Design and Development of Low Cost Shoe Polishing Machine

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Abstract— In this work, it is proposed to design a low cost shoe polishing machine, incorporating coin mechanism and shoe polish dispenser with this machine. As everyone including school college students, professionals and people attending functions want to wear a shoe which is shiny. Objectives of the project are to provide cost effective, ergonomically designed, reduce time consumption & produce quality shine product to the customer.

Key words: Single Brush Shoe, Low Cost Shoe Polishing Machine

I. INTRODUCTION

In 1945, the first hotel shoe shine machine was built and it went into series production soon after. Today, the production range is very broad ranging from a practical smaller shoe shine machine for domestic use up to exclusive models for hotels.

The first impression is the most important one in corporate world.

That's the reason, in many cases, it is still important to dress more professionally, regardless of the work environment. In this regard shoe polishing and good shoe shining plays an important role.

The draw back in manual shoe polishing is that it damages the surface of leather, there by decrease the life of the leather shoes. Also polishing consumes too much time and takes too much human effort. On other hand the draw backs in machines available in market do not produce a job equivalent to the results obtained by cleaning and polishing shoes by hand.

In order to overcome these difficulties an ergonomically designed and cost effective shoe polishing machine is essential for all ages in order to work effectively with high productivity and produce quality shoe polishing.

II. CONCEPT DEVELOPMENT

Concept development process is the sequence of steps or activities which an enterprise employs to conceive, design, and commercialize a product.

The Concept development process includes the following activities as shown in block diagram,

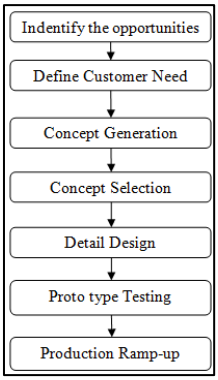

Fig. 1: Concept development process block diagram

III. CONCEPT GENERATION

A. *Concept 1*

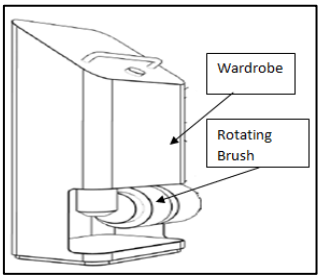

Fig. 2: First conceptual model (A) Single brush shoe polishing machine with a wardrobe for storing the polish

In this concept the shoe polish is stored in the wardrobe above the rotating brushes .Motor is assembled just below the wardrobe and connected through the belt drive. When motor is switched on the motor rotates the polishing brush. The customer has to rotate the leg to polish the different parts of the shoe.

B. *Concept 2*

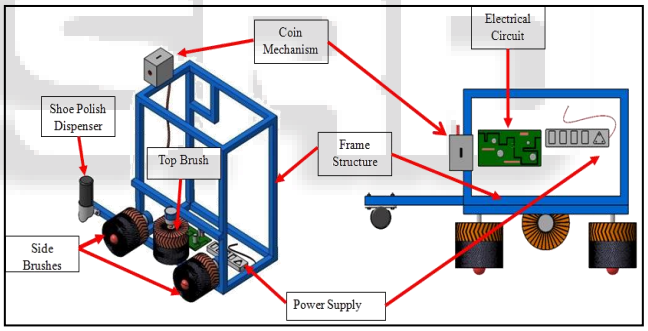

Fig. 3: Second conceptual model (B) Top and side brush shoe polishing machine with coin mechanism

In this concept top and side brushes are mounted individual motor shafts as shown in the figure 3.2. 8bit controller will be used for delay generation, 8-bit microcontroller means MC 8051 can Read, Write and Process 8 bit data. MC 8051 microcontroller has two hardware pins T0 and T1a for delay generation (timer) using these pins the microcontroller is programmed for 134 seconds for every shoe polishing operation. The shoe polishing top and side brushes starts when a coin is inserted at the coin insertion slot at the input stage.

The concept B is designed in order to overcome the disadvantages in manual shoe polishing and shoe polishing machines available in the market.

The machine is incorporated with top and side brushes to cover the whole surface and produce quality shoe shining compared to the other products available in the market. Also the product has reduces time consumption and totally eliminates the manual effort. The machine has completely eliminated the need for applying polish by introducing shoe polishing dispenser. The shoe polishing top

and side brushes starts when a coin is inserted at the coin insertion slot at the input stage.

