DESIGN AND CONSTRUCTION OF AUTOMATIC PUMPING MACHINE FOR WATER SUPPLY.

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CHAPTER ONE

**INTRODUCTION**

Water is an indispensable and inevitable substance to all living things due to its usability and high priority among other substance and materials. Provision of large volume of waters essential due to its significant purpose, which therefore called for a means by which sufficient, and good quality water can be obtained. There are different types of water namely; well water, pipe-borne waters, rain water, stream water, river water e.t.c.

In the earlier days, the use of buckets and calabash is employed in fetching water for homes, agricultural and domestic’s uses. Later, hand pumps were developed to reduce the stress and the inconveniences and other forms of contamination’s which arise due to direct contact of the body to the available water for consumption. Besides, only a small quantity of water can be made available due to physical factors such as tiredness, distance and climatic factors like dry season.

Hence, to eliminate these difficulties, pumping machines is employed to perform the job of fetching water and storing it in storage tanks for future purpose. The system consists of connecting pipes, water pump, which is connected to electric power supply and operated manually. In order to fully eliminate the stated problems and future needs for large volume of water, the concept of automatic pumping machine is developed.

This project emphasizes on the construction of automatic pumping machine which in turns provide a simple logical, versatile and economical/circuit which turns on the pump when water in the tank fall below the minimum level and also off process is achieved by the incorporating of the following to the pumping system:

**The sensor:** This measures the physical states such as the level of the water.

**The responder:** which responses to what is being sensed, it comprises of electrical and mechanical devices.

**The actuator:** This actuates the responder to sense the water level in the tank to perform the switching operation.

In summary, the automatic control system is very effective, efficient and consequently reduces labour cost, flooding, man power and provides enough water for usage.

**Background of the study**.

This project is carried out so as to provide a means of reducing stress involved in fetching water, wastage of water and flooding which may result from overfilling of the tank and eventually reduce to minimum, if not eliminating damages to the pumping machine.

# Aim and Objectives

The aims and objectives of this project are:

1. To reduce the labour involved in operating pumping machine manually.
2. To prevent or protect the coil of pumping machine from being burnt as a result of continuous work beyond its operating time.
3. To pump water automatically from water sources.
4. To prevent wastage of natural resources (water in particularly) and flooding of premises.
5. To prevent the machine from sucking mud and or air when there is no water in the well or source of water supply.

# Scope of the Study

The project is design to provide a means of storing water for the benefit of mankind and industrial purpose. The control section is used for the control of water level to various sizes of tank or reservoir. The minimum and maximum level of water in the tank is determined by the probe.

# Significance of Study

The significance of the study is to design a means of mankind water available in the storage tank for future uses such as domestic, industrial, Agricultural and economic purposes, which are beneficial to mankind. It is also reduce labour coil, wastage of water resulting from filling of the tank, which can eventually leads to flooding. Consequently it enables long life span of the pumping machine.

# Methodology

In the course of searching for information on this project, we consulted some learned professionals, lecturers, relevant textbooks, such as electrical drafting and design for the HND students, journals and past project reports in the library of the institution e.g Federal Polytechnic, Ede, Osun State, and browsing on the Internet to acquire relevant information on the design and construction of the project.

# Limitation of the Project

The major limitation of the study is that it cannot be used when there is no power supply from Power Holding Company of Nigeria (PHCN) unless an alternative means of power supply is designed to power the project.

**CHAPTER TWO**

**LITERATURE REVIEW**

**PUMPS**

A Pump – is a device used to more gases and liquid or gases from lower pressure to higher pressure, and over come this difference in pressure by adding energy to the system (such as water system). A gas pump is generally called a compressor, except in very low pressure-rise applications, such as in heating, ventilating and air conditioning where the operative equipment consists of fans or blowers.

Pumps work by using mechanical forces to push the material, either by physically lifting, or by the force of compression.

The earliest type of pump was the Archimedes screw, first used by Sennacherib, king of Assyria, for the water system at the Hanging Gardens of Babylon and Nineveh in the 7th Century BC and later described in more detail by Archimedes in the 3rd Century Bc, Stephanic Dalley and John Peter Oleson (2003). In the 13th Century AD, al-Jazari described and illustrated different types of pumps.

## TYPES OF PUMPS

Pumps can be classified into two major groups:

* Rotodynamic pumps
* Positive displacement pumps.

Their names describe the method of moving a fluid.

## Rotodynamic Pumps

Rotodynamic pumps are based on blade impellers, which rotate within the fluid to impact a tangential acceleration to the fluid and a consequent increase in the energy of the fluid. The purpose of the pump is to convert this energy into pressure energy of the fluid to be used in the associated pumping system. An example of rotodynamic pump is a centrifugal pump.

