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Design and Fabrication of Compact Friction Welding Machine

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Abstract: The aim of the project is to fabricate a compact friction welding machine that reduces the space and improve the accuracy of the weld. The regulation of this machine is completely different that of different attachment machine. The metal work piece is control within the vice. The 2 items of metal work piece is welded with the assistance high speed drilling head with friction tool. The regulation is extremely straightforward and at a similar time production time is extremely abundant reduced. This machine is best appropriate for production.
Keywords: welding, heat generation, Movable arm

I. INTRODUCTION

Welding is a process where heat is applied to join related metals. Welding can be done with or without pressing. The edges of metal parts are either melted during welding or brought to plastic condition. Welding can be achieved by putting off filler materials or by making permanent joints without welding. This is used in the manufacture of car bodies, vehicle frames, railway wagons, machine parts, structural works, tanks, furniture, boilers, general works of repair and shipbuilding is used in all metalworking industries. The American Welding Society (AWS) describes welding as "A joining method of materials used in the development of welds." A Weld is characterized as "a localized coalescence of metals as non-metals formed either by heating up the materials to suitable temperatures, using filter materials or without them.

II. METHODOLOGY

A. Metal Arc Welding

Simply known as arc welding. Arc Welding is the method of pain connecting two pieces of metal by melting their edges through an electric arc. Between two conducers the electric arc is generated. One conductor is the electrode, and another conductor is the piece of work. With a small air gap the electrode and piece of work are brought closer. As current is passed, an electric arc is produced between the electrode and the piece of work. The piece of work is melted by arc. The electrode melts, too. Both pieces of molten metal become one piece. The electrodes are additional supplies of filler metal into the joint. The current is supplied using a transformer or generator. Electrode commonly used in arc welding arc coated with a flux. This flux creates a gaseous barrier around the atmosphere around the molten metal, the metal with oxygen and nitrogen. The flux takes the impurities out of the molten metal and forms a slag. This slag is sprayed over the metal weld.

B. Gas Welding

In gas welding, the edges of metals to be joined are melted with a gas flame. On the tip of the welding torch is formed the flame. The gases used to create the welding flames are oxygen and acetylene. The flame can just heat the metal, so that the filler rod adds extra metal to the weld. A flux is used to avoid oxidation during welding, and to remove impurities. The metals are welded by 2 mm to 50 mm thick; gas welding. The oxy-acetylene renown has a temperature of around 3200 C.

C. Special Welding Process

1) *Ultrasonic Welding:* In the process a light pressure and high frequently vibration are combined to produce the weld. A frequency converter converts 50 cps electric power into high frequency power. A transducer converts the high frequency into vibratory energy. The high frequency vibration is known as ultrasonic vibration. This vibration is transmitted to a coupling system which has welding tip. The components to be joined are clamped between the welding tip and the supporting anvil. A light pressure is sufficient ot keep the components in close contact.

D. Laser Beam Welding

In this process the heat generated by a Laser beam is used for welding. The term, LASER means Light Amplification by Simulated Radiation Emission. It is a luminous pulse with a single wave length. A lens will focus the beam on a very small spot on the piece of work. Laser beam gives out very high heat at a very small spot on the work piece which can weld the metal to create the weld joint. The tool has a ruby crystal in it. As shown in the figure the crystal is placed inside a 1000 watt flash lamp coil. The xenon gas is loaded to the flash lamp. Stimulates the ruby crystal, and it releases the laser beam. The beam is focussed on the work piece to be welded by using a mirror. The piece of work is pushed on through the beam. The welding of work parts happens by the high heat of the laser beam. Welding velocity is about 12500 mm / mint. Job piece moves and machinery operation are operated automatically by a control system.

E. Fabrication of the Unit

Unit production consists of nearly all traditional welding processes such as welding, fitting, assembly, etc... The machine includes the fabrication of the following pieces.

