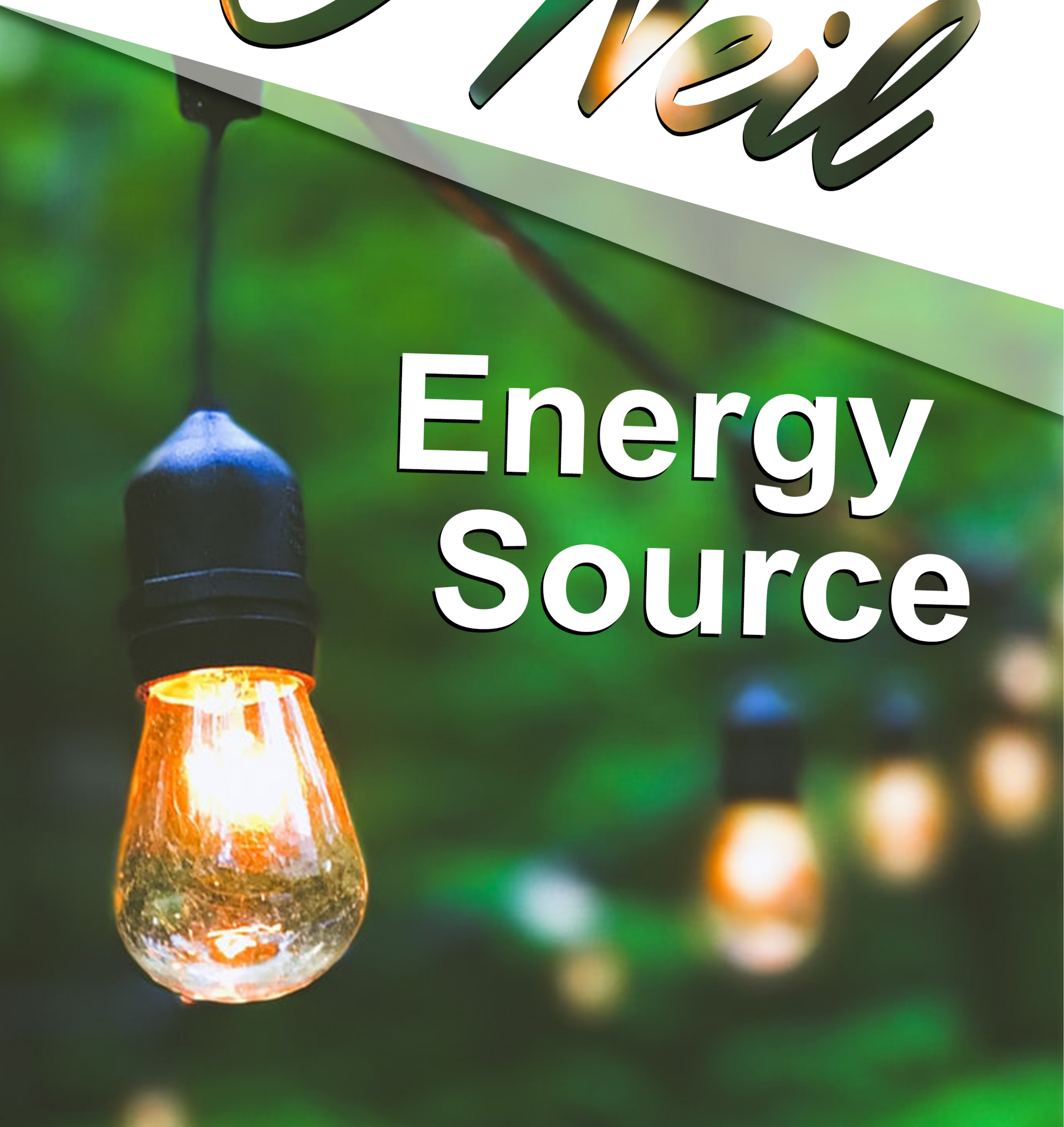
O'Neil

Energy Source



The equipment necessary for the installation

1. Three-phase asynchronous Motor with cage rotor
2. Auto Alternator
3. Load relay (Rectifier)
4. 12V car battery
5. Car DC to AC Inverter

1. Three-phase asynchronous motor with cage rotor

The car is the most asynchronous widespread electric car. It is found widely in electrical actuators make in all industrial sectors, particularly in social and arrangement of three-phase motor, machine tools, for the operation of pumps, compressors, ball Mills, electric cranes, bridges, medical apparatus, appliance etc.

Asynchronous engines are built for a wide range of powers (from ordinal W units up to tens of MW), for low voltages (below 500V) and medium voltage (3 kV, 6 kV and 10 kV) and synchronous speed the frequency f = 50 Hz commonly with equal to n = 500, 600, 750, 1000, 1500 or 3000 rpm, depending on the number of pairs of poles.

The main advantages of induction motors over other types of electric motors are:

- *constructive simplicity;*
- *low cost price;*
- *high safety of operation;*
- *high technical performance (high torque, high efficiency);*
- *stability in the functioning, operation, handling and simple maintenance;*
- *directly from the mains power supply three-phase grid by 2003;*
- *can supply motors with power less than 5KW of monophasic A.C. network using a capacitor phase.*

Engine power

Connect the three-phase motor to 400V network directly connecting the engine to the heater power supply. To reduce the current absorbed at start up the engines over 5kW is connection terminals connecting triangle star/U1-V1-V2, W2, W1-U2.

