ANALYSIS AND FABRICATION OF AN SEMI–AUTOMATIC BRUSH MAKING MACHINE

[1]Bhunesh Rathod, [2]Dharamveer Vishwakarma, [3]Gaurav Dubey, [4]Harsh Makwana, [5]Mr. Rajesh Kumar
Department of mechanical engineering ARMIET College of engineering Thane, India[1,2,3,4], Department of mechanical engineering ARMIET College of engineering ARMIET College of engineering Thane, India[5]
Rathobhunesh29@gmail.com[1],dharmveerv82@gmail.com[2], dubeygaurav52@gmail.com[3], Harshm890@gmail.com[4], mechanical.hod2017@gmail.com[5]

ABSTRACT

Man is a creature of creating nature having great imagination power. So human being is a creature, who found luxurious life for himself by discovering the truth of nature by their logical aptitude of thinking. It can be concluded that any job which is selected for project would be challenging one, simple in operation, and very economical to use. Then the idea of 'design &manufacturing of brush making machine' comes forward. The device which fabricated is nearly portable, simple in operation and gives output results in very short time. The main feature of this machine is that it needs only one person for whole operation.

Keywords: C-frame, L-shape angel((90 degree), Bearings,Battery, Pmdc motor, Drill chuck, Nylon strips, Aluminum wire,

INTRODUCTION

A wire bush is a tool consisting of a brush hose bristle are made of wire, most often steel wire and nylons. The steel used is generally a medium- to high-carbon variety and very hard and springy.

Other wire brushes feature bristles made from brass or stainless steel, depending on application. Wires in a wire brush can held together by epoxy, staples, or other binding.

Wires brushes usually either have a handle of wood or plastic or are formed in to a wheel for use on angle grinders, bench grinders, pistol-grip drill motors, or other power tools

FIG :- 1

As the brushes are extensively used in daily life of human being the production of low brush becomes crucial. Mainly these are used for domestic purpose such as washing cans, boilers etc. in small boiler plants, removing of slag or deposition of shells can be easily done by these brushes.

Considering the current Indian industries review there are many small scale industries. Because of low cost of brush making machine an ordinary man can set a small scale industry. It can be easily affordable for him. The raw material required for these brush is wire and threads. Hence one can run the plant at low initial cost.

Cylinder brushes are used for conveyor cleaning or wide face brushing of a product substrate on a production line. Spiral wound cylinder brushes are based on our strip brush technology, and are individually designed to

meet the customer's specifications. Paddle wheel style conveyor cleaning brushes also utilize our strip brush technology and offer a customer- refillable brush core.Cylinder Brush Styles, Cylindrical conveyor cleaning brushes can be filled with any of our selection of materials, including steel wire, stainless steel wire, brass wire, bronze wire, or other more specialized wire types, nylon 6-6 or 6-12, abrasive nylon, polypropylene, horsehair, tampico fiber, and other materials on request

.OBJECTIVE

- To make dual operation machine, Motorize and manually
- To make such a machine which is very simple to use.
- The Consumption of electricity should be very low.
- It should be very much affordable to all class of people.
- This machine should be operated by any gender and any age.
- It should generate employment in rural areas.

PROBLEM DEFINATION

- The Existing machine available in market is fully automated.
- This machine is useful for mass production
- The cost and quantity of production rate of machine is very high
- The space required for this machine is also very big
- Three phase power supply is required for this automated machine
- The machine is basically designed for industrial use
- It saves time and enhances productivity at lowest cost
- The manual brush making machine designed for less production and manual operation without electricity

.BASIC WORKING PRINCIPLE AND OPERATION PRINCIPLE

The main principle used in this brush making machine is twisting of wire.

(the wire is bent at middle and it becomes two wires.)

OPERATION

Operation of machine is very simple. It can make round brush of various sizes and shapes. One wire is bent at middle it is hooked at the bent portion at one of machine and held in shaft by screw.

When shaft rotates through 108° one twist is given to the wire. in this way the process is repeated. Motion is given to shaft by means of handle drive from manually and by motor also for making round, wire of various sizes and diameters and plastic material are required:

To manufacture brushes on this machine operator has to following steps: -

1. First operation is to stretch the wire.
2. The stretched wire is cut in required sizes of brush and is bent from center.
3. The nylon bristles material available is long in length so these are also cut in required size.
4. Then they are placed in the material stand and stand is slightly tightened by screws.
5. The bent wire is placed in horizontal tie bar and tied in it such the stud. The wire is then fixed in the jaws of revolving chuck with the help of nut.