IV. DESIGN OF MACHINE

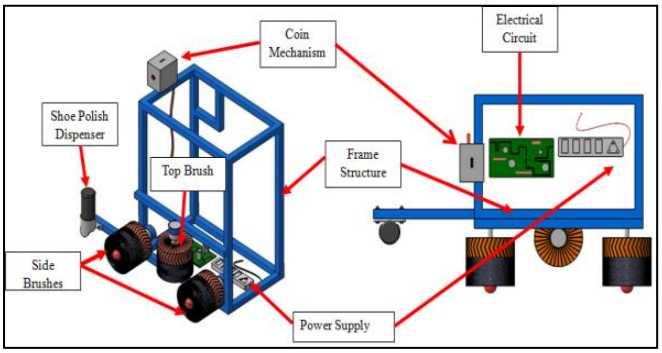

Fig. 4: Part details of Shoe polishing machine

V. DESIGN CALCULATIONS

Consider a shaft rotating at a speed of 1275rpm having power of 0.1HP. We have to calculate the diameter of the shaft.

The load W is taken as negligible. Since it has negligible effect on shaft.

W- Weight of Shoe cleaning brush& polishing brush.

Solution: The given N=1275RPM P=0.1HP

A. Step- 1: Permissible shear stress

Assume SAE 1030 from design data book as per ASME $SY_t = 300\ N/mm^2$, taking Fs=3

$$\tau = \frac{sy_s}{FS} = \frac{0.5SY_t}{3} = \frac{0.5 \times 300}{3}$$

$$\tau = 50\ \text{N/mm}^2$$

B. Step-2: Torsional Moment T

Conversion of power from HP to W

P = 0.1HP = 745.69W×0.1 = 74.56 W

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

$$T = \frac{60 \times P}{2 \times \pi \times 1275}$$

$$T = \frac{60 \times 74.56}{2 \times \pi \times 1275}$$

$$T = 555.5\ \text{N} - \text{mm}$$

C. Step-3: Diameter of Shaft

We know that $r = \frac{d}{2}$

From Torsion Equation

$$\frac{T}{J} = \frac{\tau}{r}$$

$$T = \frac{\tau \times \pi \times d^3}{16}$$

$$d = \sqrt[3]{\frac{16 \times 555.5}{\pi \times 50}}$$

d=4.8mm

Selected diameter of shaft = 8mm is greater than the calculated diameter =4.8mm. Hence the design is safe.

1) Design for Weld Strength

Fillet welds are usually fail in shear, where the shear failure occurs along a plane through the throat of the weld.

Shaft is SAE1030 (steel)

Thus Density ρ = 7.8 gm\cc

$$\rho = \frac{7.8 \times 10^{-3}}{(10)^3}$$

$$\rho = 7.8 \times 10^{-6}\ \text{kg/mm}^3$$

$$\rho = \frac{m}{v}$$

m = ρ v

$= 7.8 \times 10^{-6}$x (AxL)

$=7.8 \times 10^{-6} \times (\frac{\pi(8^2)}{4}$x220)

m =0.087kg

Mass of all 3 shaft = 87 x 3 = 0.261kg

Mass of all 3 motor = 250 x 3 =0.75 kg

Mass of a Person = 80 = 80 kg

Total mass = m =261gm+750gm+80Kg=81.01kg

Total Mass P = W=81.01 x 9.81= 794.71 N

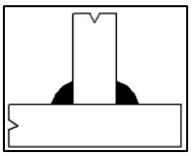

Fig. 5: Welding

Weld Thickness=4mm

Weld Length=25mm

From DDHB Vol-1[Dr. K Lingaiah]

$$\tau = \frac{P}{0.707\ w\ l}$$

$$\tau = \frac{794.71}{0.707\ \times 4 \times 50}$$

$$\tau = 5.62\ N/mm^2 \leq 50\ N/mm^2$$

Therefore Strength of Weld is Safe.

VI. CONCLUSIONS

Product found more ergonomic, cost effective and polishes the whole surface of the shoe compared to the other products available in the market. Quality of shoe shining has improved as top and two side brushes are provided in the machine .Also the product has reduced time consumption by 50% and totally eliminated the manual effort. The machine has completely eliminated the need for applying polish by introducing shoe polishing dispenser. The other advantage is a coin mechanism is added so that shoe polishing machine can be used for commercial purposes in places like super markets, airports, restaurants, educational institutions and hospitals as a vending machine.

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