Modern Welding Machine with Natural Air Cooled

Priti S. Manware[1] Mohd Bashir Sheikh[2]
[1]Priyadarshini Indira Gandhi College of Engineering [2]Priyadarshini Institute of Engineering & Technology

Abstract— Modern welding machine this concept is totally different from the ordinary machine that available in the market. It has two holders so that two people can work at a time i.e. 24 hours and the combination of winding material used in this machine to makes highly efficient. A welding power supply is a device that provides an electric current to perform welding. Welding usually requires high current (over 80 amperes) and it can need above 12,000 amps in spot welding. Low current can also be used; welding two razor blades together at 150 amps with gas tungsten. Design of this machine is also provides multi-function, this machine also can be used for charging the battery bank which used for back-up system.

Key words: Modern welding machine double user with battery charger

I. Introduction

Three Phase Welding Machine:-This concept is totally different from the ordinary machine that available in the market. It has two holders so that two people can work at a time i.e. 24 hours and the combination of winding material used in this machine to makes highly efficient. Arc welding The joining of metal parts by fusion, in which the necessary heat is produced by means of an electric arc. Sometimes accompanied by the use of a filler metal and/or the application of pressure.

As CRGO core with proper or standard design are used to get a better efficient machine. Again, choke for the current variation from the tapping of choke are provided and wide range of current i.e. 150 to 350 Amp are kept in provision. As well as, making this machine totally naturally air cooled, so, one can use this machine for continuous operation. This machine is designed in such a manner that gives low no load current to save the electricity. Again in future, I planned to make this machine more flexible and advance. We can use this machine as a rectifier/back-up charger also, by just making the different output connection to make more flexible, air cooled and compact. Many researchers were presented on the welding technology. In a view of the above, the main objectives of the research work presented in this paper are.This paper based to improve efficiency margin, designing of machine which performed multi-tasks

II. Conventional Welding Machine

The history of joining metals goes back several millennia, with the earliest examples of welding from the Bronze Age and the Iron Age in Europe and the Middle East. The ancient Greek historian Herodotus states in The Histories of the 5th century BC that Glaucus of Chios "was the man who single-handedly invented iron-welding." Welding was used in the construction of the iron pillar in Delhi, India, erected about 310 AD and weighing 5.4 metric tons. The middle Ages brought advances in forge welding, in which blacksmiths pounded heated metal repeatedly until bonding occurred. In 1540, Vannoccio Biringuccio published De la pirotechnia, which includes descriptions of the forging operation. Renaissance craftsmen were skilled in the process, and the industry continued to grow during the following centuries. In 1802, Russian scientist Vasily Petrov discovered the electric arc and subsequently proposed its possible practical applications, including welding. In 1881–82 a Russian inventor Nikolai Benardo screated the first electric arc welding method known as carbon arc welding, using carbon electrodes. The advances in arc welding continued with the invention of metal electrodes in the late 1800s by a Russian, Nikolai Slavyanov (1888), and an American, C. L. Coffin (1890). Around 1900, A. P. Strohmenger released a coated metal electrode in Britain, which gave a more stable arc. In 1905 Russian scientist Vladimir Mitkevich proposed the usage of three-phase electric arc for welding. In 1919, alternating current welding was invented by C. J. Holslag but did not become popular for another decade. Resistance welding was also developed during the final decades of the 19th century, with the first patents going to Elihu Thomson in 1885, who produced further advances over the next 15 years. Thermite welding was invented in 1893, and around that time another process, oxyfuel welding, became well established. Acetylene was discovered in 1836 by Edmund Davy, but its use was not practical in welding until about 1900, when a suitable blowtorch was developed. At first, oxyfuel welding was one of the more popular welding methods due to its portability and relatively low cost. As the 20th century progressed, however, it fell out of favor for industrial applications. It was largely replaced with arc welding, as metal coverings (known as flux) for the electrode that stabilize the arc and shield the base material from impurities continued to be developed.

A. *Arc Welding Processes*

Arc welding: These processes use a welding power supply to create and maintain an electric arc between an electrode and the base material to melt metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is sometimes protected by some type of inert or semi-inert gas, known as a shielding gas, and filler material is sometimes used as well.