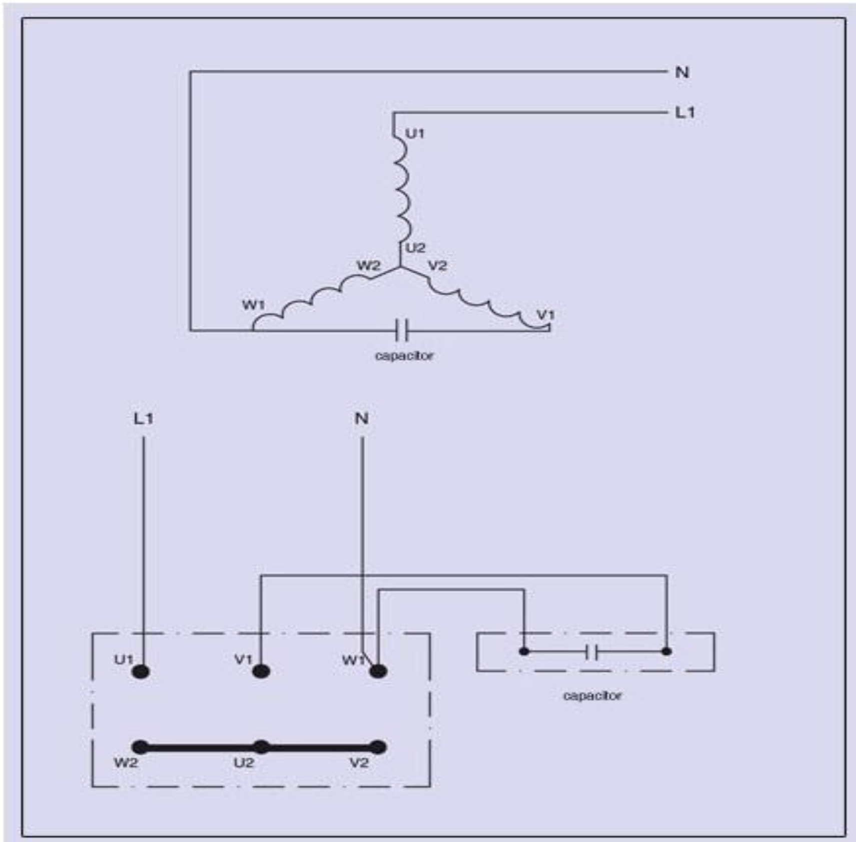
Connecting a three-phase motor to a power supply of 230V A.C. is as follows:

- first create a connection to the terminals of the motor star short circuit between terminals U2-V2-W2.

- Connect neutral (null) to the positive terminal W1;
- Connect the positive terminal U1 phase;
- The capacitor is connected to the positive terminal at the entrance and exit to W1, V1 landmark;

The direction of rotation of the motor can be reversed by changing the phase and neutral between them.

Capacitor choice phase is done depending on the engine power, its value must be 70 µF/kW.



The basic operation of asynchronous motor

Three-phase asynchronous engine receives electricity from the AC network by connecting the stator, which converts energy into mechanical energy supplied to the rotor shaft.

Three-phase currents in lower system absorbed by the stator produces a magnetic field that rotor for the fundamental harmonic is in the form

This field produces the report with a rotor (which at the time of startup is fixed) a magnetic flux of the form:

This in turn induces the flow phase has the same pulsation t.e.m.. As rotor is closed (in short circuit or a balanced consumer)
t.e.m. will give rise to a current through the rotor phase. Symmetrical three- phase system of currents in a three-rotor interacting with three phase feed system 2 Y giving rise a couple of forces which will trigger the rotor. The rotor increases its speed and thus finally is set to the value of $\Omega_2\Omega_1 < (_1 \Omega$ is the angular velocity of synchronism of the inductor).

2. Car alternator

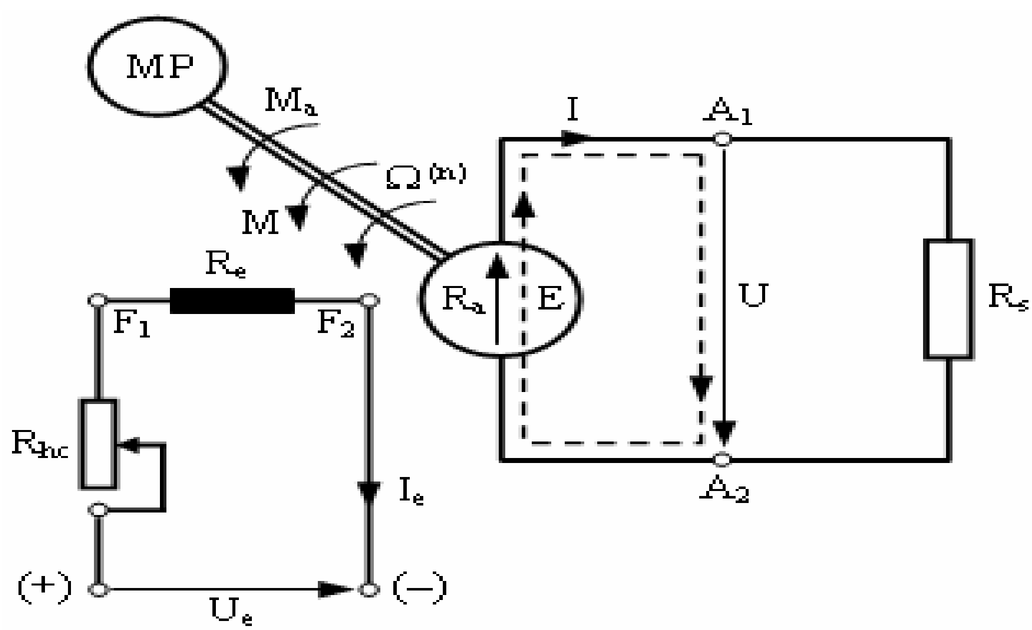
The alternator is an electromechanical device that converts mechanical energy from the engine

electricity in the form of direct current with a voltage of 12V.

The generator is a DC machine that operates by the generator, being trained by the engine.

The engine (electric motor) develops for this active couple me with the same respect as the speed of rotation. The alternator excitation winding is provided by a current of the DC source, which may be a rectifier, a battery, a DC generator or even electric car considered (auto excitation).

