Manufacturing and Assembly of Friction Welding Machine for Aluminium

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Abstract - **Friction welding method is one of the most simple, economical and highly productive methods in joining similar and dissimilar metals. It is widely used in the automotive, aircraft and aerospace industrial applications. For many applications it is often necessary to join aluminium (6061) to make finished part. In this project the main aim is to weld the small thickness of aluminum (6061) plates for that friction welding machine used is of higher cost. Here the aim is reduce the cost of friction welding machine with simple parts like three phase A.C induction motor, bush, frame stand, friction tool, universal vice, vertical moving bed, horizontal moving bed etc., The result expected would be of same strength as that of old friction welding machine.it is very easy and at same time production time is very much reduced. This machine is best suitable for mass production.**

Key Words: aluminium, friction tool, production

I. INTRODUCTION

1.1 Welding

Welding is a process of joining similar metals by the application of heat. Welding can be done with or without the application of pressure. While welding, the edges of metal pieces are either melted or brought to plastic condition. Welding can be done with the addition off filler materials or without it welding is used of making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railways wagons, machine frames, structural work, tanks, furniture, boilers, general repair work and ship building; At most in all metal working industries welding is used.

1.2 Welding Defined

Welding is define by the American Welding Society (AWS) as "A materials joining process used in making welds ". A Weld is defined as "A localized coalescence of metals as non-metals produced either by heating the materials to suitable temperatures, with or without the use of filter materials." Fig. 1 shows the Welding Techniques.

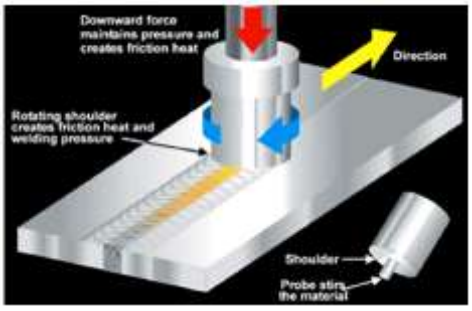

Fig. 1 Welding

1.3 Classification of Welding Processes

1.3.1 Gas Welding

In gas welding a gas flame is used to melt the edges of metals to be joined. The flame is produced at the tip of welding torch. Oxygen and acetylene are the gases used to produce the welding flame. The flame will only melt the metal so additional metal to the weld is supplied by the filler rod. A flux is used during welding to prevent oxidation and to remove impurities. Metals 2mm to 50 mm thick are welded by; gas welding. The temperature of oxy-acetylene fame is about 3200 C. Fig. 2 shows the Gas Welding Techniques.

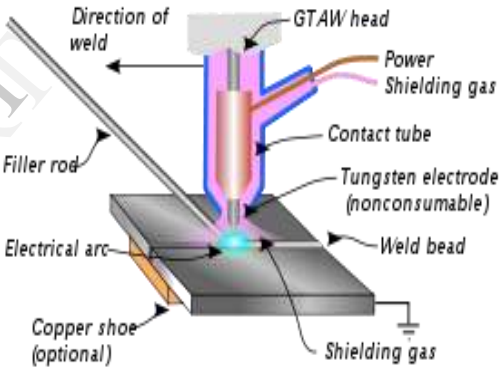

Fig. 2Gas Welding

1.3.2 Arc Welding

This is simply called arc welding. Arc Welding is the process of pain joining two metal pieces by melting their edges by an electric arc. The electric arc is produced between two conductors. The electrode is one conductor and the work piece is another conductor. The electrode and work piece are brought nearer with a small air gap.

1.3.3 Resistance Welding

In resistance welding, the two metal parts to be joined are heated to plastic state by electric resistance. At this state the metal parts are pressed together and welding takes place. In this process there are two copper electrodes in a circuit of low resistance. The metal parts to be welded are placed between the electrodes .When current is passed the electrical resistance at the metal joint becomes very high. Fig. 3 shows the Resistance Welding Techniques.

