International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

Research Article

Design and Manufacturing of Idler Welding Machine

Sateesha Patil†*, Prashant Vavhal†, Abhinav Whatte‡

†Mechanical Engineering Department, SPPU Pune, PKTC Chakan, Pune, India.
‡Mechanical Engineering Department, Marathwada Mitra Mandal's Institute of Technology, Lohgaon, Pune - 47, India.

Accepted 01 Oct 2016, Available online 05 Oct 2016, **Special Issue-6 (Oct 2016)**

Abstract

In this paper for the mass production of manufacturing the welding may be of Electric arc welding, CO2 Welding, or TIG welding. The processes of Electric arc welding or CO2 welding are normally done manually. In electric arc welding after striking the arc the electrode is moved in the direction of welding maintaining an effective arc gap, similar type of process is done in CO2 welding. Moving the electrode along the welding line is a skillful work and especially for circular components become much more difficult. That can be easy by this idler welding machine and component its working process. With the help of idler weld machine we can a make a machine for welding the housing of the idler to the pipe. The successful machining of any mass production depends upon the inter-changeability to facilitate easy to assembling and reduction of unit cost so there is necessary of special purpose tools which are used to facilitated production.

Keywords: *Inter-changeability, Idler Welding Machine & Components, Mass Production, Welding*

1. Introduction

The successful machining of any mass production depends upon the inter-changeability to facilitate easy assembling & reduction of unit cost. So there is a necessity of special purpose tools which are used to facilitate production operations like machining, assembling, inspection, etc.

The machine tool industry has undergone sufficient changes as the requirement of user engineering systems changed; first it started with the manufacturing of basic general purpose machine tools. These machines though offered higher flexibility were not suitable for mass production owing to longer set up times and the tedious adjustments of machine and tools besides requiring highly skilled operators. With growing need of fast production to meet the requirements of industry, mass production machines are conceived (Stan A. David et al, 2008). These machines were highly specialized but inflexible. The use of these machines was with a success for mass production and they have considerably reduced the production costs by way of reduced machining times and labour costs. Because of inflexibility these machine tools could not however be adopted by units involved in small lot and piece production. Because of the above, great need is felt for tools that could bridge the gap between highly flexible general purpose machine tools (which are not economical for mass production) and highly specialized, but inflexible mass production machines.

*Corresponding author: **Sateesha Patil**

In the present age of mass production it is often required to automate the manufacturing processes that were conventionally done manually. The process of joining in many applications is welding. The welding may be of Electric arc welding, CO2 Welding, or TIG welding. The processes of Electric arc welding or CO2 welding are normally done manually. In electric arc welding after striking the arc the electrode is moved in the direction of welding maintaining an effective arc gap, similar type of process is done in CO2 welding (Amar Raj Singh Suri et al, 2012). Moving the electrode along the welding line is a skill full work and especially for circular components become much more difficult. The machine tool industry has undergone sufficient changes as the requirement of user engineering systems changed; first it started with the manufacture of basic general purpose machine tools. These machines though offered higher flexibility were not suitable for mass production owing to longer set up times and the tedious adjustments of machine and tools besides requiring highly skilled operators (N. P. Maniar et al, 2012). With growing need of fast production to meet the requirements of industry, mass production machines are conceived. These machines were highly specialized but inflexible. The use of these machines was with a success for mass production and they have considerably reduced the production costs by way of reduced machining times and labour costs.

Because of inflexibility these machine tools could not however be adopted by units involved in small lot

and piece production. Because of the above, great need is felt for tools that could bridge the gap between highly flexible general purpose machine tools (which are not economical for mass production) and highly specialized, but inflexible mass production machines.

2. Problem Definition

In CO2 welding or sometimes electric arc welding the need often arises for welding of circular shape components, where the welding is carried out on the entire periphery or a partial arc length of the job. The electrode is thus moved along this circular path in the conventional method. But movement of the electrode is much more difficult and it is much easier to index the job.

The indexing of job can be done by mounting it on this indexer table for the above process is needed to have the following features:

1. Table should be stable and with ability to carry heavy table load.
2. Table should operate at different operating speeds to accommodate any given welding process or any size of electrode.
3. The table should have an auto stop after every cycle of welding operation.
4. The table should be able index any given angle in horizontal plane to accommodate any phase of staggered welding.
5. The table should have an inching facility to continue after the first stage stop, to carry out the second stage welding.
6. The table should be universal to accommodate any given size of work-piece in given specifications.

3. Objective

Primary objective of this machine is to provide a supporting structure having greater capabilities and not only being used more expediously but also of handling structural assemblies which are bulky to be handled manually. Another objective is to provide an arrangement which will result in taking as much less space as possible because space constraint is a major factor for any industry which is going to set up a new machine. It should be rugged, durable and should function effectively. We have designed the machine keeping in view that the dimension does not always remain constant and a simple but flexible way should be given to have interchangeability of idlers. Along with it, the basic but most important objective will be accuracy. The part produced should be accurate, because it is the most defining factor of any product.