The principle of the car alternator



$I_{(e)}$ -inrush current in winding excitation

$_{E}$ U-voltage at battery terminals

R_{ho} -rheostat

R_e -excitation winding resistance

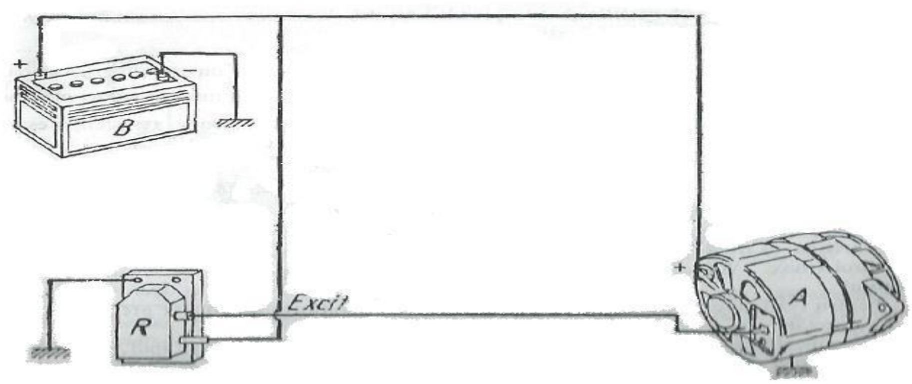
I-current in the rotor winding

E-electromotive inside the alternator

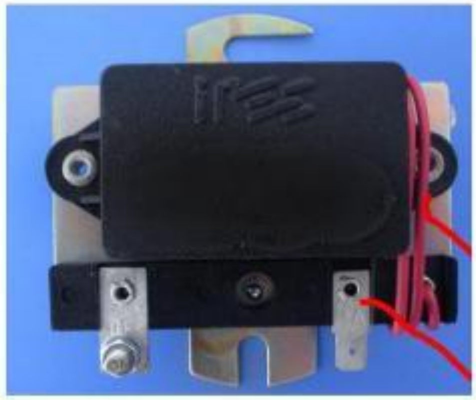
U-voltage at the alternator output

MP-primary propulsion engine

Wiring diagram - alternator connection in the circuit



3. Relay (rectifier)

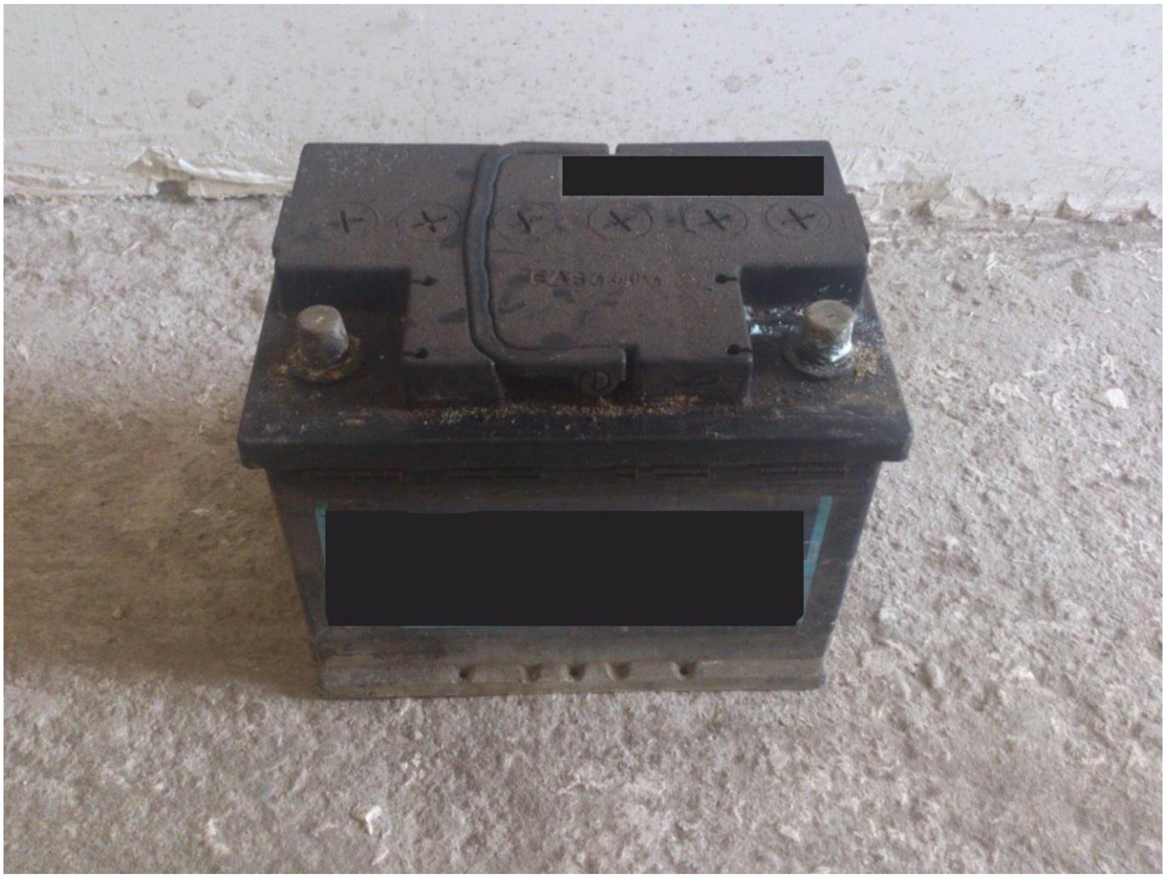


The Rectifier is designed to charge the battery with a voltage coming from the alternator. It stabilizes the charging voltage at 12V DC.

Load relay connections

- The positive terminal of the rectifier is connected to the DF to DF the alternator terminal after the Excitation circuit (2);
- The positive terminal + B is connected to battery (+);
- The positive terminal + of the meal.

4. Car Battery 12V D.C.



The battery is a source of reversible chemical consisting of an element which puts electricity and store it in the form. Its operation is based on the occurrence of an explosion-proof electric voltages kind, obtained by associating various materials in electrochemical point of view. The battery of accumulation can be acidic or alkaline (for motorcycles).

<u>Battery lead acid.</u>

It contains three elements:

1. liquid (called the electrolyte)
2. the positive electrode consists of PbO_2
3. the negative electrode composed of Pb

The operation is performed on the basis of reversible chemical reactions.

(+) $PbO_2 + 2h + H_2SO_4 \rightarrow \leftarrow PbSO_4 + 2H_2O$

(-) $Pb + H_2SO_4 + A \rightarrow \leftarrow PbSO_4 + H_2O$

Reaction between solids like Pb and PbO_2 and liquid substances such as H_2SO_4 and H_2O results lead sulfate ($PbSO_4$) to spend in the form of fine crystals of white on the electrodes. The resulting substance is water. It is observed that is consumed and the resulting H_2O, H_2SO_4 therefore electrolyte is added to increase the concentration of H_2SO_4.

5. Car inverter Dc-2003

The inverter is an electrical device that allows the conversion of direct current into alternating current. Alternating current obtained can have different voltages and frequencies. May have different modes of operation (electromechanically or semiconductor devices).

Voltage inverters with a pure sinusoid are electronic devices that convert direct current into alternating current needed many electrical appliances used by people. Alternating current produced form pure sine current quality, being the same or better with the current from the mains (the usual current of the socket).

Alternative energy systems, power inverters are an important link between the energy in a direct current to the battery and AC power that requires electrical equipment. An inverter/power supply fed from a group of batteries can be a continuous source of energy in the event of a fall of voltage or blackout.

The batteries provide energy in the form of direct current (DC-direct current) which can be used at very low voltages, but cannot be used to fuel most modern household appliances. The national network of electric current and power generators produce AC with sinusoidal waveform (AC-alternating current) that is used by the most common electrical appliances today. Voltage inverters take direct current provided by a group of traction batteries and transforms it electronically in alternating current.

