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Design of Welding Rotator

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Abstract: *The project titled "Design of Welding Rotator" addresses the key challenges encountered in manual welding of cylindrical objects. Manual welding, though common in small to medium industries due to its flexibility and lower cost, often suffers from issues such as poor precision, operator fatigue, and safety hazards—especially when rotating heavy or large workpieces by hand. To overcome these drawbacks, the project proposes the design of a welding rotator—a mechanical device that supports and rotates cylindrical objects at a controlled speed during welding operations.*

The welding rotator enhances weld quality by enabling steady rotation, allowing consistent heat application and welding speed. This not only improves the structural integrity of the welded joints but also minimizes human error and physical strain. By automating the rotation process, the device significantly boosts operational efficiency and ensures safer working conditions for the operator.

The project explores the construction and working principles of the welding rotator, emphasizing its role in improving welding outcomes. In modern industrial practices, where precision, safety, and productivity are critical, such automation tools are essential. The integration of a welding rotator represents a practical and cost-effective advancement that supports the demand for higher quality and more efficient welding processes.

Keywords: Design of Welding Rotator

I. INTRODUCTION

Manufacturing involves various processes, each essential for producing and fabricating components. Among them, machining operations like casting, forging, milling, and especially welding play a critical role. Welding, a key fabrication method, joins metals or thermoplastics by melting the base materials and adding a filler to form a solid joint. Unlike soldering and brazing, welding creates a stronger bond through actual material fusion. It can be performed using different energy sources such as electric arcs, lasers, gas flames, or even friction. Though widely used across industries and environments—including underwater and outer space—welding poses risks like burns, electric shocks, and toxic fumes, requiring strict safety measures. Recent advancements, such as Friction Stir Welding (FSW) and Inertia Friction Welding (IFW), along with automated tools like welding rotators, have improved weld quality, precision, and efficiency. These technologies not only enhance the mechanical strength and surface finish of joints but also meet modern industry demands for higher productivity and superior outcomes.

Calculation

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

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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.

$T = W \times D$

$T = 20 \times 100$

$T = 2000NM\ i.e.\ 2 \times 106\ N.mm$

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

$T = P \times (F + \mu WG)$

$20 \times 106 = P \times (130 + 0.2 \times 20 \times 9.18), P = 118.17WATT$

DESIGN OF WORM WHEEL SHAFT

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]

$= 1.8 \times 800$

$= 144\ N/mm^2$

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

⇒fsmax = 108 N/mm2 $fsmax = 108\ N/mm^2$

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

$POWER = 2\pi NT$

60

$T = 60 \times P$

$2 \times \pi \times N$

= 60 x 120× 12

2 × π × 2

T = 57.29 N-m

T design = 57.29N-m

Shaft in torsional shear failure

$Td = Xfs_{act} \times d^3$

$57.29 \times 103 = \pi/16 \times 108 \times d^3$

$d = 13.92$

from standard 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. $\sigma c = Maximum\ load$

Cross Sectional Area of shaft

$\sigma c = P$

$\pi \times d^2$

4

σc = 1200

0.785 ×152

σc = 7.79 N$/mm^2$

Check For Torsional Shear Failure Of Shaft.

$\tau\ max = {}^{1}/_{2}$

$\sigma c2 + 4(\tau)^2$

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$\tau\ max = {}^{1}/_{2}\, 7.792 + 4 \times (5.40)^2$

τ max = ½ 117.46

$\tau\ max = {}^{1}/_{2}\, 117.46$

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

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

Therefore design of shaft is Safe for torsional shear failure.

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]

$P = XFr + xYfa.$

Where;

P = Equivalent dynamic load, (N)

X = Radial load constant

Fr = Radial load (H)

Y = Axial load contact

In our case; $t/r = 57.29 \times 130/60 = 954.8$

Radial load $Fr = 954.8\ N$

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

$P = 1 \times 954.8 + 1 \times 600 = 1554\ N$

L= (C/p) p

Considering 4000 working hours

L= 60 n L h = 4.5 mre

106

⇒ $34.5 = C^3$

1350

C = 2565N

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

Bill of Materials (BOM)

SR NO.	DESCRIPTION	SIZE	WEIGHT IN KG	QTY	TOTAL WEIGHT IN KG
1	WHEEL OD - 485 mm , ID - 140 mm , 166 mm Thk, INNER ID - 70 mm , DEPTH - 50 mm	As per Drawing		2 nos	
2	M8 Tapped (csk allen bolt), 04 Nos on PCD 160 mm In RHS VIEW				
3	M16 Tapped , 06 Nos on PCD 165 mm & M8 Tapped ,06 Nos on PCD 192 (Allen Bolt)				
4	Spherical Roller Bearing for Wheel	OD 140 , ID 65, 48 mm Thk		04 nos	
5	Shaft for Bearing	Ø70 , 340 mm LG, Machining As per Drawing	10.46	2 nos	20.92

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6	Housing set	154 x 64 x 32 mm Thk, M12 Tapped - 03 nos, As per Drawing	2.52	04 set	10.09
7	Wheel Cover plate	OD 180 , ID 66 x 12 Thk , 04 nos Holes Ø10 on PCD 160 , Machining As per Drawing	1.76	04 nos	7.05

Plates Wheel Details

SR NO.	DESCRIPTION	SIZE	WEIGHT IN KG	QTY	TOTAL WEIGHT IN KG
1	WHEEL COVER PLATE	510 x 390 x 14 THK	22.28	4	89.13
2	WHEEL COVER PLATE	295 x 390 x 16 THK	11.14	2	29.45
3	WHEEL COVER PLATE	295 x 120 x 14 THK	3.96	2	7.93
4	WHEEL BASE PLATE	590 x 445 x 14 THK	15.72	2	31.43
5	SIDE SUPPORT PLATE	695 x 210 x 14 THK	16.93	2	33.87
6	CHANNEL - 01	ISMC 150 x 75 - 700 LG	6.35	4	25.4
7	CHANNEL	ISMC 150 x 75 - 2860 LG	36.854	2	73.71
8	CHANNEL - 01 BASE PLATE	295 x 100 x 14 THK	3.96	2	7.93
9	CHANNEL TOP SUPPORT PLATE	2860 x 100 x 14 THK	38.31	2	76.62
10	CHANNEL INNER SUPPORT PLATE - 01	115 x 430 x 14 THK	4.3	4	64.06
11	CHANNEL INNER SUPPORT PLATE - 02	60 x 140 x 14 THK	0.94	8	7.53

Nut, Bolt & Washer

SR NO.	DESCRIPTION	SIZE	QTY
1	BOLT - M12	60 LG	12 nos
2	CSK ALLEN BOLT - M8		16 nos
3	BOLT - M24	50 LG	16 nos
4	BOLT - M16	100 LG	16 nos

5	NUT - M16		16 nos
6	WASHER - M16		32 nos

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II. CONCLUSION

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.

FUTURE SCOPE

- Integration with robotic welding systems for enhanced automation.
- Al-based process optimization for defect detection and quality control.
- Use of lightweight yet strong materials for better efficiency.
- Expansion into renewable energy, aerospace, and offshore industries.
- Smart welding rotators with self-learning capabilities for real-time adjustments.

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