrical shops. Further study and testing may be done for the utilization and reliability of the project.

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