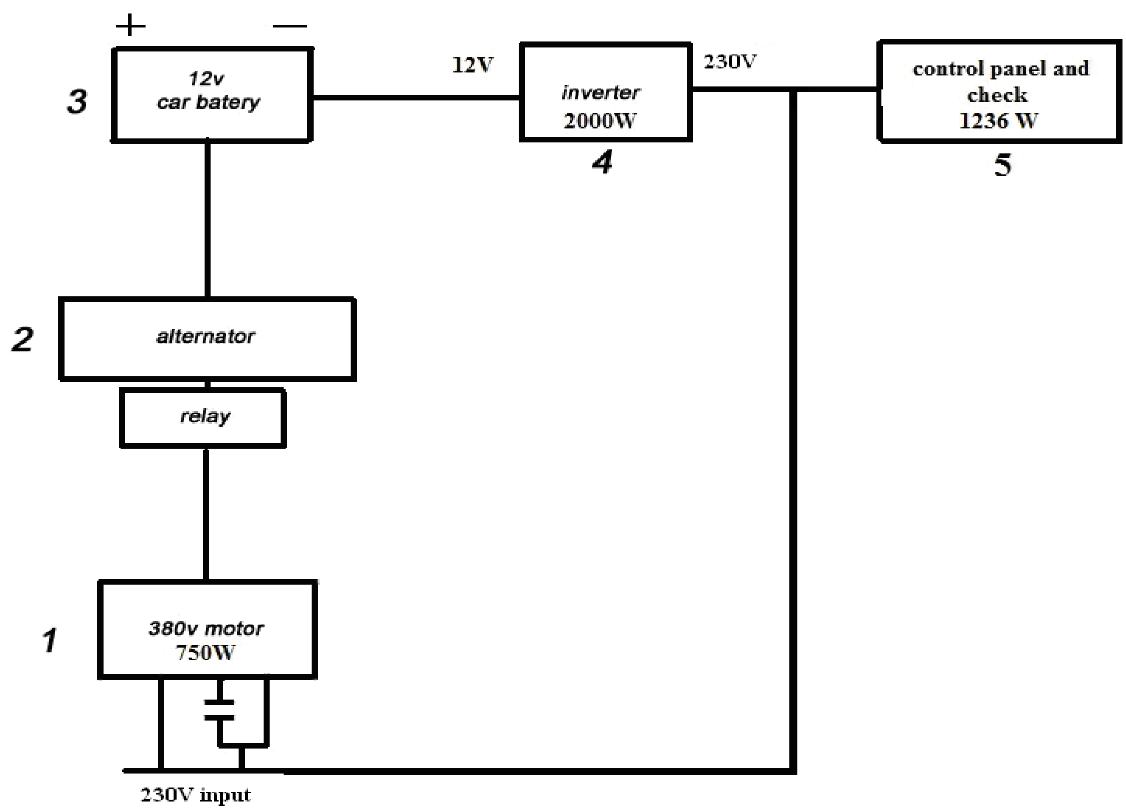
A power inverter used as energy reserve in urgent cases in a housing connected to the network will use the energy from the grid in order to keep the batteries charged and when the mains fails, it will automatically switch to absorb current from batteries and power the electrical system of the home. In a stand-alone renewable energy system, whether for a home, car, or in the inverter allows AC electrical appliances to work with energy drawn from the accumulator battery group.

Alternating electric current supplied to the national grid or motor generators has a sine wave with a pure sinusoid. This is the safest in operation for household appliances. The alternating with pure sine passes from the maximum value of the voltage to the minimum value and vice versa through a curved wave shape smoothly as opposed to jumping into the current stage alternative with modified sine. Voltage inverters with a pure sinusoid will produce alternating current of the same quality or better with the current from the mains (the usual plug), ensuring that even the most sensitive electronic equipment will function properly.

With pure sine inverters are more expensive than inverters with modified sine, but their shape quality of output waveform can be a definite advantage.

For buildings with offices, a power inverter used for energy supply in case of emergency, an inverter with pure sine will allow correct operation for all Office equipment and fluorescent lighting. For anyone who uses, battery chargers, electric drill machines, radios with digital clock or sensitive electronics will have to choose an inverter with a pure sinusoid in order to ensure the correct operation of all household appliances.

The operation of the entire circuit



The inverter is connected to the 12V car battery transforms continuous-continuous charging current of 230V AC. Three-phase motor (380V, is seas, 0.75 KW) is connected to the inverter output (outlet) (230V) using a phase capacitor (50 μF). Train engine using a car alternator drive belts. It produces a current with a voltage of 12V DC and using the load output is stored in the battery.

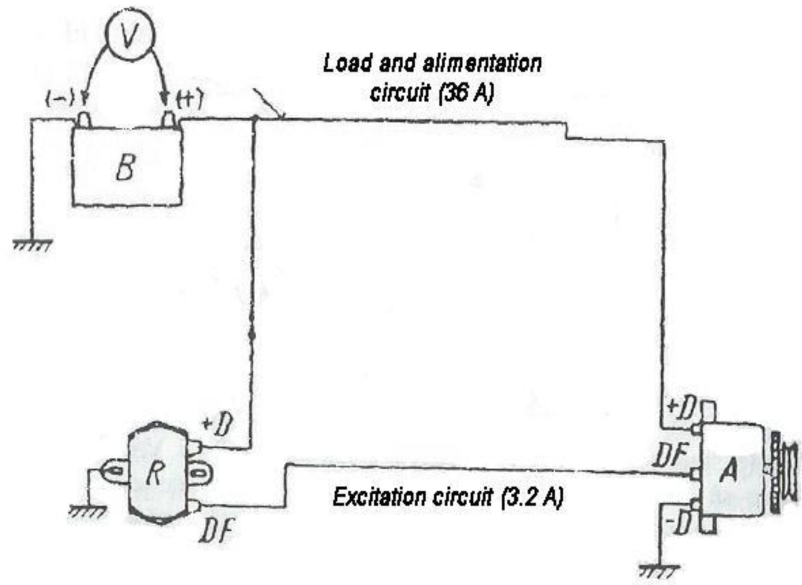
The inverter is related to both three phase motor 750W and lighting fixtures with a total power of 936 W (12 75Wşi bulbs 2 fluorescent lamps) but also an outlet with a voltage of 220 v and an output of about 300W.