4. Scope

This is able to weld idlers with varying diameter and length. But with proper modification, one can weld idler of any size and shape. With some proper arrangement, we can weld not only circular body, but of various shapes. Mass manufacturing can be done with very less operating cost. Thus lakhs of idlers of various shape and size can be welded in a matter of time. No separate machine is required for welding of different sizes of idler.

5. Components

5.1 Motor

Motor is a Single phase AC motor, Power 60 watt, Speed is continuously variable from 0 to 6000 rpm. The speed of motor is varied by means of an electronic speed variation. Motor is acommutator motor ie, the current to motor is supplied to motor by means of carbon brushes. The power input to motor is varied by changing the current supply to these brushes by the electronic speed variation, thereby the speed is also is changes. Motor is foot mounted and is bolted to the motor base plate welded to the base frame of the indexer table.

5.2 Belt Drive

The power from the motor is supplied to the input shaft of the mechanism by means of an open belt drive. The drive comprises of the motor pulley mounted on the motor shaft, the belt FZ 6x 500, and reduction pulley mounted on the input shaft.

5.3 Reduction gear box

Reduction gear box is a worm and worm wheel gear box with ratio of 1:80 ratio. The gear box comprises of the following parts:

5.4 Input worm shaft

The input shaft is a high grade alloy steel (20MnCr5) part held in ball bearings at either end carries the reduction pulley at one end. Input worm shaft has the following specifications:

GEAR DATA

Addendum diameter (Da1) = Φ 27 mm
Dedendum diameter (Df1) = Φ 20.4 mm
No. of starts = 1
Hand of operation = Right hand
Module = 1.5mm

5.5 Worm Wheel

The worm wheel is cast iron part keyed to the worm wheel shaft. Worm Wheel has the following specifications:

GEAR DATA

Addendum diameter (Da2) = Φ 123mm
Dedendum diameter (Df2) = Φ 116.4 mm
No. of teeth = 80
Hand of operation = Right hand
Module = 1.5mm

Bore diameter = Φ 22 mm
Keyway = 6x3x30

5.6 Worm wheel Shaft

The worm wheel shaft is a high grade alloy steel(EN24), held in ball bearings at either ends and carries the muff coupling to upper end. The worm wheel is keyed to the worm wheel shaft.This shaft also acts like table shaft.

5.7 Table

The table is circular plate made from structural grade steel (EN9).The table is welded to the table shaft making an integral part. The table holds the work piece on its top end. It is provided with tapped holes that receive bolts to clamp the indexer buttons.

5.8 Table shaft

The table shaft is a high grade alloy steel (EN24), held in ball bearings at one ends and carries the worm gear at lower end. The table is welded to the table shaft making an integral part.

5.9 Bearing housing

The bearing housings are of structural grade steel (EN9). It holds the ball bearing to support the table shaft. It is welded to the indexer table base frame and is provided with holes that receive the worm gear box support pins.

5.10 Ball bearing 6005

The ball bearing 6005 is a single row ball bearing with internal diameter 25 mm, outside diameter 47mm and width 12mm. It is provided with metallic dust covers/ seals at both ends. It supports the table shaft in the bearing housing Rolling-element bearing :

A rolling-element bearing is generally composed of a sleeve-like outer ring and several rows of balls retained by cages. The cages were originally machined from solid metal and were quickly replaced by stampings. It features smooth motion, low friction, high rigidity and long life. They are economical, and easy to maintain and replace. Thomson (currently owned by Danaher) is generally given credit for first producing [what is now known as] a linear ball bearing.

1. Rolling-element bearings can only run on hardened steel or stainless steel shafting (raceways).
2. Rolling-element bearings are more rigid than plain bearings.
3. Rolling-element bearings do not handle contamination well and require seals.
4. Rolling-element bearings require lubrication.

Rolling-element bearings are manufactured in two forms: ball bearing slides and roller slides.

Ball Bearing Slide

Also called "ball slides," ball bearing slides are the most common type of linear slide. Ball bearing slides offer smooth precision motion along a single-axis linear design, aided by ball bearings housed in the linear base, with self-lubrication properties that increase reliability. Ball bearing slide applications include delicate instrumentation, robotic assembly, cabinetry, high-end appliances and clean room environments, which primarily serve the manufacturing industry but also the furniture, electronics and construction industries. For example, a widely used ball bearing slide in the furniture industry is a ball bearing drawer slide.
Commonly constructed from materials such as aluminum, hardened cold rolled steel and galvanized steel, ball bearing slides consist of two linear rows of ball bearings contained by four rods and located on differing sides of the base, which support the carriage for smooth linear movement along the ball bearings. This low-friction linear movement can be powered by either a drive mechanism, inertia or by hand. Ball bearing slides tend to have a lower load capacity for their size compared to other linear slides because the balls are less resistant to wear and abrasions. In addition, ball bearing slides are limited by the need to fit into housing or drive systems.