1) Vertical Movable Bed
2) Horizontal Moving Bed
3) Vice
4) Friction Tool
5) Motor
6) Frame Stand

The components provided in the other article in detail in the process involved in the manufacture. Production and assembly of this structure was made as stiff as possible.

a) *Vertical Movable Bed (Upper Arm):* Upper arm is also called as movable Bed. As the arm can move up and down, it is called as movable arm. The upper arm is connected to the frame stand. The motor is fixed on this moving bed with suitable bolt and nut arrangement.
b) *Horizontal Moving Bed (Lower Arm):* Horizontal moving bed also called as Lower arm. As the arm can move linear it is called as movable arm. The lower arm is connected to the frame stand. On this moving bed the vice is secured with the correct bolt and nut arrangement.
c) *Vice:* The vice can be found over the machine base and from the bottom of the moving bed. A form of vice is used both to keep the piece of work in a straight and angled way. This is the way the jaws find themselves in the vice. The different part of the vice aids jaw, screw rod with self tilting jaw.
d) *Supporting Jaw:* It is located on either end of the vice and is secured by bolt and nut on the base plate. The supports the piece of work can be shifted from full angle fixing the jaw the piece of work to be cut to an angle whose edge is positioned The handle rotates the self-tilting jaw when the other side of the workpiece moves automatically to the angle and the workpiece is clenched
e) *Friction Tool:* It is connected to the three-phase induction motor on the moving vertical frame.
f) *Motor*

i) *Three-phase AC Induction Motors:* The 250W motor was disassembled from a washer. The 12 stator windings are on the left hand side of the building. Next to it is the rotor on its shaft called the "squirrel cage." The three-phase (or polyphaser) AC induction motor is widely used where there is a polyphaser electrical supply, particularly for higher-powered motors. The variations in phase between the three phases of the electrical supply in polyphaser generate a spinning electromagnetic field within the motor. The rotating magnetic field generates a current in the conductors in the rotor by electromagnetic induction, which in turn creates a counterbalancing magnetic field that causes the rotor to turn. Induction motors are the industrial workhorses and motors with outputs of up to approximately 500 kW (670 horsepower) are manufactured in highly standardized frame sizes, making them almost entirely interchangeable between manufacturers (though common measurements are European and North American).
ii) *Squirrel Cage Rotors:* The squirrel cage rotor is used by most common AC motors, which is found in virtually all domestic and light industrial alternating current engines. The squirrel cage takes its name from its form -a ring on either end of the rotor, with bars connecting the rings running the rotor's length. It is usually cast aluminium or copper poured between the rotor's iron laminates, and generally only the end rings are clear. Instead of the higher-resistance and typically varnished laminates, the vast majority of rotor currents pass through the bars. Rather low voltages are common in bars and end rings, at very high currents. High efficiency motors often use cast copper to lower rotor resistance. In operation, the squirrel cage motor may be regarded as a spinning secondary transformer-when the rotor does not rotate in accordance with the magnetic field, large rotor currents are induced; the large rotor currents magnetize the rotor and interfere with the magnetic fields of the stator to bring the rotor into contact with the field of the stator.

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iii) *Wound Rotor:* When variable speed is needed, an alternative design, called wound rotor, is used. Carbon brushes attach the slip rings to an external controller such as a variable resistor which allows the slip rate of the motor to change. The rotor has the same number of poles as the stator in this case, and the windings are made of metal, attached to the shaft's slip rings. In certain wound-rotor drives with high-power variable speeds, the slip-frequency energy is collected, rectified, and returned via an inverter to power supply. In traction applications such as locomotives, where it is known as the asynchronous traction motor, this type of motor is increasingly common. The velocity of the AC motor is determined primarily by the frequency of the AC supply and the number of poles in the stator winding, according to the ratio: Ns= 120F / p where Ns = Synchronous velocity, in revolutions per minute F = AC power frequency p = number of poles per winding step Real RPM for inducing motor is less than the measured synchronous velocity of a known sum The speed is going to be very close to synchronous, without load. Standard motors have about 2-3 percent slip when powered, special motors may have up to 7 percent slip, and a class of motors known as torque motors are rated for 100 percent slip (0 RPM / full stall) operation. The AC motor slip is determined by: S= (Ns − Nr)/Ns percentage slip= (Ns − Nr)/Ns* 100 where Nr= rotational velocity, in revolutions per minute

iv) *Frame Stand:* That is the basis of the machine's components above all.