## Centrifugal Pumps

Centrifugal pumps are Rotodynamic pumps, which convert mechanical energy into hydraulic energy by centripetal force on the liquid. Typically, a rotating impeller increases the velocity of the fluid. The casing of the pump then acts to convert this increased velocity into an increase in pressure. So the mechanical energy is converted into a pressure head by centrifugal pump. Such pumps are found in virtually every industry and in domestic service in developed countries for washing machines, dishwashers, swimming pools, and water supply. After motors, centrifugal pumps are the most common machines, and they are a significant user of energy. Pumps also wear internally, at a rate varying with the liquid pumped, materials of construction and operating regime. Again, condition monitoring can be applied to detect and quantify the extent and rate of wears and also helps decide when over haul is justified on an energy-saving basis.

**Positive Displacement Pumps.**

A positive displacement pump causes a liquid or gas to move by trapping a fixed amount of fluid and then forcing (displacing) that trapped volume into the discharge pipe.

The periodic fluid displacement results in a direct increase in pressure.

**Different Types of Positive Displacement Pumps are:**

* Root types positive displacement pump.
* Reciprocating-type pumps
* Root type pumps

The low pulsation rate and gentle performance of this roots-type positive displacement pump is achieved due to a combination of its two 900 helical twisted rotors, and a triangular shaped sealing line configuration, both at the point of suction and at the point of discharge.

## Reciprocating – Type Pumps

Reciprocating – type pumps use a piston and cylinder arrangement with suction and discharge valves integrated into the pump. Pumps in this category range from having “simplex”.

Furthermore, they are either “single acting” independent suction and discharge strokes or “double acting” suction and discharge in both directions. The pumps can be powered by air, stream or through a belt drive from an engine or motor.

## Application of Pumps

Pumps are used throughout society for a variety of purposes. Early applications include the use of the windmill or waternill to pump water. Today, the pump is used for irrigation, water supply, gasoline supply, air conditioning systems, refrigeration (usually called a compressor), chemical movement, sewage movement, flood control, marine services, e.t.c. Because of the wide variety of applications, pumps have different shapes and sizes from very large to very small, from handling gas to handling liquid, from high pressure to low pressure and from high volume to low volume.

## Hand Pumps as Public Water Supply

One type of pump that is common worldwide is a hand-powered water pump. Today, hand operated village pumps are considered the most sustainable low cost option for safe water supply in resource poor setting, often in rural areas in developing countries. A hand pump opens access to deeper groundwater that is often not polluted and also improves the safety of a well by protecting the water source from contaminated buckets. Hand pump are designed to be cheap to build and install, and easy to maintain with simple parts. It was assumed that spare parts would become available in the local market for-profit wholesalers. However, it became clear with time that often spare parts are not available locally, because of the low profit margins for wholesalers; likewise it requires too much man labour and hot quite convenient to use it to store enough water for future uses. Derek de Solla Price (1975).

# Significance of Water

Pure water is an odorless, tasteless, clear liquid. Water is one of nature’s most important gifts to mankind. Essential to life, a person’s survival depends on drinking water. Water is one of the most essential elements to good health, it is necessary for the digestion and absorption of food, helps maintain proper muscle tone; supplies oxygen and nutrients to the cells; rids the body of wastes; and serves as a natural air conditioning system. At least eight glasses of clean water is required each and every day to maintain good health. The body will not function properly without enough water. Dr. Donald Robertson. It is also useful for agricultural purposes such as in irrigation, animal; digestion and poultry feeds e.t.c. also for industrial, household and for economical purposes.

Today, drinking water treatment at the point-in-use is no longer a luxury, it is a necessity. Consumers are taking matter into their own hands and are now determining the quality of the water they and their families will drink by designing a storage tank and installing a drinking water system that will give them clean, refreshing, and healthier water.

**Classification of Water**

Water can be categorized into types depending on its source. So, we have the following types of water:

1. Well water
2. Tap water
3. Rain water
4. Stream water

All these aforementioned types of water have their advantages and as well their disadvantages.

# Well Water

Well Water is an artificial excavation or structure put down by any method such as digging, driving, boring or drilling for the purpose of withdrawing water from underground. Well water may be drawn via an electric submersible pump or a mechanical pump (e.g. from electric water-pumping machine or windmill), from a source below the surface of the earth.

Alternatively, it could be drawn up using container, such as buckets, which are raised mechanically, or by hand. Although not essential, usually a storage tank with a pressure of 40-60 pri is also added to the system (after the pump), so the pump does not need to operate constantly.