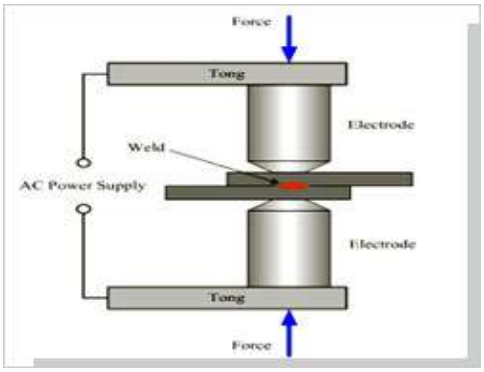

Fig. 3 Resistance Welding

1.4 Types of Weld Joints

1.4.1 Butt Joint

This joint is used to join the ends or edges of two plates or surface. The plates or surfaces are located in the same place. Open square butt joint is used for plates up to 5mm. For more than 5mm thickness, the edges of plates are made to different forms before welding.

1.4.2 Lap Joint

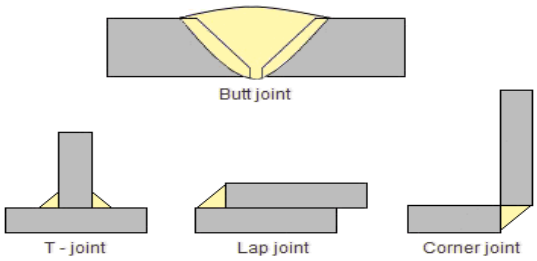

Fig. 4Types of Welding's

This is used to join two over lapping plates. The edge of each plate is welded to the surface of the other common types of lap joints curve simple lap joint and double lap joint.

1.4.3 T-Joint

This is used for welding thick sheets (above 3mm thick). The plates welded will be at 90 to each other.

1.4.4 Corner Joint

This used to weld two plates at 90 to each other. I t is used for welding boxes, tanks, and frames. Thin and thick plates can be used.

1.4.5 Flange Joint

These types of joint are used to join parallel plates as well as for plates at 90 to each other. The edges of the plates are bent to form a flange. Fig. 4 shows the types of Welding Techniques.

1.5 Testing of Welded Joints

Welded joints tested to determine the strength and find out the defects if any, Welded joints are tested using.Non Destructive tests are tests during which the welded joints will be destroyed during destructive test.

1. Nondestructive test
2. Destructive test.

II. METHODOLOGY

2.1 Components

The fabrication of unit consist of almost all the standard welding processes such as welding, fitting, assembling etc..The unit necessitates the manufacturing of following parts.

- Vertical Movable bed
- Horizontal Moving Bed
- Vice
- Friction Tool
- Motor
- Frame stand

The components manufactured in process involved in manufacturing in detail in the report else. The manufacturing and assembly of this arrangement is made as rigid as possible.

2.1.1 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.

2.1.2 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. The vice is fixed on this moving bed with suitable bolt and nut arrangement.

2.1.3 Vice

The vice is found over the base of the machine and from the bottom of the moving bed. This type of vice is used to hold the work piece in a straight manner as well as in a tilted manner. Such a way the jaws are found in the vice. The various part of the vice is supporting jaw, screw rod with self-tilting jaw. It moves towards both forward and backward direction with the specification of 3 Inches vice made up of Cast iron material.

2.1.4 Supporting Jaw

It is found on the either end of the vice which is fixed on the base plate by the help of bolt and nut. Its supports the work piece can be moved of max angle fixing the jaw the work piece to be cut is placed to an angle whose edge. Handle is rotated the self-tilting jaw, when approaches the other side of the work piece automatically moves to angle and grips the work piece.

2.1.5 Friction Tool

Friction tool is made up of mild steel. It is fixed to the three phase induction motor which is held on the vertical moving bed. Table 1 shows the Friction tool Dimensions.

Table 1 Friction tool Dimensions

S.No	Mild Steel (mm)	H.S.S (mm)
1	06	06

2.1.6 Motor

An electrical motor is an electric machine that converts electrical energy into mechanical energy. It mainly operates on the interaction between magnetic fields and winding current to generate force within the motor. Specification of the motor is three phase induction motor with 1440 rpm, 0.5 HP and 440 Volts. Fig. 5 shows the

Electric Motor and Fig. 6 shows the Components assembly of Electric motor.

