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Design of profile Gas cutting Machine

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Abstract - *The Gas Profile cutting machine is one of the essential machine tool in the workshop, in this study it has seen that when the high temperature burning flame is brought in contact with the material particle, the material particle melts and the inter-molecular bonding gets rupture to separate the material from each other. Here the design of various components required for gas cutting machine is made & calculations are interpreted in the paper. The proposal of project will thus provide considerable profitability at the shop floor & the firm on the whole.*

Key Words: Gas cutting, profile cutting, electromagnetic profile machine.

1. INTRODUCTION:

The Portable Multipurpose electromagnetic profile machine is one of the essential machine tool in the workshop. Practically all fabrication and metal cutting carry out at the shop floor needs gas cutting for various operation. The Portable Multipurpose electromagnetic profile machine aimed at reducing time required in cutting intricate and curvature shaped profile shapes will be an important step towards minimizing the cycle time of each machine works. It will also reduce fatigue of operator, improving work conditions and accuracy at the shop floor. The proposal project will thus provide considerable profitability at the shop floor & the firm on the whole.

1.1 Importance of Project

Our machine can be modified for intricate curvature profile cutting machine-

Here numbers of work pieces are clamped on the horizontal surface of a circular table, which rotates about a vertical axis, by using separate motor. Due to this arrangement, a continuous loading & unloading of work-pieces along with the profile Tamplet in the form of formed shape may be carried out by the operator, while the gas cutting is in process.

With small changes in the mechanism. It can be used for multiple drilling operations in the field of mass production. It can be used as reaming machine. We can also use potentiometric voltage regulating unit to vary speed of machine. Because for drilling rpm is most important criteria.

1.2 Principle:-

It works on the principle that, X, Y and Z axial movements are Provided to the tool with the help of dual mechanism of lead screw and magnetic roller follower track both excited by the electric motor drive. Both the motions are controlled with the help of motor control electric switch. The motors along with the reduction gear using the lead screw shaft, which is used to provide the cross way motion to the lower header using the guide nut arrangement.

Following are the different components of the machine:-

1) Post frame
2) Bearing bracket
3) Worm and worm gear motor
4) Gas cutting holder
5) Template.

2. MATERIAL & METHODS:

Material selection is important part in manufacturing process the choice of material for engineering purposes is made on basis of factors like availability of material, cost of material, physical & chemical properties of material, mechanical properties of material etc. Also the parameters like strength, stiffness, plasticity, ductility, brightness, hardness, creep, toughness etc. are taken into account. The table no 1 shows Material used for project:

Table -1: shows Material used for project

No	COMPONENTS	MATERIAL	CODE	SPECIFICATION
1	Square Frame	Mild steel	C-25 C-25	40x40x4.6 mm
2	Shaft	Mild steel	C-30	Ø20 x 350 mm rod
3	Guide Pulley	Cast magnet	c.s.-3	Ø 50mm
5	holder	mild steel	C.-30	Ø20 x Ø 40 x 100
6	Motor guide plate	M.S.	C-30	120 x150x8mm plate – 2nos.
7	Support bracket	Plain carbon steel	C-25	15 x15x 5 srips
8	Bearing	Chromium steel	P 204	20 x57x17 single row ball bearing.
9	Gears worm & worm	Gun metal alloy	B-45	10Øx 140 Øx15 blank and 20 Øx 500 mm rod
10	Motor	78 watt	Cast steel & copper	Ø15 mm shaft
11	elemeter	3 v dc		

12	Nut bolt & washer	M.S.	C-30	M8 & M10
13	Electric wires	PVC plastic and copper	cu	18 gauge x 10 meters
14	Pin	Bright steel	C-40	Ø12.5x 50mm
15	angles	m.s.	c-30	40x40x4.6x1000m m length
16	temple	m.s	c-30	

Gas cutting operation: - It is the operation where unwanted and excess quantity material is removed from the imaginary partition to separate the material in to two parts. Simply to cut the thick material which is difficult to hold on the fixture of the power saw cutting machine.

Working principle:-

The working principle of machine is that, when the high temperature burning flame is brought in contact with the material particle, the material particle melts and the inter-molecular bonding gets rupture to separate the material from each other.

And the guiding mechanism to guide the gas tool holder smoothly to follow the required fine curvature called Portable Multipurpose electromagnetic profile machine.