6. While the chuck (angular shaft) is rotating the wire must not come out from it. so the wire must be properly fixed.
7. After this preparation machine is started with the help of handle.
8. When the machine starts the shafts in which wire is fixed rotates and while rotating it gives twist to wire.
9. While twisting operation the nylon material between the wires also twisted with the wire.
10. The twisting is continued up to next end of wire come, where the wire is tied in tie plate. This process of twisting is complete in two minutes. So in 8 hours of working near about 95 to 110 brushes can be manufactured.

METHODOLOGY

FEATURES OF M/C AND USES OF BRUSH:

- **FEATURES:**

  Round brush making has reliable operation due to some following features.

- **LESS TIME:**

  As the operation of brush making is very simple. so it requires less manufacturing time. A single man can make 160 to 200 brushes per day.

FIG 2.1

(COMMON BRUSH)

- **LESS MAN POWER:**

  For operating machine less man power is required having minimum skills. Once the nylon and wire are arranged in stand the function of operator is just to start the machine and after completion of twisting off the machine. When twisting is completed the nylon comes into wire and brush is ready.

- **LESS MAINTENANCE COST:**

  As the frictional parts in the machine are less maintenance is also less. There is only need to lubricate gear box and bearing only.

- **LESS COST:**

  As the operating principle of machine is so simple and other construction is so easy that overall cost of machine becomes less. hence it is easily affordable to small scale industry.

- **LESS FLOOR SPACE:**

  Hence we can put this machine anywhere and also it is compact hence less floor space is needed.

LITERATURE REVIEW

A brush is a common tool with bristles, wire or other filaments. It is used for cleaning, grooming hair, make up, painting, surface finishing and for many other purposes. It is one of the most basic and versatile tools in use today, and the average household may contain several dozen varieties. They generally consist of a handle or block to which filaments are affixed either parallel- or perpendicular-wise, depending on the way the brush is to be gripped during use. The material of both the block and bristles or filaments is chosen to withstand hazards of its application, such as corrosive chemicals, heat or abrasion

MANUFACTURE

A common way of setting the bristles, brush filaments, in the brush is the staple or anchor set brush in which the filament is forced with a staple by the middle into a hole with a special driver and held there by the pressure against all of the walls of the hole and the portions of the staple nailed to the bottom of the hole. The staple can be replaced with a kind of anchor, which is a piece of rectangular profile wire that is anchored to the wall of the hole, like in most toothbrushes. Another way to attach the bristles to the surface can be found in a fused brush, in which instead of being inserted into a hole, a plastic fibre is welded to another plastic surface, giving the option to use different diameters of bristles in the same brush.

Configurations include twisted-in wire (e.g. bottle brushes), cylinders and disks (with bristles spread in one face or radially).

Removal of material (cleaning and polishing)

FIG 2.2(Assortment of cleaning brushes, including bottle brushes)

The action of these brushes is mainly in the tip of each flexible bristle which dislodges particles of matter.

- Tooth brush
- Floor brush (yard brush, yard broom, hand brush)
- Scrubber

- Shoe-polish brush (buffer)
- Curling brush (sport)
- Nailbrush
- Milk-churn brush
- Lavatory brush (toilet brush or slang bog brush

FIG 2.3

(A clothes brush)

- Clothes brush, a brush for removing detritritus from clothing
- Chip brush
- Car-wash brush

CALCULATION

Material = C 45 (mild steel)