Fig. 5Electric Motor

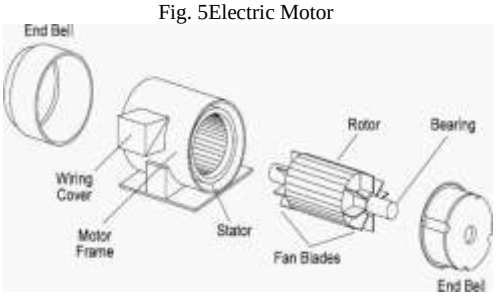

Fig. 6 Components assembly of Electric Motor

2.1.7 Frame Stand

It is made up of mild steel. This is the base of the above all components of the machine. Table 2 shows the Top and Bottom plate Dimensions for the Frame Stand.

Table 2 Top and Bottom plate Dimensions for Frame Stand

S.No	Thickness (Inches)	Dimensions (mm)
1	1 (Top)	3.2
2	1.5 (Bottom)	6.4

III. CONSTRUCTION AND WORKING

3.1 Principle

Two pieces are welded together due to the pressure exerted by the two materials, which are connected to the lower and upper arms, where the upper arm is movable and the lower arm is also movable.

3.2 Working

Traditionally, friction welding is carried out by moving one component relative to the other along a common interface, while applying a compressive force across the joint. The friction heating generated at the interface softens both components, and when they become plasticized the interface material is extruded out of the edges of the joint so that clean material from each component is left along the original interface. The relative motion is then stopped, and a higher final compressive force may be applied before the joint is allowed to cool. The key to friction welding is that no molten material is generated, the weld being formed in the solid state.

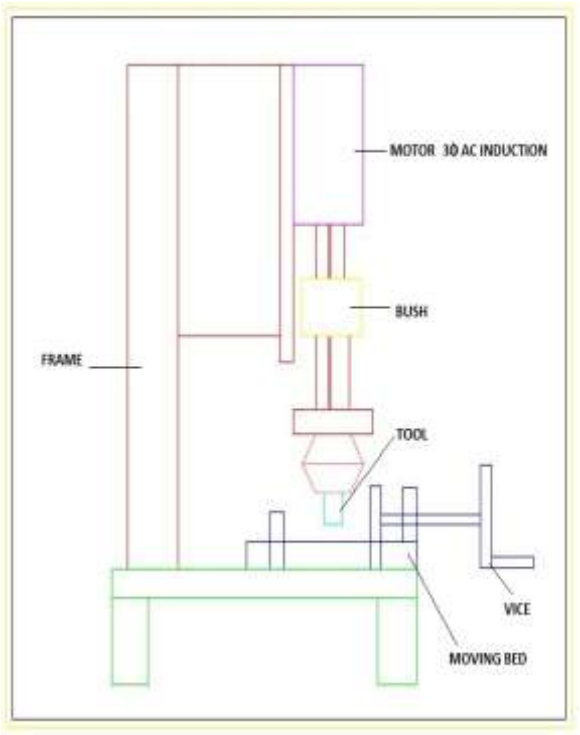

Fig. 7 2D View of Friction Welding machine (AUTOCAD)