F. Edge Preparations

The edges of the plates that are to be welded are formed accordingly. The edges of the plates absorb dust, sand, water, gasoline, and grease. Preparation of edges is performed to obtain good welded joints. The following forms form at the edges of the plates

1) Square
2) Single-v
3) Double-v
4) Single-U
5) Double-U

Square butt weld is used from 3 mm to 5 mm for plate thickness. Edges for welding the plates 2 are mounted about 3 mm apart. Single-v butt weld is used between 8 mm and 16 mm for plate thickness. Double-v butt welding is used for the 16 mm thick plates. Welding happens on both sides of the boards.

III. WORKING

Traditionally, friction welding is achieved by moving one part relative to the other along a standard interface, while applying a compressive force throughout the joint. The friction heating produced at the interface softens both components and the interface material is extruded from the edges of the joint when they become plasticized so that clean material. The relative motion is then stopped and, before the joint can cool, a higher final compressive force may be applied. The secret to friction welding is that no molten material is made, in the solid state the weld is formed.

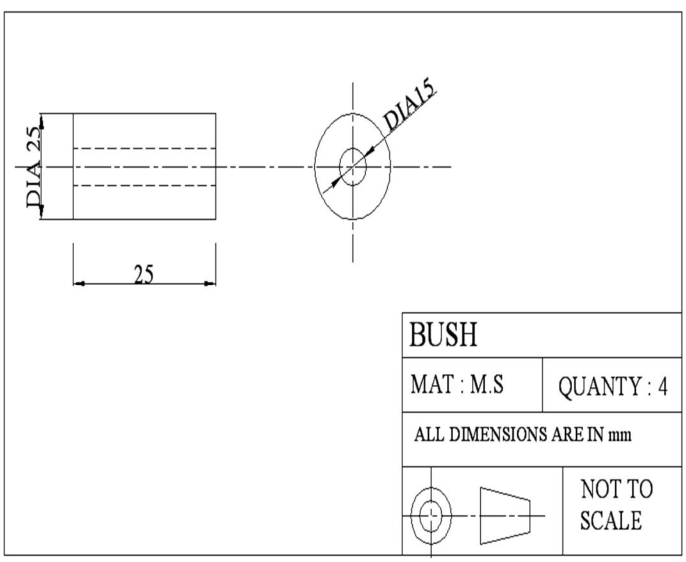

Fig 2.1 Bush

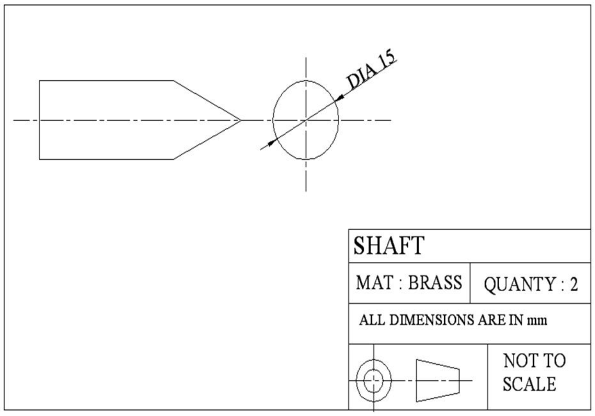

Fig 2.2 Shaft

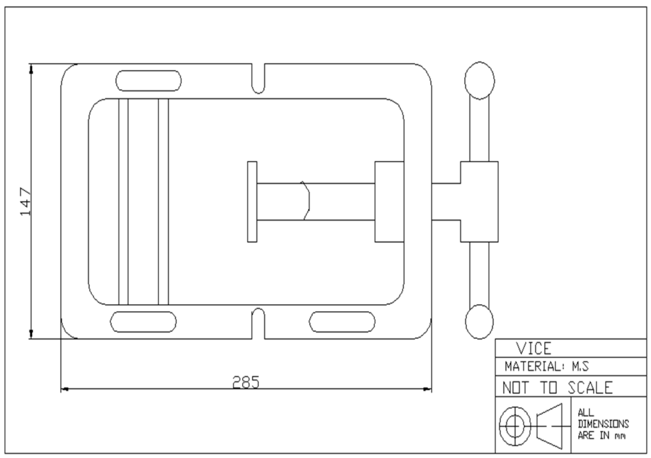

Fig 2.3 Vice

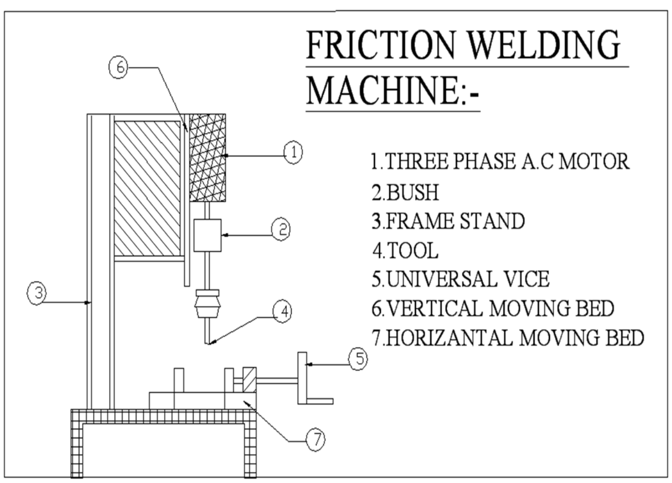

Fig 3.1 Friction welding machine

IV. ADVANTAGES

A. The process is completed in a few seconds with very high reproducibility - an essential requirement for a mass
B. The friction heating is produced locally, therefore there is no widespread assembly softening.
C. The weld is formed across the entire cross-sectional area of the interface in a single shot process.
D. The technique is capable of joining dissimilar materials.

V. APPLICATIONS

A. The initial friction welding method was welding long lengths of material in the aerospace, shipbuilding, and rail industries.
B. Types include large fuel tanks and other space-launch vehicle containers, high-speed ferry freight decks and train carriage roofs.
