DESIGN OF WELDING ROTATOR

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ABSTRACT

There are many manufacturing processes. There are several machining operations like casting, forging, surface finishing, welding, milling, drilling etc. plays an important role in any industry.
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.
There are various such joints in the machines or the components made in industry which are difficult to weld. Welding them requires a work of high stability and work is to be carried out in proper specific angles. An attempt has been made in our project work to design such a stable welding machine or a rotator of the welding machine.

Keywords: Difficult Components, Fabrication, Specific Angles, Welding, Welding Rotator

I. INTRODUCTION

There are many manufacturing processes. There are several machining operations like casting, forging, surface finishing, welding, milling, drilling etc. plays an important role in any industry.
Welding is a fabrication or sculpturalprocess 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 weldpool) 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 energysources can be used for welding, including a gas flame, an electricarc, a laser, an electronbeam, friction, and ultrasound. While often an industrial process, welding can be done in many different environments, including open air, underwater and in outerspace. Regardless of location, welding remains dangerous, and precautions are taken to avoid burns, electricshock, eye damage, poisonous fumes, and overexposure to ultravioletlight.
There are many new technologies are to be introduce in last 10 years. Like friction stir welding, inertia friction welding, by using welding fixtures or rotators. These are advanced automated technologies. It helps to give high quality of weld. Which improves the performance of part welded and the look also.

II. DESIGN OF WELDING ROTATOR

The attempt is made to design a special purpose machine and have to adopt a very careful approach; the total design work has been divided into two parts mainly;

- System design
- Mechanical design

In system design the focus mainly concentrate on the following parameter[1]

2.1 System Selection Based on Physical Constraints

The selection of machine is based on the availability of the floor area. This project is specially made for small scale industry, where small work pieces are welded together. As it is design for small scale industry, the space is the major constrain. So, the system should be very compact.[2]

2.2 Components of System

As already stated, system should be compact enough so that it can be easily accommodated at anywhere of a shop floor. All the moving parts should be well closed & compact. A compact system gives a better look & structure. Following are some example;

- Height of machine.
- Energy expenditure in hand operation, lighting condition of machine.

2.3 Chances of Failure

The losses incurred by owner in case of failure of a component are important criteria of design. Factor of safety, while doing the mechanical design, is kept high so that there are less chances of failure. Periodic maintenance is required to keep the machine trouble free.

2.4 Servicing Facility

The layout of components should be such that easy servicing is possible especially those components which required frequent servicing can be easily dismantled.

2.5 Height of Machine from Ground

For ease and comfort of operator the height of machine should be properly decided so that operator may not get tired during operation .The machine should be slightly higher than that the level also enough clearance be provided from ground for cleaning purpose.

2.6 Weight of Machine

The total weight of machine depends upon the selection of material components as well as dimension of components. A higher weighted machine is difficult for transportation & in case of major break down it becomes difficult to repay.

III. SELECTION OF MOTOR

The motor is an electric drive which is use to transmit power. Motor converts an electric energy to twisting of the shaft or axle. The selection of the motor is depending upon the following factors:-

1. Required Torque (T)
2. Nature and Magnitude of load (W)
3. Gravitational force (G)

4. External Force (F)
5. Coefficient of friction (μ).

Torque is the force that produces rotation. It causes an object to rotate. Torque consists of force acting on a distance. Torque, like work, is measured is N.mm. however, torque, unlike work, may exist even though no movement occurs.

Consider, the load acting on motor is 20 N acting at a distance of 100 mm.

T = W x D

T = 20 x 100

T = 2000 NM i.e. 2×10^6 N.mm

An external force is a force exerted by welding gun on a work piece. It is nearly 130N.

T = P x (F + μWG)

$20 \times 10^6 = P \times (130 + 0.2 \times 20 \times 9.81)$, P=118.17 WATT

III. DESIGN OF WORM WHEEL SHAFT

3.1 Asme Code For Design of Shaft

Since, the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the constant load. According to ASME code permissible values of shear stress may be,

Calculated by considering various equations [3]

= 0.18 x 800

= 144 N/mm^2

Shaft is provided with key way; this will reduce its strength. Hence reducing above value of allowable stress by 25%

$\square fs_{max} = 108\ N/mm^2$

This is the allowable value of shear stress that can be induced in the shaft material for safe operation.

To Calculate Worm Wheel shaft Torque

POWER = 2 ΠNT

60

T = 60 x P

2 x □ x N

= 60 x 120

2 x □ x 20

T = 57.29 N-m

T design = 57.29N-m

Shaft in torsional shear failure

$Td = x\ fs_{act} \times d^3$

$57.29 \times 10^3 = \square/16 \times 108 \times d^3$

d = 13.92 mm

from standared table shaft sizes 15 mm is selected for the project.

As vertical maximum load of 1200N may be acting on shaft, bending stress fc act on shaft.