Lighting and grip on the Panel are connected in parallel in order to avoid system downtimes at the failure of one of them.

Connecting the alternator to the circuit is performed according to the scheme below:

- The positive terminal "+" battery to the positive terminal of the car "+ D" of the alternator;
- The "-" Terminal of the generator to the ground;
- The terminal "DF" alternator "DF" to the positive terminal of the relay load;
- The positive terminal "+ D" load relay to the positive terminal "+" battery;

- The "-" Terminal of the car battery to ground.



All system produces a stream of 2000W 750W of which are consumed by the three-phase asynchronous engine, and what follows after powering the engine, a current of the power supply are you using 1250W lighting fixtures and electrical outlets.

ELECTRICAL

Reading Electrical Plans

INTRODUCTION

The first thing that a technician should do upon receiving a set of plans for a building is to review them, scanning each one to get an overview of the building. The electrical system, the air-conditioning and heating system, and the plumbing system for a building are very closely related. Design technicians and installation technicians must coordinate the systems of all trade areas to have a well-designed and smooth installation on the job. This chapter will deal with the reading of the electrical plans.

On larger buildings, the electrical plans usually contain plans for lighting, power distribution (showing receptacles and special connections), panel schedules, and other schedules and details pertaining to the electrical system.

READING THE ELECTRICAL PLANS

The larger drawing on Sheet E-1, **Electrical Figure 1**, is the floor plan. The lighting plan and the power distribution plan are consolidated on the same floor plan. Lighting fixtures are shown with rectangles for fluorescent fixtures and circles for other types of fixtures. Each lighting fixture is identified by a letter of the alphabet. These letters are shown on the lighting fixture schedule on the plan.

The power distribution is also shown on the plan. The electrical receptacles use the standard symbol. The hash marks on the circuit lines indicate the number of conductors (wires) required. All of the circuits are indexed (numbered), and these numbers indicate the number of the circuit breaker in the distribution panel. A schedule for Panel A is shown on the plan with each circuit numbered. The service to the panel is shown with a separate detail. The main circuit breaker is located inside Panel A.

THE ELECTRICAL WIRING

The electrical wiring is shown with an arched line to electrical devices and arched lines between lighting fixtures or between receptacles. The exact location of the wiring and conduit is left to the installing technician. On each wire are hash marks indicating how many wires are required with the circuit. The arrowhead at the end of the wiring symbol indicates that the conduit is to be extended to the panel. The small number located at the arrowhead gives the number of the circuit breaker to which the wiring is to be connected. The panel detail located in the lower left-hand side indicates the circuit breaker numbers. The wiring shown with bro- ken lines, and the receptacles connected with these broken lines, are alternate (marked ALT). The ALT marking means that the contractor should give a separate price for this work, and the owner can decide whether to include this work in the contract.

ADDITIONAL INFORMATION SHOWN ON ELECTRICAL PLAN

The electrical plan on Sheet E-1 contains additional information that should be noted at this point. A lighting fixture schedule on the plan describes the lighting fixtures that are to be used on the job. Each fixture shown on the floor plan has a letter that corresponds to the fixture schedule.

A symbol schedule identifies the symbols used on the plan. The power riser diagram is shown in the lower right-hand corner. A general note is also shown on the plan giving instructions to the contractor. A note at the top right corner of the plan restricts the use of the plans.

ELECTRICAL SPECIFICATIONS

The electrical specifications, like the mechanical specifications, contain written instructions and descriptions about construction equipment and procedures. The specifications for this job were bound with the General Contract specifications and are not available with this text.

UNDERSTANDING THEPLANS

As previously noted, it is very important for persons reading the plans to understand the plans thoroughly before attempting to estimate the cost of the job or to construct the job. After construction is begun, the various trades often have to do their installations in the same limited space. For this reason, coordination on the job between the different contractors is necessary to complete the job satisfactorily.