B. *Power Supplies*

To supply the electrical energy necessary for arc welding processes, a number of different power supplies can be used. The most common welding power supplies are constant current power supplies and constant voltage power supplies. In arc welding, the length of the arc is directly related to the voltage, and the amount of heat input is related to the current. Constant current power supplies are most often used for manual welding processes such as gas tungsten arc welding and shielded metal arc welding, because they maintain a relatively constant current even as the voltage varies. This is important because in manual welding, it can be difficult to hold the electrode perfectly steady, and as a result, the arc length and thus voltage tend to fluctuate. Constant voltage power supplies hold the voltage constant and vary the current, and as a result, are most often used for automated welding processes such as gas metal arc welding, flux cored arc welding, and submerged arc welding. In these processes, arc length is kept constant, since any fluctuation in the distance between the wire and the base material is quickly rectified by a large change in current. For example, if the wire and the base material get too close, the current will rapidly increase, which in turn causes the heat to increase and the tip of the wire to melt, returning it to its original separation distance. The type of current used also plays an important role in arc welding. Consumable electrode processes such as shielded metal arc

III. Different type of welding

A. Shielded Metal Arc Welding

One of the most common types of arc welding is shielded metal arc welding (SMAW); it is also known as manual metal arc welding (MMA) or stick welding. Electric current is used to strike an arc between the base material and consumable electrode rod, which is made of steel and is covered with a flux that protects the weld area from oxidation and contamination by producing carbon dioxide (CO_2) gas during the welding process. The electrode core itself acts as filler material, making a separate filler unnecessary. The process is versatile and can be performed with relatively inexpensive equipment, making it well suited to shop jobs and field work. An operator can become reasonably proficient with a modest amount of training and can achieve mastery with experience. Weld times are rather slow, since the consumable electrodes must be frequently replaced and because slag, the residue from the flux, must be chipped away after welding. Furthermore, the process is generally limited to welding ferrous materials, though special electrodes have made possible the welding of iron, nickel, aluminum, copper, and other metals.

B. Resistance Welding

Resistance welding involves the generation of heat by passing current through the resistance caused by the contact between two or more metal surfaces. Small pools of molten metal are formed at the weld area as high current (1000–100,000 A) is passed through the metal. In general, resistance welding methods are efficient and cause little pollution, but their applications are somewhat limited and the equipment cost can be high. is a popular resistance welding method used to join overlapping metal sheets of up to 3 mm thick. Two electrodes are simultaneously used to clamp the metal sheets together and to pass current through the sheets. The advantages of the method include efficient energy use, limited work piece deformation, high production rates, easy automation, and no required filler materials. Weld strength is significantly lower than with other welding methods, making the process suitable for only certain applications. It is used extensively in the automotive industry—ordinary cars can have several thousand spot welds made by industrial robots. A specialized process, called shot welding, can be used to spot weld stainless steel. Like spot welding, seam welding relies on two electrodes to apply pressure and current to join metal sheets. However, instead of pointed electrodes, wheel-shaped electrodes roll along and often feed the work piece, making it possible to make long continuous welds. In the past, this process was used in the manufacture of beverage cans, but now its uses are more limited. Other resistance welding methods include butt welding, flash welding, projection welding, and upset welding.

C. Solid-State Welding

Like the first welding process, forge welding, some modern welding methods do not involve the melting of the materials being joined. One of the most popular, ultrasonic welding, is used to connect thin sheets or wires made of metal or thermoplastic by vibrating them at high frequency and under high pressure. The equipment and methods involved are similar to that of resistance welding, but instead of electric current, vibration provides energy input. Welding metals with this process does not involve melting the materials; instead, the weld is formed by introducing mechanical vibrations horizontally under pressure. When welding plastics, the materials should have similar melting temperatures, and the vibrations are introduced vertically. Ultrasonic welding is commonly used for making electrical connections out of aluminum or copper, and it is also a very common polymer welding process. Another common process, explosion welding, involves the joining of materials by pushing them together under extremely high pressure. The energy from the impact plasticizes the materials, forming a weld, even though only a limited amount of heat is generated. The process is commonly used for welding dissimilar materials, such as the welding of aluminum with steel in ship hulls or compound plates. Other solid-state welding processes include friction welding (including friction stir welding), electromagnetic pulse welding, co-extrusion welding, cold welding, diffusion welding, exothermic welding, high frequency welding, hot pressure welding, induction welding, and roll welding.

IV. Working of Three phase natural cooled welding machine

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces. Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding may be performed in many different environments, including open air, under water and in outer space. Welding is a potentially hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to radiation. Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for centuries to join iron and steel by heating and hammering. Arc welding and oxyfuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after. Welding technology advanced quickly during the early 20th century as World War I and World War II drove the demand for reliable and inexpensive joining methods. Following the wars, several modern welding techniques were developed, including manual methods like shielded metal arc welding, now one of the most popular welding methods, as well as semi-automatic and automatic processes such as gas metal arc welding, submerged arc welding, flux-cored arc welding and electro slag welding. Developments continued with the invention of laser beam welding, electron beam welding, electromagnetic pulse welding and friction stir welding in the latter half of the century. Today, the science continues to advance. Robot welding is commonplace in industrial settings, and researchers continue to develop new welding methods and gain greater understanding of weld quality.