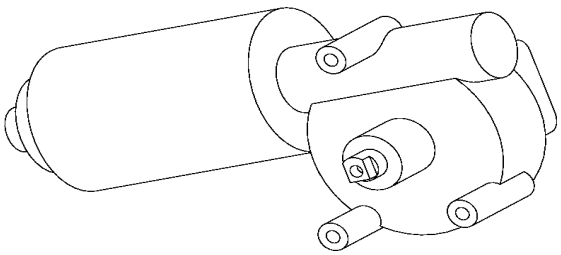
$\sigma_t = \sigma_b = 540\ N/mm^2$

$\sigma_s = 0.5\ \sigma_t$

$= 0.5 \times 540$

$= 270\ N/mm^2$

1. **Design calculation of motor**



1. **Torque generated by motor**

Power of Shaft = P = 15 watt

Power transmitted by shaft,

$$P = \frac{2 \pi N T}{\text{----------}}$$

60

Where, N→ Rpm of motor shaft = 24

T →Torque transmitted

$$15 = \frac{2\pi \times 24 \times T}{60} \times 10^3$$

T = 5967N-mm

2. Design of chain:

NUMBER OF CHAIN

Now, Chain Sprocket of 36 And 36 Teeth Is Mounted

Same number of teeth are used so torque and rpm will be same.

The cycle chain and sprocket is used which are designed for 150kg load, hence it will be safe

So, Torque transmitted,

1. Force generated by motor

T = Force × radius of free wheel

$$5967 = F \times 37.5$$

$$F = 159.12 \text{ N}$$

$$F = \frac{159.12 \text{ N}}{9.81}$$

F = 16.21 Kg

This is the force generated by free wheel for twisting the wires

3. BEARING SELECTION

1. BEARING FOR ANGULAR SHAFT:

Shaft Diameter = 20mm

Hence, Inner Diameter of Bearing (d) = 20mm

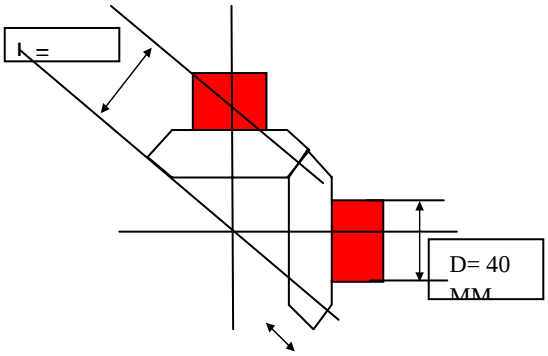
Outer Diameter of Bearing (D) = 48mm

Face Width (B) = 12mm

Hence, Selection of Bearing from Manufacturers Catalog (SKF Bearings Ltd.)For Above Specifications of Shaft

Bearing No.:- 6204

4. DESIGN OF BEVEL GEARS



A pair of teeth of bevel gears mounted, which are interesting at right angles, consists of 16 teeth on both the pinion gears.

Wt = (fo x Cv) b x 3.14 x m x y' (L – B / L)

(REFER MACHINE DESIGN BY R.S. KHURMI & J.K.GUPTA pg. no 880)

Fog = Fop = Allowable static stress = 85 N /mm^2

v = Peripheral speed in m/sec.

v = 3.14 x D x N / 60

v = 3.14 x m x T x N / 60

v = 3.14 x m x 16 x 1000 / 60

v = 837 mm/sec

v = 0.837 mm/sec

Cv = velocity factor

Cv = 6 / (6 + v)

Cv = 6 / (6 + 2 m)

b = face width = 16 mm

m = module

L = slant height of pitch cone. = 47 mm L = slant height of pitch cone. = 47 mm

y' = tooth form factor

θp1 = tan^{-1} (1/V.R) = tan^{-1} (Tp/Tg) = tan^{-1} (16/16) = 45

θp2 = θps- θp1 =90 – 45 = 45

So formative number of teeth for the gear

Teg = Tg . sec θp2 = 16 x 1 = 16

y'G = 0.124 – 0.684 / Teg

y'G = 0.124 – 0.684 / 16

y'G = 0.08125

Fog x y'G = 85 x 0.08125 = 6.90

Also for pinion

Fop x y'P = 85 x 0.08125 = 6.90

Since the product of Fog x y'G & Fop x y'P is same so design should be

based on gear which is same for pinion.

Mean Radius (Rm):-

Rm = (L-b/2) Sin θp

θP = 45^0

L = 47mm

B = 16 mm

Rm = (47-16/2) sin 45

=27.57 mm

Tangential force applied at bevel gear shaft end is 1 kg = 10 N (approximate)

Torque $T = f \times l = 10 \times 100 = 1000$ *N- mm*

Tangential Force bearing capacity of bevel gear

$Wt = (fo \times Cv)\, b \times 3.14 \times m \times y' (L - B / L)$

Wt = (85 x 6/(6+2x 2.5)) 16 x 3.14 x 2.5 x 0.08125 (47 – 16 / 47)

Wt = 341.83 N

Wt = 34.84 kg

As Tangential Force bearing capacity of bevel gear is more than applied force thusdesign of bevel gear is safe

DESIGN OF BEVEL GEAR SHAFT

SAE 1040 SAE (SOCIETY OF AUTOMOBILE ENGENEERING)

10 =Plain carbon steel

40 = 0.4 % of carbon

Velocity Ratio (V.R.) = Np /NG

=16/16

= 1

θp_1 = $\tan^{-1}$ (1 / V.R.)