Wells can vary greatly in depth, water volume and water quality. Well water typically contains more minerals in solution than surface water and may require treatment to soften the water by removing minerals such as arsenic, iron and manganese. These are different types of well water such as;

* Dug wells
* Driven wells
* Drilled wells

# Dug wells

Until recent centuries, all artificial wells were pumpless dug wells of varying degrees of formality. Their indispensability has produced numerous literary references, literal and figurative, to them, including the Christian Bible Story of Jesus meeting a woman at Jacob’s well (John 4:6) and the “Ding Dong bell” nursery rhyme about a cat in a well.

# Driven wells

Driven well may be very simply created in unconsolidated material with a “well point”, which consists of a hardened drive point and a screen (perforated pipe). The point is simple hammered into the ground, usually with a tripod and “driver”, with pipe sections added as needed. A driver is a weighted pipe that slides over the pipe being driven and is repeated dropped on it. When groundwater is encountered, the well is washed of sediment and a pump installed.

# Drilled Wells

Drilled wells can get water from a much deeper level by mechanical drilled. Drilled wells with electric pumps are currently used throughout the world, mainly in developing and developed countries, typically in rural or sparsely populated areas, though many urban areas are supplied partly by municipal wells. Water wells typically in rural or sparsely populated areas, though many urban areas are supplied partly by municipal wells. Water wells typically range from 20 to 600 feet (180m), but in some areas can go deeper than 3,000 feet (910m). Typically, boreholes drilled into completed, regardless of the machine used.

# Tap Water

Tap water is the one being supplied by the water co-operation. The water is very good for drinking because of would have been treated with chlorine’s, alums e.t.c. Before it is supplied to the consumers. One of the disadvantages of this type of water is that, it is not free of charge. The co-operation charges certain amount of money based on the amount of water consumed every month. Also, there is irregularity in its supply.

# Rain Water

Rainwater is heavenly gift. It is not being produced by human being. Research even tells that it is purest water being collected directly without falling on the roofing sheet. The moment rainwater falls on the roofing sheet, it is no longer pure because dirtiness on the roofing sheet must have polluted it. In this case, boiling is the best option before drinking. For washing purpose, rainwater is not the best because of its hardness. If used, it will certainly waste soap because it does not foam lather easily with soap this is as a result of presence of calcium and magnesium ion on it (Ca2+ and mg 2+). It is seasonal and it cannot be stored indefinitely.

### Stream Water

Stream water is surface flowing water that does not require the digging of g round before it can flow. It is easy and economical since it requires no permanent before fetching, but it is highly prone to various water diseases if the water is not properly treated or boiled before consumption.

### Storage Tank

Storage tanks are either plastic or metal constructed casing that can accommodate solid, liquid or gases for future use or preservation. They are typically of different sizes, weight and shapes. Water storage tanks are so design to have both inlet and outlet attachment. The inlet opening is located at the top of the tank while the outlet is located at the bottom side.

There are different types of storage tank such as:

* Overhead storage tanks
* Surface storage tanks
* Underground storage tanks

### Overhead Storage Tank

They are most use for storing liquid content such as water for future uses. The water or other liquid content in the tank has pressure to flow under gravity.

### Surface Storage Tank

It is mostly used for storing solid materials and liquid where pressure for the flow of the liquid is not so important.

### Underground Storage Tank

It mostly used for the storing of gases or liquid, which are highly inflammable.

#### DESIGN LAYOUT

The design of automatic pumping machine consist of the following:

* 1 no of 1 h.p electric pumping machine.
* An automatic control panel divided into two major portions.

1. The electrical part
2. The electronic part

The electrical part: consist of the following:

* A contractor
* A floatless relay
* An overload pole switch
* A double pole switch
* 3 coloured indicating lamp, red, green and yellow which indicate power supply, water running and water drainage respectively.

The electronic part consist of the following:

* A veroboard
* Two C9014 NPN transistor
* Five (5) nos of IN4007 diode
* One (1) 10 kilo ohms resistor

Other materials used one: 5 nos of probes:

* 1 big size bucket which serves as the well.
* 1 medium size bucket which serves as the over load storage tank.
* 1 small size bucket use for fetching water.
* Various sizes and lengths of cable used for connections.
* Different size of bolts and nuts
* A length of 1 PVC water pipe and other plumbing accessories.

A relay

A 220/12V transformer

Some lengths of connecting cable and jumpers

# CALCULATION ON DESIGN

##### Number of slots = 24

Frequency = 50Hz

Number of pole = 4

Speed of the motor (in revolution per minutes)

N = 120f = 120 x 50 = 1500 rev/min

P 4

# TURNS OF THE WINDING

**MAINS (TURNS) HELPING (TURN)**

1 – 6 = 38 1 – 6 = 22

1 – 8 = 38 1 – 8 = 20

1 – 10 = 37 1 – 10 = 88

1 – 12 = 37 1 – 12 = 88

size of wire gauge = 21mm/1 (S.W.G) = 23mm/1

#### TYPES OF WIRE GUAGE USED

Magnetic wire (copper magnet wire) of gauge 23mm.