Roller Slides

Also known as crossed roller slides, roller slides are non-motorized linear slides that provide low-friction linear movement for equipment powered by inertia or by hand. Roller slides are based on linear roller bearings, which are frequently criss-crossed to provide heavier load capabilities and better movement control. Serving industries such as manufacturing, photonics, medical and telecommunications, roller slides are versatile and can be adjusted to meet numerous applications which typically include clean rooms, vacuum environments, material handling and automation machinery.

Consisting of a stationary linear base and a moving carriage, roller slides work similarly to ball bearing slides, except that the bearings housed within the carriage are cylinder-shaped instead of ball shaped. The rollers crisscross each other at a 90° angle and move between the four semi-flat and parallel rods that surround the rollers. The rollers are between "V" grooved bearing races, one being on the top carriage and the other on the base. The travel of the carriage ends when it meets the end cap, a limiting component. Typically, carriages are constructed from aluminum and the rods and rollers are constructed from steel, while the end caps are constructed from stainless steel.

Although roller slides are not self-cleaning, they are suitable for environments with low levels of airborne contaminants such as dirt and dust. As one of the more expensive types of linear slides, roller slides are capable of providing linear motion on more than one axis through stackable slides and double carriages. Roller slides offers line contact versus point contact as with ball bearings, creating a broader contact surface due to

the consistency of contact between the carriage and the base and resulting in less erosion.

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

Fig.1 Ball Bearing

5.11 Welding

Welding is fabrication process usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal. In addition to melting the base metal, a filler material is often added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that can be as strong, or even stronger, than the base material. Pressure may also be used in conjunction with heat, or by itself, to produce a weld. Although less common, there are also solid state welding processes such as friction welding or shielded active gas welding in which metal does not melt. Some of the best known welding methods include: Gas metal arc welding (GMAW) - commonly termed MIG (metal, inert gas), uses a wire feeding gun that feeds wire at an adjustable speed and flows an argon-based shielding gas or a mix of argon and carbon dioxide (CO2) over the weld puddle to protect it from atmospheric contamination.

5.12 Frame

Frame is a mild steel (MS) structure made from MS Plates It supports the entire assembly of the indexer table. It provided with a sheet metal panel which holds the sensor, relay, and speed regulator and inching switch.

5.13 Indexer buttons (2No's)

Table is provided with tapped holes that receive bolts to clamp the indexer buttons. Indexer buttons acts as stops, such that when they come in front of the proximity sensor the table the relay is operated to stop the table motion.

5.14 Electronic Speed Regulator

Motor is acommutator motor i.e., the current to motor is supplied to motor by means of carbon brushes. The power input to motor is varied by changing the current supply to these brushes by the electronic speed variator, thereby the speed is also is changes.

5.15 Electronic relay

The electronic relay is mounted on the sheet metal panel on the base frame. The electronic relay is connected to the proximity sensor and the motor input circuit. The function of the electronic relay is to cut off power supply when the proximity sensor is operated.

5.16 Electronic Proximity sensor

The electronic proximity sensor is mounted on the sheet metal panel on the base frame by means of a Z shaped clamp. The proximity sensor as the name suggests senses the proximity of the indexer buttons which acts as stops, such that when they come in front of the proximity sensor the table the relay is operated to stop the table motion. The proximity sensor is connected to the electronic relay and the power source.

5.17 Inching switch

The inching switch is connected between the electronic relay and the proximity sensor, this switch when operated by-passes the proximity sensor, thereby operating the motor momentarily as long it is kept pressed.

5.18 Multi-Axis Welding Positioner

This is the ideal small bench top welding positioner. It has quality and features normally found on only much larger welding positioners.

1. Solid State A.C. infinitely variable speed table rotation.
2. Heavy duty fully enclosed worm gear rotation drive.
3. On/off electric foot control.
4. 200 amp welding ground at 50% duty cycle.
5. 230 VAC 50/60 Hz input power.
6. Machined table with centering grooves and slots for clamping
7. Dynamic braking brings table rotation to a quick stop.
8. Manually variable table tilting with degree scale.

Highest quality design and construction available.