A. Geometry of Welding Machine

Welds can be geometrically prepared in many different ways. The five basic types of weld joints are the butt joint, lap joint, corner joint, edge joint, and T-joint (a variant of this last is the cruciform joint). Other variations exist as well—for example, double-V preparation joints are characterized by the two pieces of material each tapering to a single center point at one-half their height. Single-U and double-U preparation joints are also fairly common—instead of having straight edges like the single-V and double-V preparation joints, they are curved, forming the shape of a U. Lap joints are also commonly more than two pieces thick—depending on the process used and the thickness of the material, many pieces can be welded together in a lap joint geometry.

B. Quality of Welding Machine

Many distinct factors influence the strength of welds and the material around them, including the welding method, the amount and concentration of energy input, the weld ability of the base material, filler material, and flux material, the design of the joint, and the interactions between all these factors. To test the quality of a weld, either destructive or nondestructive testing methods are commonly used to verify that welds are free of defects, have acceptable levels of residual stresses and distortion, and have acceptable heat-affected zone (HAZ) properties. Types of defects include cracks, distortion, gas inclusions (porosity), non-metallic inclusions, lack of fusion, incomplete penetration, lamellar tearing, and undercutting. Welding codes and specifications exist to guide welders in proper welding technique and in how to judge the quality of welds. Methods such as visual inspection, radiography, ultrasonic testing, dye penetrant inspection, Magnetic-particle inspection or industrial CT scanning can help with detection and analysis of certain defects

C. Heat-Affected Zone

The effects of welding on the material surrounding the weld can be detrimental—depending on the materials used and the heat input of the welding process used, the HAZ can be of varying size and strength. The thermal diffusivity of the base material plays a large role—if the diffusivity is high, the material cooling rate is high and the HAZ is relatively small. Conversely, a low diffusivity leads to slower cooling and a larger HAZ. The amount of heat injected by the welding process plays an important role as well, as processes like oxyacetylene welding have an unconcentrated heat input and increase the size of the HAZ. Processes like laser beam welding give a highly concentrated, limited amount of heat, resulting in a small HAZ. Arc welding falls between these two extremes, with the individual processes varying somewhat in heat input. To calculate the heat input for arc welding procedures, the following formula can be used: $Q = [(V*I*60)/ S* 100]*$ Efficiency where , Q = heat input (kJ/mm), V = voltage (V), I = current (A), and S = welding speed (mm/min). The efficiency is dependent on the welding process used, with shielded metal arc welding having a value of 0.75, gas metal arc welding and submerged arc welding, 0.9, and gas tungsten arc welding, 0.8.

D. Safety Issues

Welding, without the proper precautions, can be a dangerous and unhealthy practice. However, with the use of new technology and proper protection, risks of injury and death associated with welding can be greatly reduced. Because many common welding procedures involve an open electric arc or flame, the risk of burns and fire is significant; this is why it is classified as a hot work process. To prevent them, welders wear personal protective equipment in the form of heavy leather gloves and protective long sleeve jackets to avoid exposure to extreme heat and flames. Additionally, the brightness of the weld area leads to a condition called arc eye or flash burns in which ultraviolet light causes inflammation of the cornea and can burn the retinas of the eyes. Goggles and welding helmets with dark face plates are worn to prevent this exposure, and in recent years, new helmet models have been produced that feature a face plate that self-darkens upon exposure to high amounts of UV light. To protect bystanders, translucent welding curtains often surround the welding area. These curtains, made of a polyvinyl chloride plastic film, shield nearby workers from exposure to the UV light from the electric arc, but should not be used to replace the filter glass used in helmets.