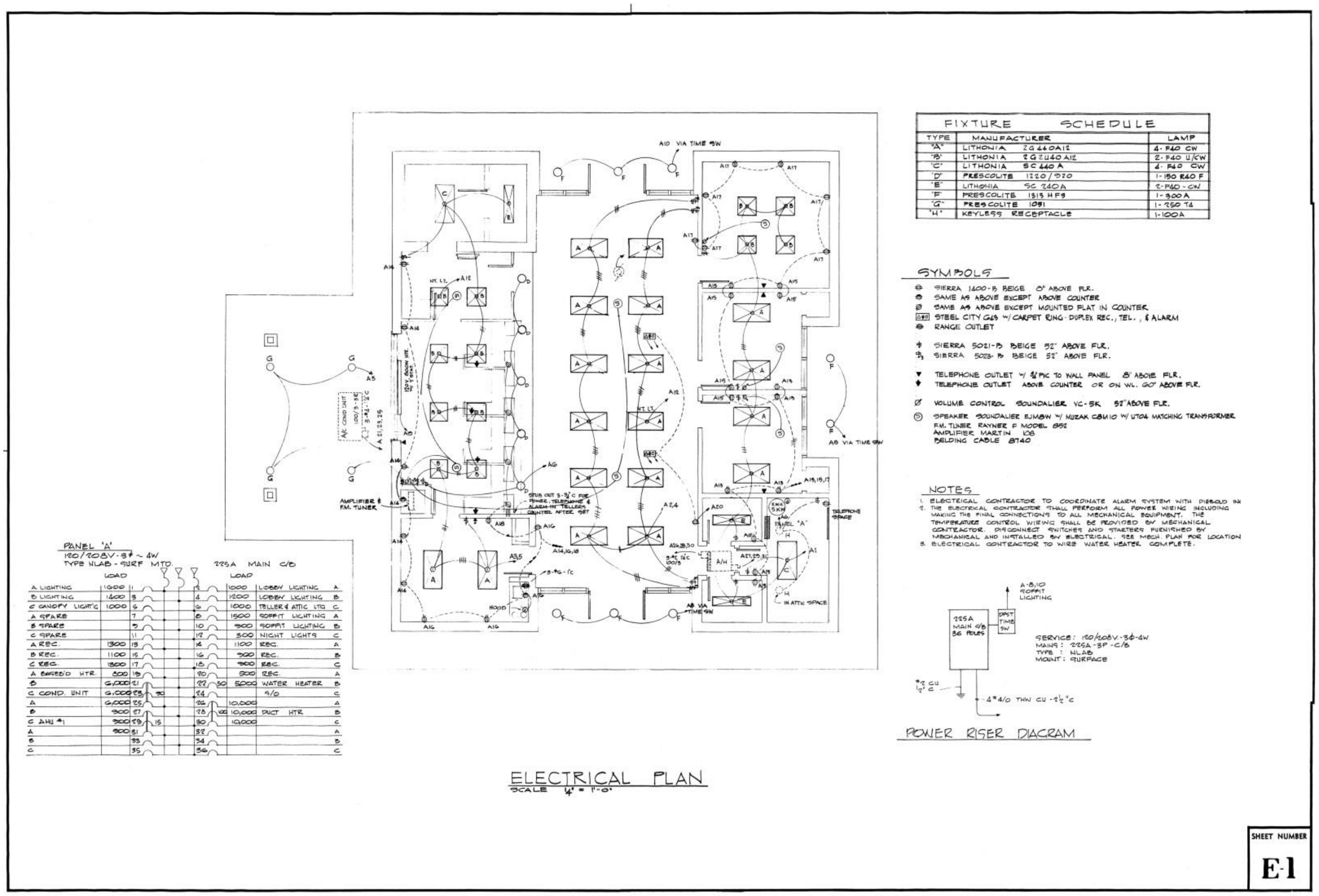
ELECTRICAL

Electrical work shown on the site plan can be the first sheet of the electrical section. The electrical section also includes the following:

1. **Foundation/Basement Plan**—shows electrical equipment (panel boards, switches, electrical outlets, etc.) required for the basement, located in the crawl space, or located under a slab on grade.
2. **Floor Plans**—show the electrical equipment required for each floor, including receptacles, lighting fixtures, and necessary electrical connections to equipment furnished by other contractors.
3. **Roof Plan**—electrical wiring, equipment, and electrical connections to equipment on the roof are shown on the electrical roof plan.
4. **Elevations, Sections, and Details**—these are detailed drawings showing how the electrical equipment is installed. Special instructions and information are relayed to the electrical worker through these drawings.
5. **Schedule Plan**—contains schedules for the electrical devices, including the following:
   - A. Lighting fixture schedule
   - B. Panel board schedule
   - C. Conduit and raceway schedule

Sheet E-1 of the construction drawings in this chapter shows the electrical floor plan, symbol schedule, lighting fixture schedule, and a panel board schedule for a small house.

The HVAC technician should be familiar with the electrical plans. The location of equipment electrical dis- connects will be important when installing HVAC equipment. Codes also require lighting in certain attic spaces and a GFCI protected circuit near ground level and rooftop air conditioning equipment.



ELECTRICAL Figure 1. Electrical plan — small house.

CURRENT,VOLTAGE, RESISTANCE, AND WATTS

To understand the wiring in a building you should know how electricity flows. Electricity is energy. To do any work (turn a motor, light a lamp, or produce heat) the electrical energy must have movement. This movement is called *current.* The amount of current is measured in **amperes,** sometimes called *amps*. A single household-type light bulb requires a current of slightly less than 1 ampere. An electric water heater might require 50 amperes.

The amount of force of pressure causing the cur- rent to flow affects the amount of current. The force behind an electric current is called *voltage*. If 115 volts causes a current flow of 5 amperes, 230 volts will cause a current flow of 10 amperes.

The ease with which the current is able to flow through the device also affects the amount of current. The ease or difficulty with which the current flows through the device is called the *resistance* of that device. As the resistance goes up, the current flow goes down. As the resistance goes down, the current flow goes up. The amount of work the electricity can do in any device depends on both the amount of current (amps) and the force of the current (**volts**). Electrical work is measured in **watts**. The number of watts of power in a device can be found by multiplying the number of amperes by the number of volts. Stated another way the current flowing in a device can be found by dividing the number of watts by the volt- age. For example, how much current flows through a 1,500-watt heater at 115 volts? 1,500 divided by 115 equals about 13 amperes. **Electrical Figure 2** shows the current, wattage, and voltage of some typical electrical equipment.

ELECTRICAL Figure 2. Current, voltage, and power ratings of some typical electrical devices.

DEVICE	AMPERES	VOLTS	WATTS
Ceiling light fixture	1.3	115	150
Vacuum Cleaner	6.1	115	700
Radio	0.4	115	4
Clock	0.4	115	4
Dishwasher	8.7	115	1,000
Toaster	13	115	1,500
Cook Top	32	230	7,450
Oven	29	230	6,600
Clothes Dryer	25	230	5,750
Washing Machine	10	115	1,150
Garbage Disposal	7.4	115	850

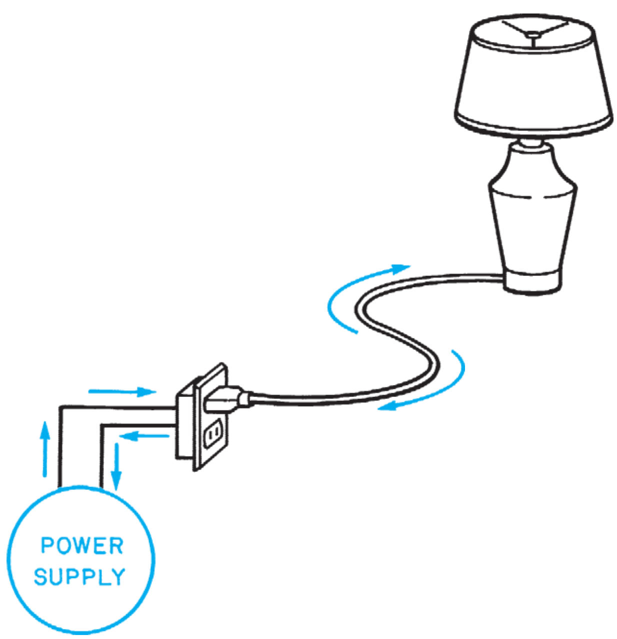
CIRCUITS

In order for current to flow, it must have a continuous path from the power source, through the electrical device, and back to its source. This complete path is called a *circuit*, **Electrical Figure 3.**

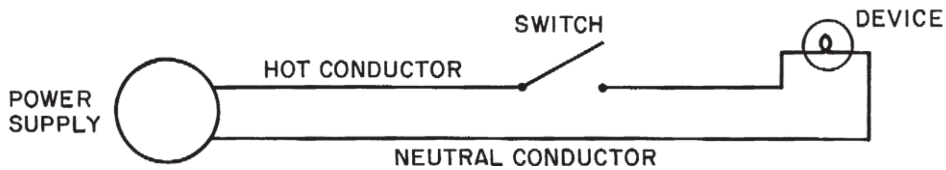
Many circuits include one or more switches. A switch allows the continuous path to be broken, **Electrical Figure 4.** By using two 3-way switches, the circuit can be controlled from two places, **Electrical Figure 5.** When the circuit is broken by a switch, a bro- ken wire, or for any other reason, it is said to be *open.* Any material that carries electric current is called a **conductor.** In **Electrical Figure 3** each of the wires is a conductor. When two or more wire conductors are bundled together, they make a cable, **Electrical Figure 6.**

In larger buildings the wiring is frequently installed by pulling individual wires through steel or plastic pipes, called *conduit.* In houses it is more common to use cables containing the needed wires plus one ground conductor. The ground conductor does not normally carry current. The *ground,* as it is usually abbreviated, connects all of the electrical devices in the house to the ground. If, because of some malfunction, the voltage reaches a part of the device that someone might touch, the ground protects him or her from a serious shock. The current that might otherwise flow through the person follows the ground conductor to the earth. The earth actually carries this current back to the generating station.