= $\tan^{-1}$ (1/1)

=45^0

right hand side horiz load $W_{RH} = W_{RV}$ right hand side ANGULAR. Load otherwise it will be ablonged.

$WT = W_N \times \cos\Phi$ (REFER MACHINE DESIGN BY R.S. KHURMI &J.K.GUPTA pg.no 881)

Φ → Pressure Angle

10 = W_N cos 20

W_N = 10.64 N

W_R = $W_N \sin\Phi$

= 10.64 x sin 20

= 3.6 N

W_{RH} = W_R x sin θp

= 3.6 x sin 45

= 2.54 N

W_{RV} is also = 2.54 N

Bending moment due to W_{RH} and W_{RV}

M_1 = W_{RV} x Overhang – W_{RH} x Rm

Overhang = 80

M_1 = 2.54 x 80 –2.54 x 27.57

= 133.17 N – mm

M_1 = 2.54 x 80 –2.54 x 27.57

= 133.17 N – mm

M = $\sqrt{M_1^2 + M_2^2}$

$\sqrt{(133.17)^2 + (800)^2}$

= 811 N-mm

Equivalent Torque

= $\sqrt{Te M^2 + T^2}$

= $\sqrt{(811)^2 + (1000)^2}$

=1287.52 N-MM

We know that

Te = π/16 x dp^3 x fs

Select permissible shear stress fs from design data book

Fs = 240 N/mm^2

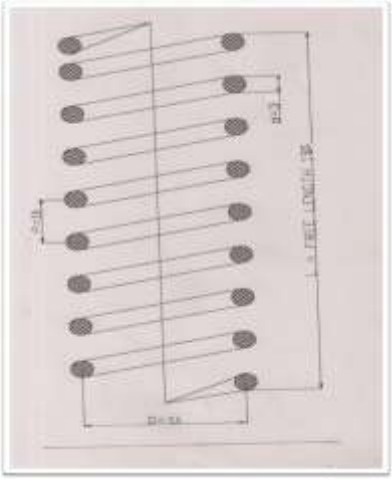
Therefore, 1287.52 = π /16 x dp^3 x 60

D = 4.78 mm

Consider factor of safety for shaft dia is2

Dactual = D x 2 = 4.78 x 2 = 9.56 mm

We select dia. of bevel gear shaft = 9.56 =10 mm



5. SPRING DESIGN

Data of Standard Spring Used:

P = Axial Load = 300 N

D = Mean Diameter of Coil = 28mm = 0.028m

d = Diameter of Spring Wire = 3mm = 0.003m

N = No. Of Active Coils = 11
□□□□Deflection of spring =5
C = Spring index = 8
We Know That Wahl's Stress Factor,

$$K = \frac{4C-1}{4C-4} + \frac{0.165}{C}$$

$$= \frac{4 \times 9 - 1}{4 \times 9 - 4} + \frac{0.165}{9}$$

$$= \frac{36-1}{36-4} + \frac{0.165}{9} = 1.108$$

Maximum Shear Stress (F_s) =

$$410 = K \times \frac{8WC}{□ d^2}$$

$$210 = 1.108 \times \frac{8 \times 135 \times 8}{□ d^2}$$

$$d^2 = \frac{1.180 \times 8 \times 135 \times 8}{□ \times 410}$$

$d^2 = 7.432$
d = 2.72 Say d = 3mm
d = 3mm
D = d x c

D = 3 x8 mm=24 say D =28
Now,
We have to find out no. of active coil
We know that compression of spring

$$\delta = \frac{8\,WC^3n}{Gd} \quad \text{.....}$$

Where G = Modulus Of Rigidity

$$\delta = \frac{8 \text{ X } 40 \text{ X } 8^3 \text{Xn}}{8x10^3x3} \quad \text{.....}$$

$$n = \frac{84 \text{ X}10^3\text{X } 5 \text{ X } 3}{8 \text{ X } 40 \text{ X } 8^3} \quad \text{.....}$$

n = 8.691
Say n = 9 mm
Total No. Of Coils = n+2 (With Grounded Ends)
N = 9+2
N = 11
Now Free Length of Spring 'L' Is,
We Know That,