E. Costs and Trends

As an industrial process, the cost of welding plays a crucial role in manufacturing decisions. Many different variables affect the total cost, including equipment cost, labor cost, material cost, and energy cost. Depending on the process, equipment cost can vary, from inexpensive for methods like shielded metal arc welding and ox fuel welding, to extremely expensive for methods like laser beam welding and electron beam welding. Because of their high cost, they are only used in high production operations. Similarly, because automation and robots increase equipment costs, they are only implemented when high production is necessary. Labor cost depends on the deposition rate (the rate of welding), the hourly wage, and the total operation time, including both time welding and handling the part. The cost of materials includes the cost of the base and filler material, and the cost of shielding gases. Finally, energy cost depends on arc time and welding power demand. For manual welding methods, labor costs generally make up the vast majority of the total cost. As a result, many cost-saving measures are focused on minimizing operation time. To do this, welding procedures with high deposition rates can be selected, and weld parameters can be fine-tuned to increase welding speed. Mechanization and automation are often implemented to reduce labor costs, but this frequently increases the cost of equipment and creates additional setup time. Material costs tend to increase when special properties are necessary

V. Design of Machine

Twelve (12) Considerations When Selecting an Arc Welding Power Supply. Maximum Amperage, Duty cycle, Amperage range, Amperage adjustment mechanism,Input power requirements, Initial cost and operating cost, Size and portability, Future needs for a power supply, Available skills, Safety, Manufacturer's support, Open circuit voltage.

VI. Amperage Output

The maximum output of the power supply determines the thickness of metal that can be welded before joint beveling is required.

185 to 225 amps is a common size. For an individual weld, the optimum output amperage is determined by the thickness of the metal, the type of joint, welding position and type of electrode.

A. Duty cycle

The amount of continuous welding time a power supply can be used is determined by the duty cycle of the power supply. Duty cycle may be 100%, but usually is less.
Duty cycle is based on a 10 minute interval.
Many power supplies have a sloping duty cycle.

Fig. 1:

Arc Welding Electrical Terms: To understand how an electric arc welder works, must understand the following electrical terms.

Electrical Circuit, Direct current (DC), Alternating current (AC), Ampere, Volt, Resistance, Ohms Law, Constant potential, Constant current, Voltage drop, Open circuit voltage, Arc voltage, Polarity.

B. Alternating Current

Alternating current: The type of current where the flow of electrons reverses direction (polarity) at regular intervals. Recommended current for SMAW general purpose electrodes and flat position.