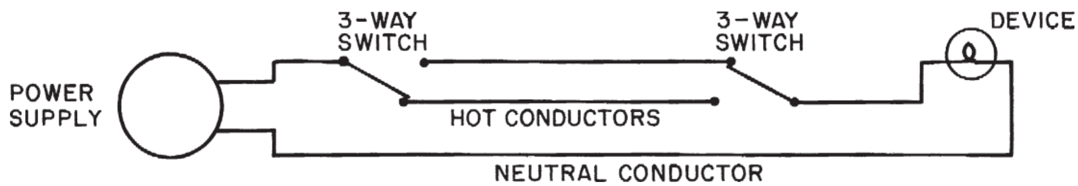
Additional protection against serious shock can be provided by using a *ground-fault circuit interrupter* (GFCI or GFI). A GFCI is a device that measures the flow of current in the hot (supply) conductor and the neutral (return) conductor. If a faulty device allows some of the current to flow through a person rather



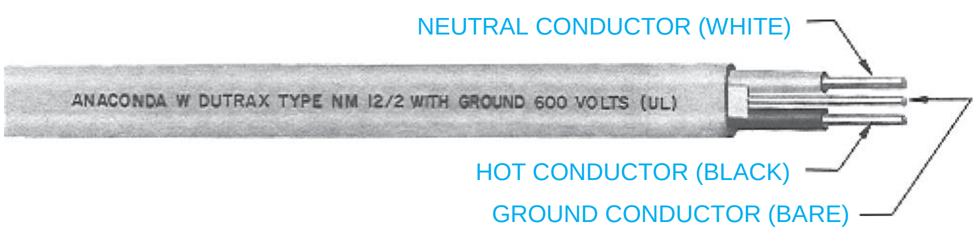
ELECTRICAL Figure 3. A complete circuit includes a path from the supply to the device and back again.



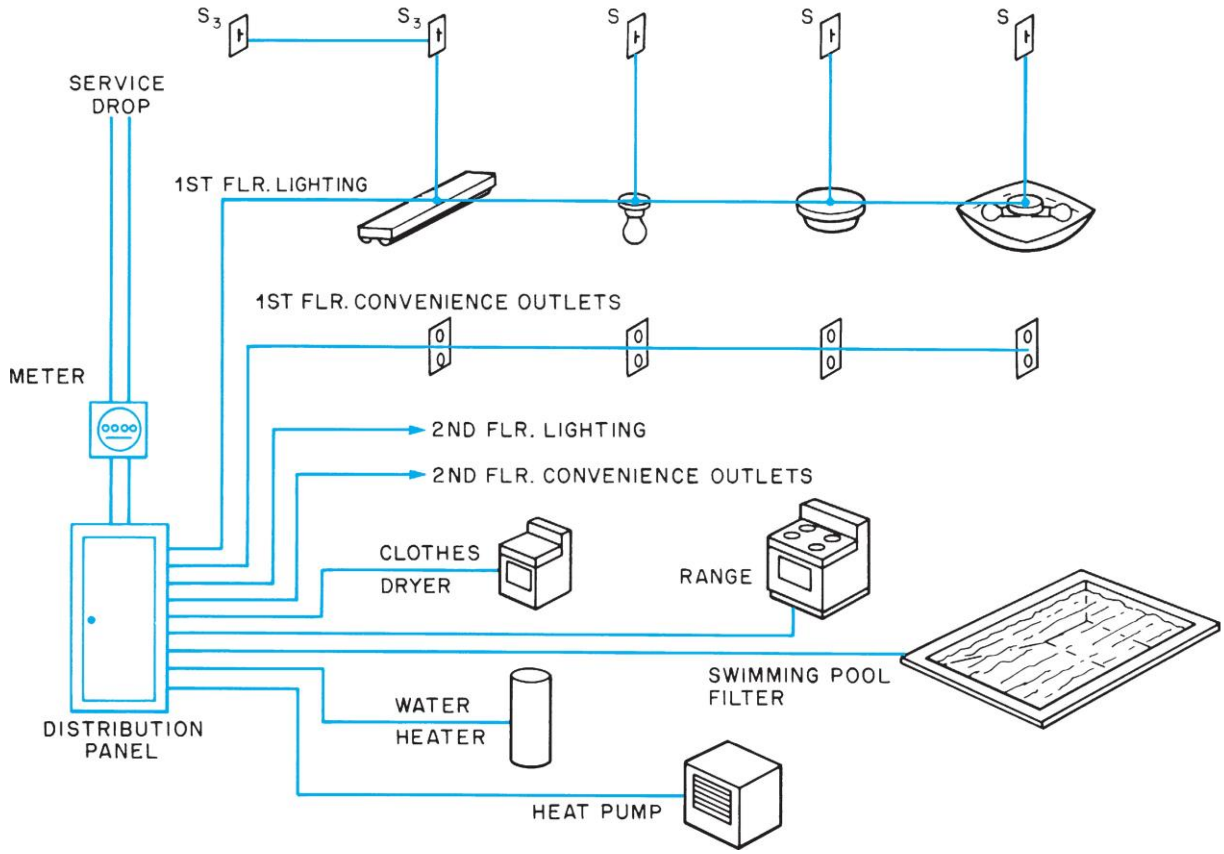
ELECTRICAL Figure 4. A switch is used to break (or open) the circuit



ELECTRICAL Figure 5. Three-way switches allow a device to be controlled from two locations. Notice that if either switch is activated, the device will be energized.