Table 1 Experimental procedure parameters

Maximum capacity table in the flat position	30Kg
Maximum capacity table at 90 degrees	15 kg
Maximum rotation torque	65 lb-inches
Rotation centroid max capacity	12mm
Rotation centroid max capacity	4mm
Tilting centroid at max capacity	25 mm
Table tilt degrees	0 to 45
Rotation speed model PS-1F-15	1 to 20 rpm
Table diameter	250 mm
Tee slots	3at 120 degrees
Table height in the flat position	240mm
Weight approximate	20 kg

6. Assembly

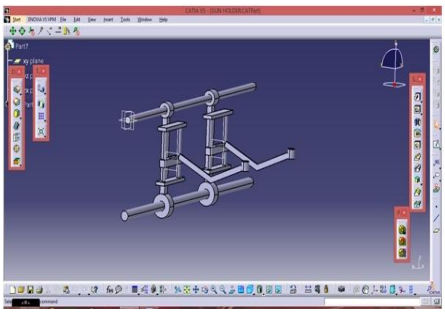

Fig.2 Linear Bearing Assembly

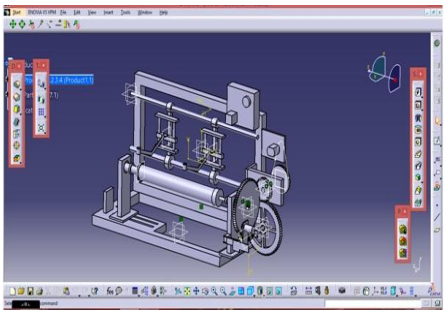

Fig.3 Front View of Assembly

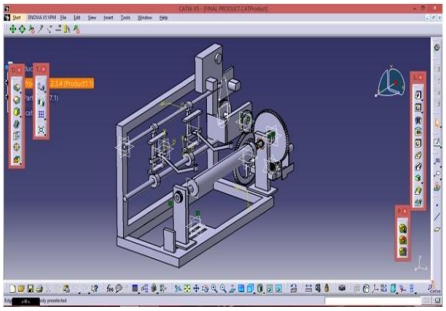

Fig.4 Left Hand Side View Of Assembly

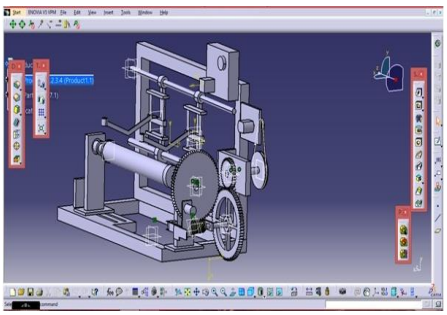

Fig.5 Right Hand Side View of Assembly

7. Working

7.1 Complete Circular Welding

The job to be welded is placed on the indexer table and considering the welding process and electrode size the speed regulator is adjusted to give desired table speed. The table carries only one indexer button and it is indexed to the stop position. Now inching switch is operated simultaneously as the welding process is started, the job rotates as welding operation is done, after one complete rotation the indexer button again comes in front of the proximity switch there by stopping the welding process and the table movement. The job welded is unloaded and new work-piece is loaded for the next operation.

7.2 Staggered Circular Welding

The job to be welded is placed on the indexer table and considering the welding process and electrode size the speed regulator is adjusted to give desired table speed. The table carries indexer buttons as per no of welds and position of the same. Table is indexed to the first stop position. Now inching switch is operated simultaneously as the welding process is started, the job rotates as welding operation is done, after the second indexer button comes in front of the proximity switch it stops the welding process and the table movement. Inching switch is operated which starts the next position welding and the process is repeated till the last stop ie, the first stop comes in front of the proximity switch. The job welded is unloaded and new work-piece is loaded for the next operation.

Conclusions

Thus we were able to successfully design and manufacture a machine which welds idler automatically, not only of same dimensions, but of various dimension whether it is change in diameter or length. Though capital cost might seem high, it becomes very feasible in terms of mass production. Thus this machine successfully carters to the need of industry which relies on accurate, fast and feasible production.

Future scope

1. If the unloading and loading is made automatic, then it will increase the number of production.
2. It can be designed according to the dimensions required by the company.
3. In a fully automatic system, it will play a crucial part.
4. If some changes are made, it can not only handle, shafts, but also rectangular bars.

References

Amar Raj Singh Suri, A.P.S. Sethi, (2012), Development of Gear Hobbing Fixture Design for Reduction in Machine Setting Time, *International Journal of Scientific and Research Publications,* 2 (10), 1-3.

N. P. Maniar, D. P. Vakharia, (2012), Design& Development of Rotary Fixture for CNC, *International Journal of Engineering Science Invention,* 1(1), 32-43.

C.A. Arjun, Wahid Hussain,(2014), Design and Fabrication of Welding Fixture for a Single Doorframe, *International Journal Of Scientific Research,* 3(11), 166-168.

Stan A. David, TarasankarDebroyetal. (2008), Trends in Welding Research, *Proceedings of the 8th International Conference*, 1-17.

A. Frittellaetal. (1991), Mathematical Selection Criteria with particular reference to the influence of additional loads.