Insulation classes – class A (Ambient temperature of 1050C).

Class B (1300C)

Class F (1550C)

Class H (1800C)\

Therefore, class B is suitable for the windings because of the tolerance ambient temperature (1300C).

The gauge of the wire depends on the size of the stator and the bigger the stator, higher the size of the wire, then the higher the rating.

#### List and functions of components & other materials used

Diode

Resistor Diode

Bridge

Transistor

Resistor

Contractor

## Contactor

Designed load current per contact (pole) rates contractor, maximum fault withstands current, duty cycle, voltage, and coil voltage.

A general purpose motor control contractor may be suitable for heavy starting duty on large motors; so called “definite purpose” contractors are carefully adapted to such application as electric motor for water pump and air-conditioning compressor motor starting.

### Diodes

A diode is a two-terminal device (thermionic diodes may also have one or two auxiliary terminal for a heater). They have two active electrodes between which the signal of interest may flow, and most are sued for their uni-directional electric current property. The varicap diode is used as an electrically adjustable capacitor.

The directionality of current flow most diodes exhibit is sometimes generically called the rectifying property. The most common function of a diode is to allow an electric current to pass in one direction (called the forward biased condition). And to block it in the opposite direction (the reverse biased condition). Thus, the diode can be thought of as an electronic version of a check valve.

Today the most common diodes are made from semi-conductor materials such as silicon or germanium.

Circuit Symbol

## Function of Diode

Diodes allow electricity to flow in only one direction. The arrow of the circuit symbol shows the direction in which the current can flow. **Note:** Valves are in use before the advent of diode.

## Forward voltage drop

Electricity uses up a little energy pushing its way through the diode, rather like a person pushing through a door with a spring.

This means that there is a small voltage across a conducting diode, it is called the forward voltage drop and is about 0.7V for all normal diodes which are made from silicon. The forward voltage drop of a diode is almost constant whatever the current passing through the diode so they have a very steep characteristic.

## Reverse Voltage

When a reverse voltage is applied a perfect diode does not conduct, but all real diodes leak a very tiny current of a few NA or less. This can be ignored in most circuits because it will be very much smaller than the current flowing in the forward direction. However, all diodes have maximum reverse voltage (usually 50V or more) and if this is exceeded the diode will fail and pass a large current in the reverse direction, this is called breakdown.

## Connecting and Soldering

Diode must be connected the correct way round, the labeled a or + for anode and k or for cathode (yes it really is k, not c, for cathode!). the cathode is marked by a line painted on the body. Diodes are labeled with their code in small print, you may need a magnifying glass to read this on small signal diodes!

Small signal diodes can be damaged by heat when soldering, but the risk is small unless you are using a germanium diode (codes beginning OA) in which case you should use a heat sink clipped to the lead between the joint and the diode body. A standard crocodile clip can be used as a heat sink. Rectifier diodes are quite robust and no special precautions are needed for soldering them.

#### Different Types of Diode

##### Signal Diodes

* Zener Diodes

**Signal Diodes (small current)**

Signal diodes are used to process information (electrical signals) in circuits, so they are only required to pass small currents of up to 100mA.

General purpose signal diodes such as the IN4148 are made from silicon and have a forward voltage drop of 0.7V Germanium diodes such as the DA90 have and this makes them suitable to use in radio circuits as detectors which extract the audio signal from the weak radio signal. For general use, where the size of the forward voltage drop is less important, silicon diodes are better because they are less easily damaged by heat when soldering, they have a lower resistance when conducting, and they have very low leakage currents when a reverse voltage is applied.

###### **Zener Diodes**

### Zener Diodes

A = anode, K = Cathode

Zener diodes are used to maintain a fixed voltage. They are designed to ‘breakdown’ in a reliable and non-destructive way so that they can be used in reverse to maintain a fixed voltage across their terminals. The diagram shows how they are connected with a resistor in series to limit the current, zener diodes can be distinguished from ordinary diodes by their code and breakdown voltage which are printed on them. Zener diode codes being BXZ or BZY… their breakdown voltage is printed with V in place of a decimal point, so 4V7 means 4.7V for example. Zener diodes are rated by their breakdown voltage and maximum power:

* The minimum voltage available is 2.4V.
* Power ratings of 400mW and 1.3W are common.

#### Protection Diodes for relays

Signal diodes are also used to protect transistors and ICS from the brief higher voltage produced when a relay coil is switched off. The diagram shows how a protection diode is connected ‘backwards’ across the relay coil.