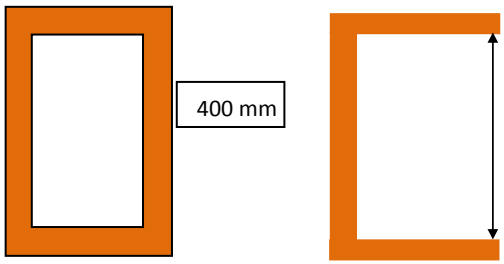
L = N.d + d (Max) + 0.015 δ
L = 11 x3 + 95 + 0.15x5
L = 135 mm
Say L = 135 mm
Finding Pitch of spring,

$$P = \frac{\text{Free Length}}{N-1} = \frac{135}{10} \quad \text{.....}$$

P = 13.5 mm

Say P = 14 mm

DESIGN OF C-SECTION



MS C-CHANNEL FRAME

Material: - M.S. C45

The vertical column channel is subjected to bending stress

Stress given by => M/I = fb / y

In above equation first we will find the moment of inertia about x and y Axis and takethe minimum moment of inertia considering the channel of ISLC 75 x 40 sizes.

We know the channel is subject to axial compressive load

In column section the maximum bending moment occurs at channel of section

M = W x L/4 = 3141 x 310/4 = 243427.5 N-mm

We know

Fb = M/Z

Z $= \frac{BH^2}{6} - \frac{bh^3}{6H}$

= $75x40^2/6 - 65x35^3/6x75$

= 20000-6193

=13807 mm^3

fb induced = M/Z =

fb induced =243427/13807 = 17.6 N/mm^2

As induced stress value is less than allowable stress value design is safe.

Design of fillet 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 L

= 0.707 x 3.4 x π x 20

= 139 mm^2

Force Exerted = 30 x 9.81

= 300 N

Stress induced = Force Exerted / Area of Weld

= 300 / 142.15

= 2.11 N/mm^2

For filler weld :

Maximum Allowable Stress for Welded Joints = 210 Kgf/ cm^2

= 21 N/mm^2

Hence safe.

CONCLUSION

The designed machine is both manually operated and can be operated by using battery or electricity. The design machine is low cost and affordable by poor person to start his own business with very low budget. The required raw material is only metal wire and bristles so the running cost of machine is very low, also the selling price of product is quite high as compared to raw material which is done in the study of market survey. The cost of making a single brush is comparatively low to the selling price. The machine is operated by any age group and requires very less power if rotated by hand also. The machine maintenance cost is very low because very less components are used and all standard component are used in manufacturing of the machine. The spare parts are easily available with very low cost. The machine size is also compact so it can fit in any home it does not require special shop the machine working is very silent it does not create any noise pollution for any kind of pollution.

The Bottle and beverage equipment cleaning brushes are essential products for busy coffee shops, diners, and restaurants bottle brush making equipment

- Wide-face cylinder brushes for conveyor cleaning, surface preparation, surface finishing, scrubbing, dusting, applying, and polishing.
- In addition, Spiral Brushes Inc. offers an extensive line of stock and custom configurable industrial power brushes and maintenance brushes. These include wheel brushes, cup brushes, end brushes, twisted-knot brushes, tube brushes, and various maintenance style brushes. Wire brushes are available filled with carbon steel, stainless steel, brass or bronze wire. Most styles of power brushes are also available with synthetic fill materials, such as nylon, abrasive nylon, or polypropylene, as well as horsehair and Tampico fiber. Other more exotic types of wire brushes and special materials brushes are available for specific applications.

REFERENCES

- Bhandari V.B., “Design Of Machine Elements”, Tata Magraw Hill Publishing Company Ltd., New Delhi. 8Th Reprint 19
- New Nashikworkshop,Alephata .
- Design of Machine Element (Niraliprakashan)
- Production Technology (Niraliprakashan)
- http://www.wiki.pedia .co.in/