σc = Maximum Load

Cross Sectional Area of shaft

$$\sigma c = \frac{P}{\frac{\Pi \times d^2}{4}}$$

$$\sigma c = \frac{1200}{0.785 \times 15^2}$$

$\sigma c = 7.79\ N/mm^2$

Check For Torsional Shear Failure Of Shaft.

$\tau\ max = ½ \quad \sigma c^2 + 4(\ \tau)^2$

$\tau\ max = ½ \quad 7.79^2 + 4 \times (5.40)^2$

$\tau\ max = ½ \quad 117.46$

$\tau\ max = 6.6607\ N/mm^2$

but $\tau\ max = 108\ N/mm^2$

Therefore design of shaft is Safe for torsional shear failure.

IV. DESIGN (SELECTION OF INPUT SHAFT BALL BEARING)

In selection of ball bearing the main factor is the system design of the drive i.e.; the size of the ball bearing is of major importance; first select an appropriate ball bearing first select an appropriate ball bearing first taking into consideration convenience of mounting the planetary pins and then we shall check for the actual life of ball bearing. [4]

P = X Fr + Yfa.

Where;

P=Equivalent dynamic load, (N)

X=Radial load constant

Fr= Radial load (H)

Y = Axial load contact

In our case; = t/r = 57.29x 103 / 60 =954.8

Radial load Fr= 954.8N

Axial load F_a = Maximum table load = 60 kg =600 N

P= 1 x 954.8 +1 x 600 =1554N

□L= $(C/p)^{p}$

Considering 4000 working hours

$$L = \frac{60\ n\ L\ h}{10^6} = 4.5\ mre$$

$$\Rightarrow \quad 4.5 = \frac{C^3}{1350}$$

□C = 2565N

AS; required dynamic of bearing is less than the rated dynamic capacity of bearing

TABLE 1

MATERIAL SPECIFICATION: EN 9

RAWMATERIAL SIZE: 170X150X16

Time in minutes	Total time	15	19	25	25	25	25
	M/C time	-	14	-	10	10	10
	Setting time	15	5	25	15	15	15
Tools	Measuring Instrument	-	Venire	-	Venire	Venire	Venire
	Cutting Tools	-	Facing cutter	-	Twist drill	Boring tool	Boring tool
	M/c Tools	Milling	Milling	Lathe	Lathe	Lathe	Lathe
	Jigs & Fixture	M/C Vice	M/C Vice	4 jaw chuck	4 jaw chuck	4 jaw chuck	4 jaw chuck
Description of Operation	Clamp stock	Facing All Sides Sq. to total length 165x144x 12 mm	Clamp stock on lathe	Drilling Ø 25 through thickness	Boring Ø 28through thickness	Counter Boring Ø 35 through 10thickness	-

QUANTITY: - 01 NO’S[5]

TABLE 2.STANDARD TABLE

Sr No.	Description	Qty	Cost
1.	Motor	01	450
2.	Belt	01	110
3.	Grub Screw	09	36
4.	Bearings	05	680

V. COST ESTIMATION

5.1 Bill of Materials

TABLE 3

Sr No.	Description	Qty	Material
1.	Motor	01	S
2.	Belt	01	Rubber
3.	Reduction Pulley	01	Ms
4.	Worm Shaft	01	20mncr5
5.	Worm Gear	01	Cast Iron
6.			

5.2 Machining Cost

TABLE 4

Operation	Rate Rs /Hr	Total Time Hrs	Total Cost Rs/-
Lathe	80	18	1440
Milling	90	10	900
Drilling	60	4	240
Hobbing	-	-	980
Total			3560

Figure 1: Welding Rotator with Proximity Sensor [6]

VI. MISCELLANEOUS COSTS

TABLE 5

Operation	Cost(Rs)
Gas Cutter	300
Sawing	120
Total	420

The cost of purchase parts = Rs 3566/-

6.1 Total Cost

TOTAL COST = Raw Material Cost +Machine Cost + Miscellaneous Cost + cost of Purchased Parts +Overheads

Hence the total cost of machine = Rs 10036/-

VII. CONCLUSIONS

From the above report, it is concluded that, welding rotator is very essential equipment for heavy and light fabrication shop. It is mainly used to rotate or position the cylindrical jobs for circumferential welding. A substantial opportunity exists in the technology of using welding rotator to relieve people from boring, repetitive, hazardous and unpleasant work in all forms of a human labour.

On the shop floor level, an organization pays Rs.6000 per month for a skilled operator. While the initial investment in the welding rotator is nearly Rs.11000/-. The production rate for manual welding is 150 jobs per day; hence the manual welding is very time consuming. While using welding rotator the production rate is increased up to 225 jobs per day (By considering 8 Hr). An investment of welding rotator is covered within 3 months. Simultaneously, the man-hours and human effort require is reduced. The wastage of weld material decreased compare to the manual welding.

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