Current flowing through a relay coil creates a magnetic field, which collapses suddenly when the current is switched off. The sudden collapse of the magnetic filed induces a brief high voltage across the relay coil which is very likely to damage transistors and ICS. The protection diode allows the induced voltage to drive a brief current through the coil (and diode so the magnetic field dies away).

Quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and Ics.

**Rectifier Diode large current.**

Rectifier diodes, are used in power supplies to convert alternating current (AC) to direct current (DC), a process called rectification. They are also used else where in circuits where a large current must pass through the diode.

All rectifier diodes are made from silicon and therefore have a forward voltage drop of 0.7V. The table shows maximum current and maximum reverse voltage for some popular rectifier diodes. The IN4001 is suitable for most low voltage circuits with a current of less than 1A.

The table below shows different diode with their maximum current and maximum reverse voltages.

|  |  |  |
| --- | --- | --- |
| DIODE | MAXIMUM CURRENT | MAXIMUM REVERSE VOLTAGE |
| 1N4001 | 1A | 50v |
| 1N4002 | 1A | 100v |
| 1N4007 | 1A | 1000v |
| 1N5401 | 3A | 100v |
| 1N5408 | 3A | 1000v |

Table 1: Maximum current and reverse current Voltage.

# BRIDGE RECTIFIERS

There are several ways of connecting diodes to make a rectifier to converts AC to DC. The bridge rectifier is one of them and it is available in special packages containing the four diodes required. Their maximum current and maximum reverse voltage rates bridge rectifiers. They have four leads or terminals: the two DC outputs are labeled + and – the two AC inputs are labeled.

**BRIDGE RECTIFIER**

# TRANSISTOR

They are semiconductor devices, which can operate as a conductor when a signal (current or voltage) is passed through them. Their mode of conduction depends on their nature of construction.

# Types of Transistor

There are two types of standard transistors, NPN and PNP, with different circuit symbols. The letters refer to the layers of semiconductor material used to make the transistor. Most transistors used today are NPN transistors because this is the easiest type to make from silicon. In a general-purpose low power NPN transistor for example BC108, BC 182. The small base current controls the larger collector current. When the switch is closed; small current flows into the base (B) of the transistor it is just enough to make LED B glow dimly. The transistor amplifiers this small current to allow a larger current to flow from its collector (C) to its emitter (E). This collector current is large enough to make LED C light brightly. When the switch is open; no base current flows so the transistor switches off the collector current. Both LEDs are off. A transistor amplifies current and can be used as a switch. This arrangement where the emitter (E) is in the controlling circuit (base current) and in the controlled circuit (collector current) is called common emitter mode.

**Transistor as Current Amplifier.**

The larger connector current IC is proportional to the base current IB according to the relationship IC = BIB, or more precisely it is proportional to the base-emitter voltage VBB. The smaller base current controls the larger collector current, achieving current amplification. The analogy to a valve is sometimes helpful. The smaller current in the base acts as a “valve”, controlling the larger current from collector to emitter. A “signal”` in the form of a variation in the base current is reproduced as a larger variation in the collector-to-emitter current, achieving an amplification of that signal.

**Resistor**

Resistors are devices that create an opposition to the flow of current. The rate of opposition produce depends on the rating of the resistor and this rating can be identified by the colour coding on them.

Colour coding of this form is becoming rare newer equipment, most passive components come in surface mount packages. Many of these packages are unlabelled and those that are normally use alphanumeric codes, not colours. In one popular marking method. The manufacturer. Prints 3 digits on components: 2 value digits followed by the power of ten multiplier. Thus, the value of a resistor marked 472 is 4, 700Ω a capacitor marked 104 is 100 might seem to be a 100Ω unit, and we must rely upon experience to interpret the marking as 10Ω (10 x 106). Another way is to use the “kilo” – or “mega” – prefixes in place of the decimal point:

1K2 = 1.2KΩ = 1, 200Ω

4M7 = 4.7MΩ = 4,700,000Ω

6R8 = 6.8Ω

For 1% resistors, a three-digit alphanumeric code is sometimes used, which is not obviously related to the value but can be derived from a table of 190 values. For instance, a resistor marked 68C is 499 (68) x 100© = 49,900Ω. In this case the value 499 is the 68th entry of a table of 190 values between 100 and 999. It is sometimes not obvious whether a colour coded component is a resistor, capacitor, or inductor and this may be deduced by knowledge of its circuit function, physical shape or by measurement.

A B C D

**RESISTOR**

Resistors values are always coded in ohms, capacitors in Pico farads (pf), inductors in micro henries (μH) and transformers in volts.