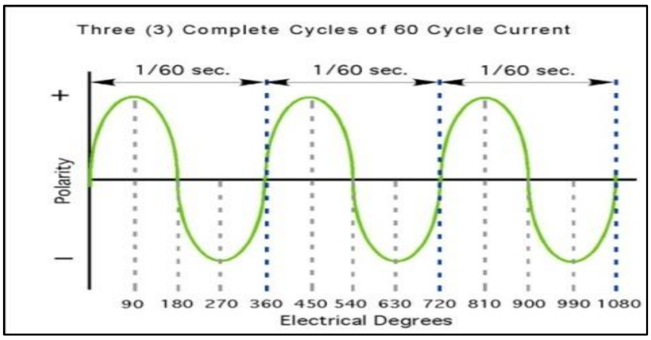

Fig. 2: Current Waveform

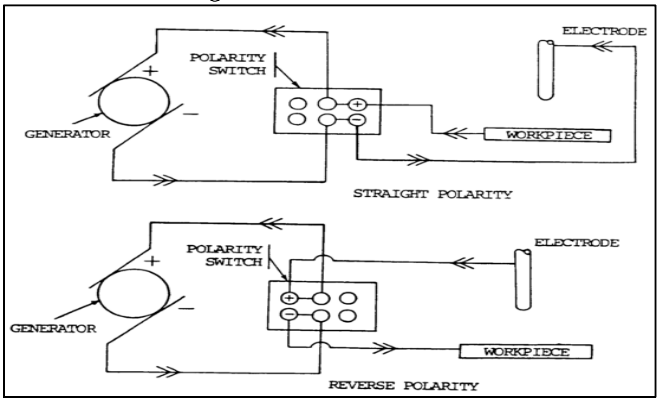

Fig. 3: Polarity of Welding current

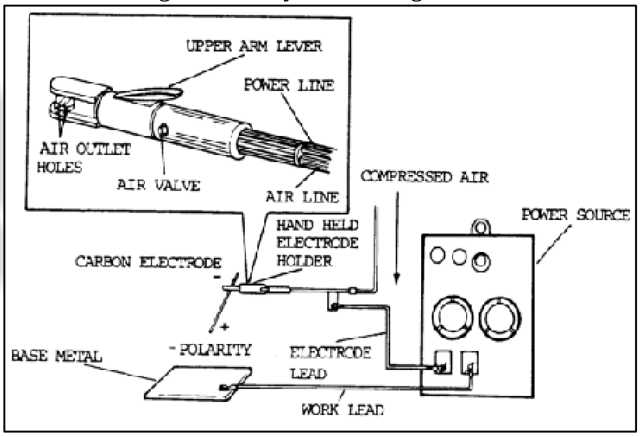

Fig. 4: Block diagram of Welding Machine

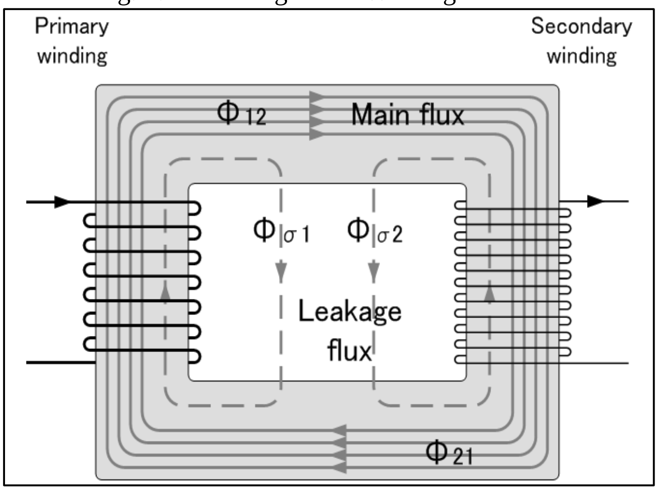

Fig. 5: Cross-Section of Transformer

VII. DESIGNING AND CALCULATIONS

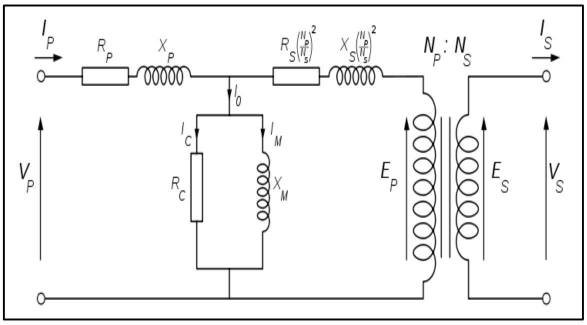

Fig. 6: Equivalent circuit of transformer

$$E = \frac{2\pi f N a B}{\sqrt{2}} \approx 4.44 f N a B$$

A. Dimensions of Core

a) Overall height 18 inch
b) Overall width 15.9 inch
c) Left and right limb 3*3.5 each
d) Central limb 3.5*3.9
e) Gap between two limbs 3.2 inch
f) Limb height 12.2 inch

B. Winding Design

a) Primary turns 210+210=420 turns SWG 10 no DCC Alu.
b) Copper Secondary turns 21+21=42 SWG 10*7 copper conductor.
c) Aluminum secondary turns 18+18=36 turns SWG 10*7 Alu.conductor.

C. Comparing with Ordinary Machine

– Use of CRGO core makes it highly efficient than ordinary machine.
– "No load" current is less compare to ordinary machine.
– It is a natural air cooled machine where as ordinary machine have either oil cooled or force cooled.
– Mixed winding of copper and aluminum is used where as in ordinary machine either purely copper or aluminum is used.
– It is a heavy duty machine, in which it can be used for 24 hrs.
– It is compact and portable, with fewer losses.

VIII. CONCLUSION

In this paper, a detailed study of WELDING machine with battery charger is presented. The machine design and calculation is carried out by manual method for better performance. The design is for higher efficiency and better performance. The result of such design proves the higher performance and better cooling, low maintained and higher efficiency, it is expected that modern welding machine will replace the conventional machine in many industrial application.

APPENDIX

V_1 = 415 v, V_{21} = 45 v, V_{22} = 50v, I_1 = 25 A, I_0 = 4.2A, I_{21} = 300 A, I_{22} = 250 A, ϕ = 3

REFERENCES

[1] J. B. Gupta, "Utilization of Electric Power & Electric Traction", S. K. Kathria &Sons publication, pp: 243-310.
[2] V. Subrahmanyam, "Electric Drives", Tata McGRAW Hill publication, pp: 602- 644.
[3] R. K. Rajput , "Utilization of Electric Power", Laxmi publication, pp:65-154.
[4] R.Caasanueva, "TIG welding machine", IEEE 2011 X.Wang, "The designe and research of heating welder temperature control", Elecctronics,communication and network (CECNET),international conference 2011
[5] Cary, Howard B; Scott C. Helzer. "Modern Welding Technology. Upper Saddle River" New Jersey: Pearson Education.(2005) ISBN 0-13-113029-3.
[6] Deshang Sha, Xiaozhong Liao, "Digital control of double pulsed gas metal arc welding machine", 6th international power electronics and motion control conference,Vol:3,pp-2573-2576 publisher ieee, 2009.