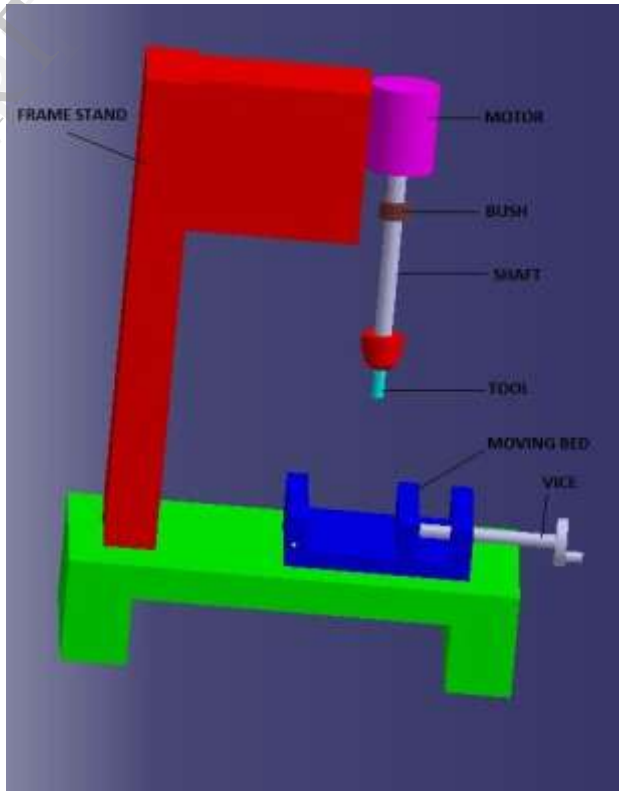

Fig. 83D View of Friction Welding machine

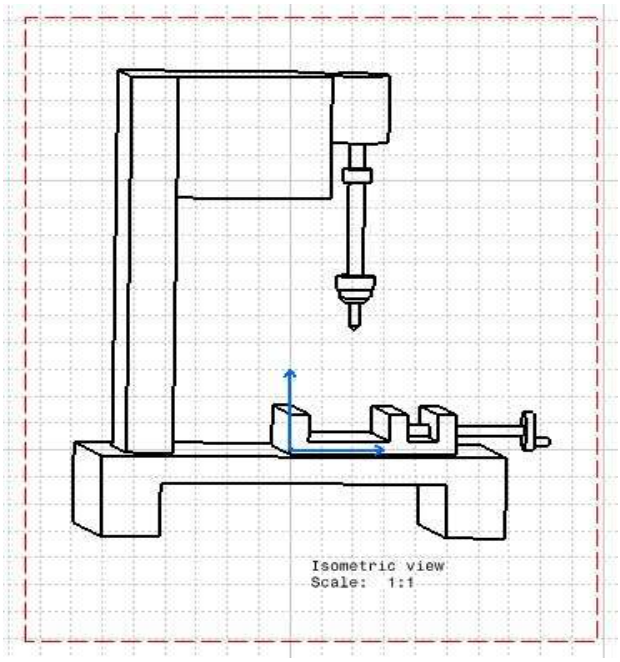

Fig. 9 2D View of Friction Welding machine (CATIA)

The Fig. 7 shows the 2D View of Friction Welding machine (AUTOCAD). Fig. 8 shows the 3D View of Friction Welding machine. Fig. 9 shows the 2D View of Friction Welding machine (CATIA). Where 2D- Two Dimensional and 3D- Three Dimensional.

3.3 Edge Preparations

The edges of plates to be welded are suitably shaped. Dust, sand, dirt, oil and grease are removed from the edges of plates. This is called edge preparation. Edge preparation is done to get good welded joints. The shapes of edges depend upon thickness of plates.

The following types of shapes are formed at the edges of plates

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

- Square butt weld is used for plate thickness from 3mm to 5mm. Edges are placed about 3mm apart for welding the plates
- Single-v butt weld is used for plate thickness from 8mm to 16mm.
- Double-v butt weld is used for plates over 16mm thick. Welding is done on both sides of the plates.
- Single-U and Double-U butt welds are used for plates over 20mm thick.

IV. RESULT

Fig. 10 Assembly of Friction Welding machine

Fig. 11Welded piece using Friction Welding machine

In the above Fig. 10 shows the assembly of Friction Welding machine and the Fig. 11 shows the Welded piece using Friction Welding machine. In the Friction Welding Machine is used for welding the both low and high thickness plates like Aluminium.

V. TENSILE TEST

1. Tensile Strength of Aluminum Base Plate
Maximum Load = 303 kgf
Cross-sectional Area = 9.48 × 3.11 mm²
Ultimate Tensile strength =
[(303 * 9.81) / (9.48 * 3.11)] =100.82 MPa

2. Tensile Strength of Defective Aluminum Welded plate
Maximum Load = 138 kgf
Cross-section Area = 6.41 × 1.67 mm2
Ultimate Tensile Strength =
[(138 * 9.81) / (6.41 * 1.67)]= 126.466 MPa

3. Tensile Strength of Successful Aluminum Welded Plate
Maximum Load = 539kgf
Cross-sectional Area = 10.97 × 3.04 mm²
Ultimate Tensile strength =
[(539 * 9.81) / (10.97 * 3.04)]= 158.554 MPa

VI.CONCLUSION

The friction welding process was very efficient in the welding of dissimilar materials as aluminium. According to this project the result expectation by comparing with existing friction welding machine is light weight, strength of the welded work piece from this machine more or less equal to the existing friction welding machine.

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