* B and A is first significant figure of component value.
* B and B is the second significant figure.
* B and C is the decimal multipli9er.
* B and D if present, indicates tolerance of value in percent (no colour means 20%).
* For example, a resistor with bands of yellow, violet, red and gold will have first digit 4 (yellow in table below), second digit 7 (violet), followed by 2(red) zeros: 4,700 homs. Gold signifies that the tolerance is ± 5%, so the real resistance could lie anywhere between 4,465 and 4,935 ohms.

**Relays**

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. Joseph Henry invented it in 1985. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be in a borad sense, a form of an electrical amplifier.

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, a force returns the armature approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. in a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing. If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a spike of voltage and might cause damage to circuit components. Some automotive relays already include that diode inside the relay case. Alternatively, a contact protection network, consisting of a capacitor and resistor in series, may absorb the surge. If the coil is designed to be energized with AC, a small copper ring cans e crippled to the end of the solenoid. This shading ring” creates a small out of phase current, which increases the minimum pull on the armature during the AC cycle. (Gurevich Vladimir 2005). Electrical relays: Principles and Application – New York: CRC Press.

**Different types of relays are:**

* Latching relays
* Red relays
* Polarized relays
* Machine-tools relay
* Contactor relays
* Solid state contactor relays
* Buchhole relays
* Overload protection relays
* Floatless relays.

**Latching Relay**

A latching relay has two relaxed states (bi-stable). These are also called ‘keep’ or ‘stay’ relays. When the current is switched off, the relay remains in its last state. This is achieved with a solenoid operating a ratchet and can mechanism, or by having two opposing coils with an over center spring or permanent magnet to hold the armature and contacts in position while the coil is relaxed, or with a remnant core. This type of relay has the advantage that it consumes power only for an instant, while it is being switched, and it retains its last setting across a power outage.

**Reed Relay**

A reed relay has a set of contacts inside a vacuum or inert gas filled glass tube, which protects the contacts against atmospheric corrosion. The contacts are closed by a magnetic field generated when current passes through a coil around the glass tube. Reed relays are capable of faster switching speeds than larger types of relays, but have low switch current and voltage ratings. So also reed switch.

**Polarized Relay**

A polarized relay placed the armature between the poles of a permanent magnet to increase sensitivity. Polarized relays were used in middle 20th century telephone exchanges to detect faint pulses and correct telegraphic distortion. The poles were on screws, so a technician could first adjust them for maximum sensitivity and then apply a bias spring to set the critical current that would operate the relay.

**Machine Tool Relay**

A machine tool relay is a type standardized for industrial control of machine tools, transfer machines, and other sequential control. They are characterized by a large number of contacts (sometimes extendable in the field) which are easily converted from normally open to normally closed status, easily replaceable coils, and a form factor that allows compactly installing many relays in a control panel. Although, such relays ones were the backbone of automation in such industries as automobile assembly, the programmable logic controller (PLC) mostly displaced the machine tool relay from sequential control applications.

**Contactor Relay**

A contactor is very heavy-duty relay used for switching electric motors and lighting loads. With high currently, the contacts are made with pure silver. The unavoidable arcing causes the contacts to oxidize and silver oxide is still a good conductor. Such derides are often used for motor starters. A motor starter is a contactor with overload protection devices attached. The overload sensing devices are a form of heat operated relay where a coil heats a bi-metal strip, or where a solder pot melts, releasing a spring to operate auxiliary contacts. These auxiliary contacts are in series with the coil. If the overload senses excess current in the load, the coil is de-energized. Contactor relays can be extremely loud to operate, making them unfit for use where noise is a chief concern.

**Solid State Contactor Relay**

Solid state conductor is a very heavy-duty solid state relay, including the necessary heat sink, used for switching electric heaters, small electric motors and lighting loads; where frequent on/off cycles are required. There are no moving parts to wear out and there is no contact bounce due to vibration. AC control signals or DC control signal from programmable logic controller (PLCs), PCs, transistor-transistor logic (TTL) sources, or other microprocessor controls activate them.

**Buchholz Relay**

A Buchholz relay is a safety device sensing the accumulation of gas in large oil-filled transformers, which will alarm on slow accumulation f gas or shut down the transformer if gas is produced rapidly in the transformer oil.

**Overload Protection Oil**

Heating element in series with the electric motor operates one type electric motor overload protection relay. The heat generated by the motor current operates a bi-metal strip or melts soldier, releasing a spring to operate contacts. Where the overload relay is exposed to the some environment as the motor, a useful though crude compensation for motor ambient temperature is provided.