C. The push to create more fuel-efficient vehicles in the automotive sector has led to increased aluminum use in an attempt to save weight, which also increases recyclability when the vehicles
D. This was the interest in friction welding, which was patented not so long ago, that significant efforts are being made to move the technological advantages of aluminium and magnesium to higher temperature materials such as copper, titanium and steel.

VI. TESTING OF WELDED JOINTS

Welded joints are tested to assess the strength and evaluate the defects if any, using the Welded joints.

A. Non destructive test
B. Destroyal test.

A non-destructive test is test that will break the welded joints during the destructive test. The different types for non-destructive testing and destructive testing are explained below.

1) *Magnetic Particle Test:* The magnetic tests will detect cracks and slag inclusions. Fine iron powder is poured over the work surface. If there is a crack it will attract magnetic poles at the crack. The iron powder is drawn to the crack, and the crack appears as a line. This approach is called detection of magnetic crack. This approach only applies to ferrous metals.
2) *Ultrasonic Test:* A beam of ultrasonic waves generated by a transducer is passed through the component being tested in the ultrasonic test. If there are errors, the echoes are lost, and a receiver can pick them up. Ultrasonic waves are converted into an electric signal by the receiver. The signals are amplified and are computer projected (CRT) as shown in the figure. The specimen's top surface A and bottom surface C are indicated by signals A and C in the screen. In the indicator, signal B shows the internal defect at B in the specimen. By this testing method both surface defects and internal defects can be found.
3) *Nick Break Test:* In this examination the amount of grain below the openings, the flash eye and the inclusions of foreign material are examined. A test specimen is selected that is 200 mm long. To the opposite sides of the welded section, 6 mm deep lots are cut with a saw. The specimen is backed up on two rollers. A hammer blow is applied at the nicked section to sever the weld.