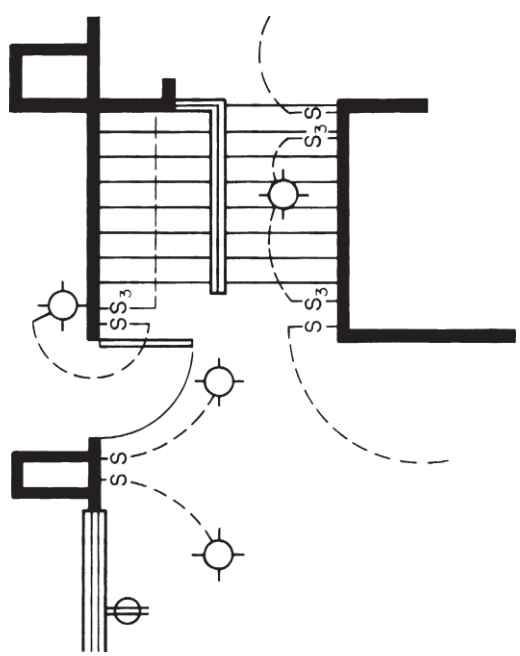


ELECTRICAL Figure 6. This cable has two circuit conductors and one ground conductor. *Courtesy of Anaconda Wire and Cable Division*



ELECTRICAL Figure 7. The electrical service is split up into branch circuits at the distribution panel.

ELECTRICAL Figure 8. Switch legs on a plan.



than the neutral conductor, the GFCI stops all current flow immediately. GFCIs are so effective that the *National Electric Code®* requires their use on circuits for outlets installed outdoors, in kitchens, bathrooms, garages, and near any other water hazards.

The service feeder cable ends at a distribution panel. From the distribution panel, the electrical sys- tem is split up into several **branch circuits, Electrical Figure 7.** Each branch circuit includes a circuit breaker or fuse. The circuit breaker or fuse opens the circuit if the current flow exceeds the rated capacity of the circuit. Branch circuits for special equipment such as water heaters and air conditioners serve that piece of equipment only. Branch circuits for small appliances and miscellaneous use may serve several outlets. Branch circuits for lighting are restricted to lighting only, but a single circuit may serve several lights. Lighting circuits also include switches to turn the lights on and off.

The National Fire Protection Association publishes the *National Electrical Code®*, which specifies the design of safe electrical systems. Electrical engineers and electricians must know this code, which is accepted as the standard for all installations. The following are among the items it covers:

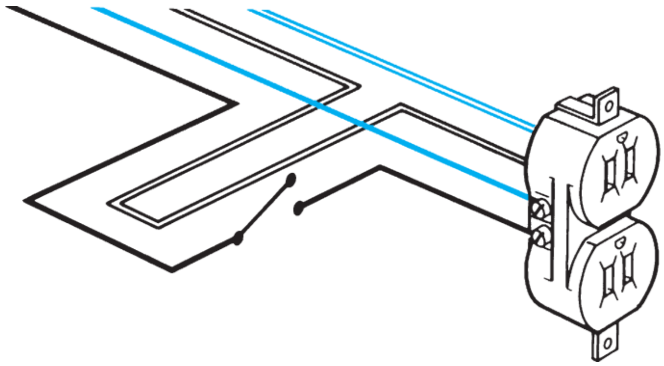
- Kinds and sizes of conductors
- Locations of outlets and devices
- Overcurrent protection (fuses and circuit breakers)
- Number of conductors allowed in a box
- Safe construction of devices
- Grounding
- Switches

The specifications for the structure indicate such things as the type and quality of the equipment to be used, the kind of wiring, and any other information that is not given on the drawings. However, electricians must know the *National Electrical Code®* and any state or local codes that apply because specifications sometimes refer to these codes.

ELECTRICAL SYMBOLS ON PLANS

The drawings for residential construction usually include electrical information on the floor plans. Only the symbols for outlets, light fixtures, switches, and switch wiring are included. The exact location of the device may not be dimensioned. The position of the device is determined by the electrician after observing the surrounding construction. It should also be noted that all wiring is left to the judgment of the electrician and the regulations of the electrical codes. Switch wiring for light fixtures is included only to show which switches control each light fixture. Switch wiring is shown by a broken line connecting the device and its switch, **Electrical Figure 8.**

In rooms without a permanent light fixture, one Or more convenience outlets may be split wired and controlled by a switch. In split wiring one-half of the outlet is always hot; the other half can be opened by a switch, **Electrical Figure 9**.



ELECTRICAL Figure 9. Split wired outlet.

SUMMARY

- Working drawings are original drawings prepared by the architect and engineer to give information to the contractor on a construction job.
- Working drawings are usually classified in the following categories: site work, general construction, structural, mechanical, plumbing, and electrical.
- Site work plans give details on the preparation of the site for construction.
- General construction plans include the foundation plans; floor plans; roof plans; elevations, sections, and details; and equipment schedules.
- Structural plans give information to contractors on the foundation, framing, and other structural information needed for erecting the building.
- Plumbing plans are sometimes shown as part of the mechanical section.
- The mechanical section contains information about piping, ductwork, and systems to be installed in the building.
- The electrical section contains details on panel boards, electrical outlets, and electrical fixtures to be installed in the building.
- Coordination among the various tradespersons is necessary for a successful construction project.
- Lighting fixtures are identified by symbols and letters on the lighting schedule.
- Electrical receptacles, circuits, and circuit breakers are shown on the power distribution plan.
- Specific information regarding the electrical wiring is given on the plan, but the exact location of wiring and conduit is usually left up to the installing technician.
- The exact description of each lighting fixture is given on the fixture schedule.
- Electrical specifications give instructions about equipment and procedures and are sometimes listed under the General Contract specifications.
- It is important to understand plans thoroughly before attempting to estimate a job or construct a project.

Warning and Disclaimer

Please use caution when working on any of the projects outlined within this manual. By reading this manual you agree to that you are responsible for your own actions. The publisher and the author will not be held accountable for any loss or injuries. Moreover, every effort has been made to make this digital book as complete and as accurate

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Make sure all the connections are made properly.

Use rubbed gloves and **DO NOT TOUCH** the spark gap or any other component when the device is running

Build this project at your own risk! We are not responsible for errors in the plans, diagrams, instructions or other people opinions on these projects! Some of these projects deal with very high voltages! If you are not familiar with high voltage/amps we recommend you to seek the services of a qualified licensed professional to help you! High voltage can KILL in an instant, so be careful and learn all that you can about high voltages safety before attempting this project! Always wear rubber gloves, long sleeve jacket and rubber shoes when working with electricity

Keep Away From Children!!!