**Floatless Relay**

A floatless relay is a device that controls a circuit by sensing the minimum and maximum level of fluid, such as water. It is mostly suitable for any non-volatile fluid. It operates on AC voltage and has a protection against interference from power surge. It has eight terminals, then terminal 1,2 linked to terminal 8 while terminal 1,3 and 4 serves as probes which represent common earth, minimum and maximum level respectively. Terminal 5 is a normally closed terminal (NC) which indicate drainage while terminal 6 is normally open (NO) which activate to close position indication water supply.

It also consists of LED indicator for water supply or drainage.

When the liquid level in the tank exceed the minimum level E2 on terminal 4, the motor will turn ON and water supply LED is ON and drainage LED is OFF.

When the level of water in the tank rises to maximum level E3 on terminal 4, the motor will stop and drainage light switched ON while water supply LED switched OFF.

**CHAPTER THREE**

* **A Relay**

Wiring diagram of automatic water supply running.

The AFR-1 controls the levels of water by using 3 probes as shown in fig. 3.1. The operation is as follows:

When the water level rises to the maximum level in the tank touching the probe E3, the contractor will automatically de-energized supply from the pump with the help of the floatless relay. Hence, the pump stops, indicating supply in the control panel and water is ready for use respectively. When the water level is drained to the minimum level in the tank, i.e. below the probe E2, the contractor will automatically re-energized the supply to the pump with the aid of the floatless relay.

The green indicating light switching on and the pump automatically starts working until the fills up the tank again.

The circuit and connection diagrams are shown below:

12v

Relay coils

Q2

GND

2N9304

Q1

Diode

2N9304

10k

Probes

|  |  |
| --- | --- |
| Type | AFS/AFR |
| Operatibng | AC (v): 220 – 240 |
| Rated frequency | 50/60 HZ |
| Contact rating | 250VAC 5A (Resistive load) |
| Operating resistance | 0 4KΩ |
| Release resistance | 1 5K φΩ |
| Power consumption | 3.2VA |
| Life | Mechanical 5,000,000 Electrical 100,000 times |
| ON response time | 100 msec |
| OFF response time | 100 msec |
| Sensitivity of probe | > 40 KΩ |
| Indication | Green LED relay on  Yellow LED relay off |
| Output | 5V |
| Ambient temperature | -10 + 500C  MAX 85% RH |
| weight | Approximately 150Kg |

**Table 2: Specification of floatless relay.**

Characteristics of floatless relay and its suitability.

* For any electrolytic fluid surface (no volatile fluid).
* AC operating voltage
* Protection against interference from power surge.
* Low electrode ac voltage to prevent electrolysis for longer life expectance.
* 2 led status indicator for water supply or drainage.
* Automatic water supply or drainage.
* Wiring diagram of the Automatic control system for both water supply running and drainage running.

Electrical legend

|  |  |
| --- | --- |
| Normally close stop  Normally open button  Start button  Motor contactor coil  Magnetic contactor | 1  2  M  L1  L2 T2  2 3 |

TABLE 3: Electrical Legend

The relay switch in the circuit is activated when a pair of probes comes in contact with water in the well. It indicates the level of water in the well and also serves as switches that control the circuit.

The diagram below is a conductive water operated relay. Transistor Q1 and Q2 are a Darlington pair configured as a common emitter, and relay coil RY1 is the collector load.

The circuit relay is normally open (No), but it is activated when the probes are placed across a resistance path has a value generally use a bulk resistance below level relay switch. Rely RY1 activate a circuit that switch on a pump.

**CHAPTER FOUR**

**PROBLEMS ENCOUNTERED, SOLUTION AND TEST**

|  |  |  |
| --- | --- | --- |
| **FAULTS** | **CAUSES** | **REMEDY** |
| If the motor does not start and make no noise. | There may be electricity disconnection or protective fuse failure | Any burnt out cable is changed |
| If the motor does not start but makes noise. | The mains voltage might a different from the rated value on the plate | Ensure merging voltage value |
|  | Wrong connections, capacitor might be faulty | Avoid wrong connection  Replacement of faulty capacitor |
| If motor turns with difficulty | Incomplete phase on terminal board insufficient voltage | Resistor missing phase.  Ensure adequate voltage |
| The pump does not deliver | Moving part may be scoping against fixed parts blockage foot value. | Cause of scarping delimited.  Clean the foot value |
|  | Insufficient diameter of the intake pipe. | Larger diameter pipe is used. |
| If pump supplies insufficient flow | Blockage foot value.  Blockage or worn impeller  Insufficient diameter of the intake pipe | Clean the foot value.  Obstruction is removed and worn parts replaced.  Larger diameter pipe in used. |
| If pump vibrates and operates noisily | Loose contactor connection between the pump and the pipes. There is cavitations i.e the demand for water is higher than it is able to pump. | The loose parts are more carefully fixed.  Intake height is reduced or load looses checked. |