Fig 7.1 Photography of friction welding machine

VII. CONCLUSION

We are very happy and proud to create this "FRICTION WELDING MACHINE" project. This machine is used when welding metals of all kinds.

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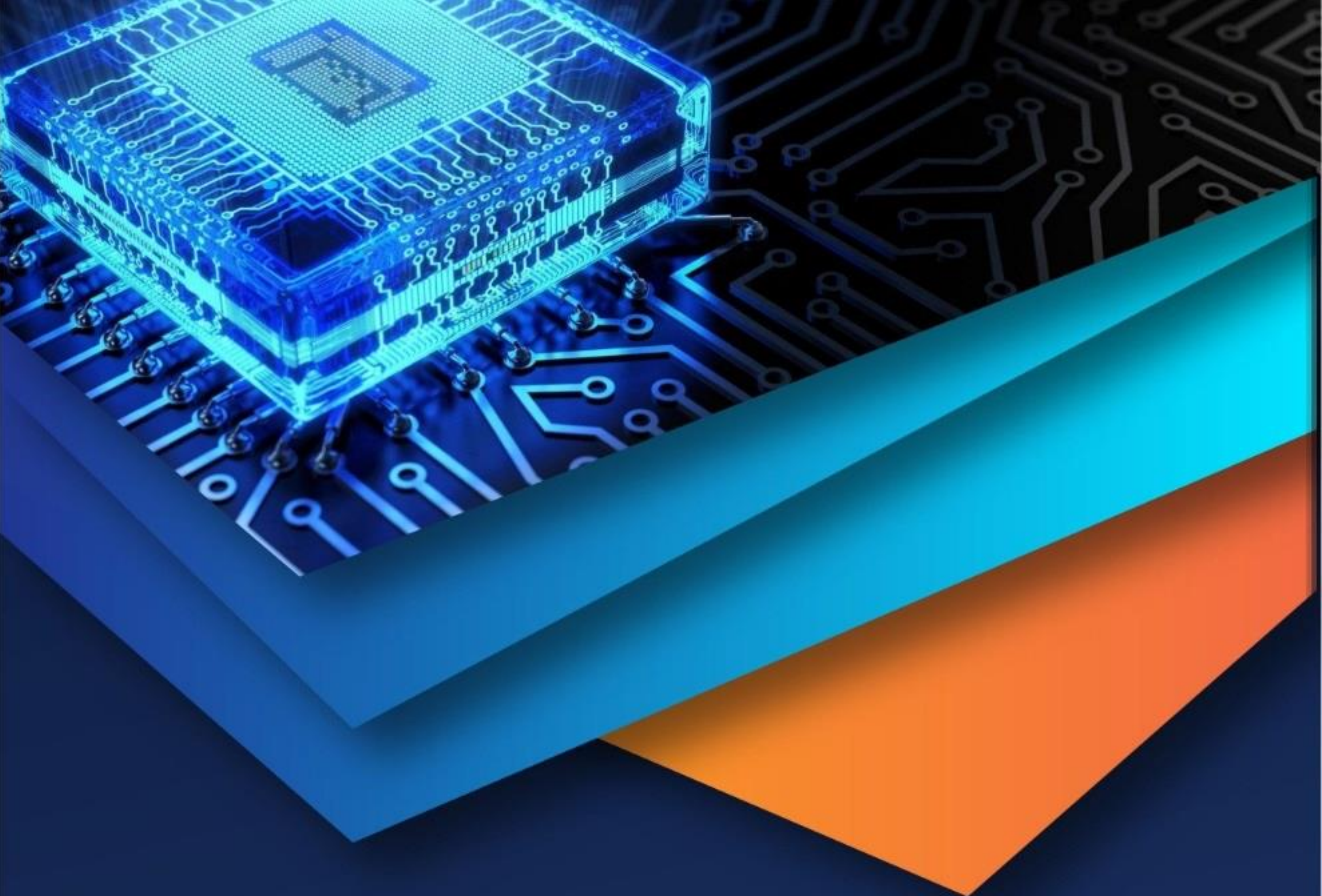

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