Operation: - The magnet rest strip is the template on which the motor shaft magnetic pulley rests. This template strip can be replaced by the profile shape which we desire to cut. Then the guiding magnetic pulley is rest against the template. The motor switch is made 'ON', the pulley and motor along with the gas holding bracket is guided to follow the required path of profile which is to be cut. Main switch installed on the body of the machine is started, prime mover i.e. motor shaft starts rotating. The magnetic pulley installed on the motor shaft starts rotating.

3.0 RESULT & DISCUSSIONS:

Following different parts we have designed as the part of planning the project before manufacturing.

1) Power transmission unit
2) Arbor design
3) Design of bolt

DESIGN OF PROFIL MOTOR

Power of motor = 10 N- m /s

Rpm of motor = 80 rpm

Output rpm of roller = 3.5rpm

Load on roller = 2 kg = 2 x 9.81 = 19.42 N

Number of stage in gear box = 2

Ratio of gearing =1: 25

Power of motor =P=3.5 watt.

$$P = \frac{2\pi N T}{60}$$

Where, N = Rpm of motor =80

T = Torque transmitted

$$3.5 = \frac{2\pi \times 80 \times T}{60}$$

$$T = 0.41 \text{ N-m}$$

$$T = 410 \text{ N-mm}$$

Calculation of Torque Obtain By Gear Box

In put torque of gear box = 410 N- mm

In put rpm of gear box = 80 rpm

Torque & rpm obtain at first gearing ratio

$$\frac{N1}{N2} = \frac{T2}{T1}$$

$$\frac{80}{x} = \frac{75}{15}$$

$$x = \frac{80 \times 15}{x = 16 \text{ rpm}}$$

N big gear = 16 rpm

Torque & rpm obtain at second gearing ratio

N big gear = 3.2rpm

TORQUE AT OUT PUT OF MOTOR SHAFT GEAR

T shaft = T MOTOR X TOTAL REDUCTION

T shaft = 410 x 25 = 10250 N-mm

So output torque = 10250 N-mm

Output rpm = 3.2 rpm

Calculation of minimum torque required to move the roller shaft

We know

Torque = force x distance

Torque = force x radius of roller

Torque = 410 x 20 /2

Torque = 4100 N –mm

Considering 30% over load

Torque = 4100 x 1.3 N –mm

Torque = 5330 N –mm

As output torque is much more than required torque value so design of gearing system is safe.

4) Design of welded joint:-

Checking the strength of the welded joints for safety

The transverse fillet weld welds the side plate and the edge stiffness plates,

The maximum load which the plate can carry for transverse fillet weld is

P = 0.707 x S x L x ft

Where, S = factor of safety, L = contact length = 50mm

The load of shear along with the friction is 50 kg = 500N

Hence, 500 = 0.707 x 5 x 50 x ft

Hence let us find the safe value of 'ft'

$$\text{Therefore ft} = \frac{500}{0.707 \times 5 \times 50}$$

ft = 2.88 N/mm2

Since the calculated value of the tensile load is very smaller than the permissible value as ft=56 N/mm2. Hence welded joint is safe.

Assumptions

Material C45 – 0.45 % carbon

σ ut = 320 N/mm2

FOS = 2

Now,

σ t = σ b = σ ultimate / FOS = 320/2 = 160 N/mm2.

σ s = σ t / 2 = 160/2 = 80 N/mm2

5) DESIGN OF ARM:-

Load = 15 kg = 150 N
Length = 275 + 220 = 495 mm
M = 150 x 495 = 74250 N-mm
Z = π/32 x d3 = 3.142/ 32 x 203 = 785 mm3
σ b = M / Z = 74250 / 785 = 94.58 N/mm2
σ b INDUCED < σ b ALLOWED
94.58 N/mm2 < 160 N/mm2

DESIGNING OF SHAFT

Torque transmitted by shaft,

T = F x R
= 10 x 275
= 2750 N-mm.

T = π/16 x τ x d3
Therefore, 2750 = π /16 x 203 x
σ s = 2750 x 16/3.142 x 203
σ s = 1.75

σ b INDUCED < σ b ALLOWED

1.75 N/mm2 < 80 N/mm2
By using 20mm shaft, our shaft design is safe.
For 20mm Shaft diameter we take standard breaking no. P204
P=pedestal bearing
2=spherical ball or deep groove ball bearing
=04=5 * 4 = 20mm
Bore diameter of bearing.