**TESTS**

1. Insulation Test: - Using Megger Tester.
2. Resistance Test: - Ohms Tester
3. Ground Test: - A test lamp is used to test for ground on a capacitor in a metal container.
4. Test for Winding: - If the capacitor is replaced and the motor still does not run, or if it does not run properly it will be necessary to test the motor winding.
5. Test for Capacitor: - To determine the strength of a capacitor in microfarad, an a-c voltage and ac ammeter is employed. An ammeter is placed in series with the capacitor and a voltmeter across it. Also the electrolytic capacitor should be kept in circuit for a very short period from the meter reading. The rating of the capacitor in microfarads is obtained from the formular,

Capacitor in μf = 15,300 x amp

Frequency volt

This is for any frequency 50Hz and any current.

**TESTING, MEASUREMENT AND RESULT**

**Out Of Circuit Test**

This refers to the testing of all component used in this project before they were mounted on the board in order t confirm their working ability.

**Short Circuit Test**: When there is short circuit there will be very high current flowing through the components or electrical appliances. An ohmmeter was used to test the components and the readings were in good condition.

**Open Circuit**: There will be no current in the circuit if there is an open circuit, it may be as result of damage component or in the connecting lead. Also an ohmmeter was used to check for the discontinuity this and the reading shows good condition.

Continuity Tests: This was carried out with the use of ohmmeter. The test was carried out on transformer, power capable, fuse switch, resistor and relay. All were confirm okay.

**The System Testing:** Testing of the entire appliance is very important. The (automatic pump controller) is subjected to test by operating it for long time. It is free from the following observation.

* No humming sound
* No heat generated
* No abnormal odour from the panel

We were able to clarify it for satisfactory performance.

Suspending three (3) probes into tanks set up the system, one sensing maximum level and the other one sensing minimum level while the third probe serve as common earth to them.

Several testing were done to ascertain the reliability of the appliance, the pumping machine was initially primed. After this, the automatic pump was switch on to start pumping into the tank as soon as it touches the maximum level probe the pumping machine. When the water in the stores is exhausted below the minimum level the pumping machine star pumping again.

Secondly, by removing the probe from the well, the control circuit stops the pumping machine. It shows that when there is no water in the well the control circuit is isolated from the supply and the pumping machine stops immediately, so when the probe was restarted, the control circuit worked perfectly again.

**Problems Encountered**

Some problems were encountered during the construction and testing of the project. Some of them were discussed below:

* The testing of machine and soldering of the component to the vero required electric power supply but power is not always constant.
* There was burning of component like transistor etc due t short –circuiting or to much application of heat. We overcome the problem by following the step in soldering techniques.

**CHAPTER FIVE**

**CONCLUSION AND RECOMMENDATION**

**Conclusion**

Since water is essential to mankind in general and we cannot do without it, hence, it should be made available at all times. The design and construction of this automatic water pumping machine has taken care of making water. Available all time for mankind usage, reduction of human efforts, wastage of water and flooding is also eradicated. This project has also exposed us to the practical aspect of out course of study in Electrical / Electronics Engineering and to build us for future challenged.

**Recommendation**

In view of the design and construction carried out on the project, we hereby recommend the following:

* This project should be assigned to students to embark upon every year so as to improve it on modern design and control system.
* Supervisors should ensure that the project is designed and constructed by the student in charge of he project.
* God grades should be given to students that actually design the project by themselves under the supervision of the supervisor.
* Alternative means of powering the project should be made available to reduce waste of time on the project.

**BILL OF ENGINEERING MEASUREMENT AND EVALUATION (BEME)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/N** | **QUANTITY** | **DESCRIPTION** | **RATE (#)** | **AMOUNT (#)** |
| 1 | 1 | 9 way plastic box | 1800 |  |
| 2 | 1 | Floatless relay | 1600 |  |
| 3 | 1 | Contactor | 1000 |  |
| 4 | 1 | 9 – 13A overload relay | 900 |  |
| 5 | 1 | Stabilize switch | 70 |  |
| 6 | 3 | Pilot bulb | 100 |  |
| 7 | 2 | Transistors | 100 |  |
| 8 | 1 | 13Amp plug | 50 |  |
| 9 | 8 | Connecting cable | 80 |  |
| 10 | 1 | Resistor (10kΩ) | 1 |  |
| 11 | 1 | Relay | 150 |  |
| 12 | 1 | Veroboard | 100 |  |
| 13 | 5 | [IN4007] diode | 15 |  |
| 14 | 1 | Transformer [220v/12v] [500mA] | 500 |  |

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