1.Design of Welded Joint on shaft

Perimeter = π x dia = 3.142 x 20 = 62.83 mm
Hence, selecting weld size = 3.4 mm
Area of Weld = 0.707 x Weld Size x R
= 0.707 x 3.4 x π x 20
= 139 mm2

Force Exerted = 30 x 9.81
= 300 N
Stress induced = Force Exerted / Area of Weld
= 300 / 142.15
= 2.11 N/mm2

For filler weld:
Maximum Allowable Stress for Welded Joints = 210 Kgf/ cm2
= 21 N/mm2

Hence safe.

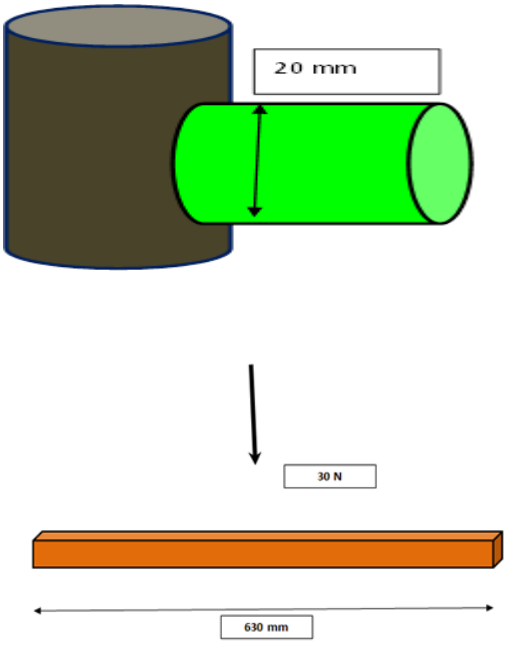

Fig: 1 showing some design components.

M = W L / 4 = 30 X 630/ 4 = 4725 N/mm
Z = B3 – b3 / 6 = 323 - 263 / 6 = 2532 mm3
σ b = M / Z
σ b = 4275 / 2532 = 1.86 N/mm2
σ b INDUCED < σ b ALLOWED

1.86 N/mm2 < 160 N/mm2

MANUFACTURING

The process of conversion of raw material in to finished products using the three resources as Man, machine and finished sub-components. Manufacturing is the term by which we transform resource inputs to create Useful goods and services as outputs. Manufacturing can also be said as an intentional act of producing something useful.

It's the phase after the design. Hence referring to the values we will plan. The numerous processes using the following machines:-

i) Universal lathe
ii) Milling machine
iii) Grinding machine
iv) Power saw
v) Drill machine
vi) Electric arc welding machine

4. CONCLUSIONS AND FUTURE SCOPE

Since; old age man is constantly trying to gain more and more comfortable. Man is always trying to develop more and more modified technique with increasing the aesthetic look and economic concern. Hence there is always more and more scope towards whatever he might have created of course after having the experience of the presently manufactured things. But being the Engineers and having the ability to think and plan. But due to some time constraints, and also due to lack of funds, we only have thought and put in the report the following future modifications:-

1) The arms can be installed with the hydraulic cylinders and the hydraulic microprocessor controlled pump can regulate and control the actuation of the cylinder and thus the arm can be made to operate hydraulically.

2) Installing the unit on the circular platform it can be made swiveling type by installing the platform by the cross roads and bearing arrangement.

3) The swiveling platform can be made to rotate gradually by installing the gear box installed with the motor or using high torque stepper motor. Instead of the gas cutting machine holder by installing extra holding attachment, it can be used as the grinding cum boring cum drilling machine. Thus it can be made multipurpose or all in-one type.

4) The longitudinal arm can be made to reciprocate to and fro and along the cross direction pneumatically operated or hydraulic operated type by installing the rack and pinion arrangement and hand lever by hydraulic cylinder and the pneumatic cylinder and direction control valve.

5) It can be made hydraulic power operated by installing the gear oil pump at the place of the hand operated power cylinder inlet port valve. It can be made as polishing machine also by replacing the holder by the polishing brushes.

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