

Development and Study of Universal Fish Cutting Apparatus

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Abstract: Fish cutting and grading is considered as one of the most important operation during pre-processing of fish. Generally descaled fishes are cut in to a piece which is suitable for cooking. This process is carried out traditionally using knives and it is also a tedious task which requires excess time and also causes harm and wound to the hands of person involved. The machine has been developed with the concept and combination of detecting the quality, cutting and cleaning the fish. Designing of fish cutting is the best way for reducing the human work and also hygienic handling of fish. The feed adjuster is used to maintain the pieces in an even thickness. In order to obtain higher production rate multiple work centers can be installed using single drive, in our setup we have implemented dual drive centers for performing fish cutting operation, handling efficiency of is high when compared with existing systems available in markets.

Keywords: Fish cutting, Multi blade, SKF6302, Pulley, Multi-tasking.

1. Introduction

Based on the bibliographic studies, we notice that the basic method of fish cutting is the traditional method using knives and skilled human labor. So as a mean to change this we planned to build a universal fish cutting apparatus that can be used anywhere and by anyone to descale and cut any type of fish as per requirement and to check its efficiency in the market. The process of cutting and cleaning are using a knife and involve more workers. However, with modern technology these processes can be made faster by using specialized machines. The product is dependent on the demand and the machine is designed to produce the product according to the current demand.

A. The Necessity of the Study

The market study on the necessity of skilled labor for the traditional fish cutting process conducted at sathyamangalam market among a group of fish stall owners:

- to collect information on the current procedures and the limitations of the same;
- to identify the current requirements, disagreements and future needs of the current beneficiaries in order to improve the activity of the companies and to anticipate the future trend in their production;
- to identify new beneficiaries;

- to test the reaction of the industrial consumers to such actions, which are usually seen in a structured market economy.

2. Design of the Component

A. SolidWorks

SolidWorks is a solid modeling computer-aided design and computer-aided engineering computer program published by Dassault Systèmes, that runs primarily on Microsoft Windows. While it is possible to run SolidWorks on an Intel-based Mac with Windows installed, the application's developer recommends against this.

1) Design-1

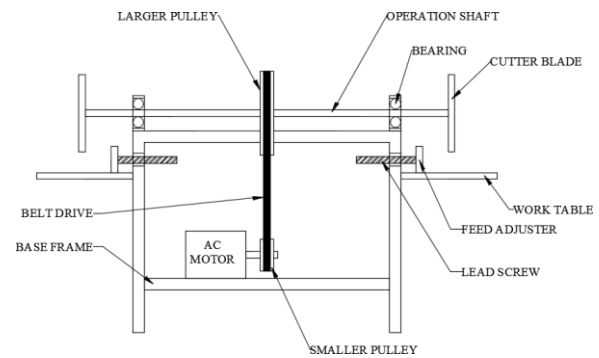


Fig. 1. 2D design

2) Design-2

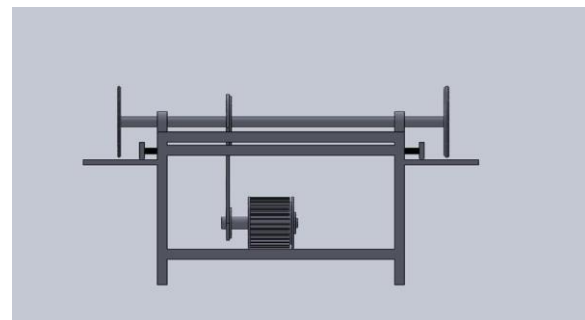


Fig. 2. 3D front view

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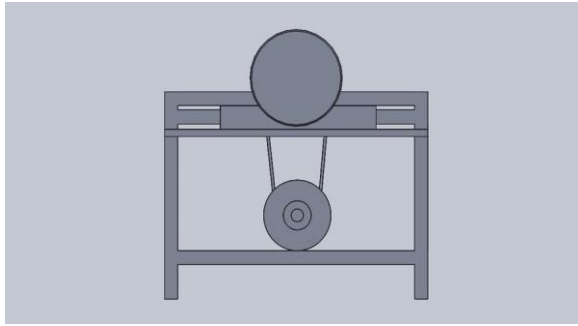


Fig. 3. 3D side view

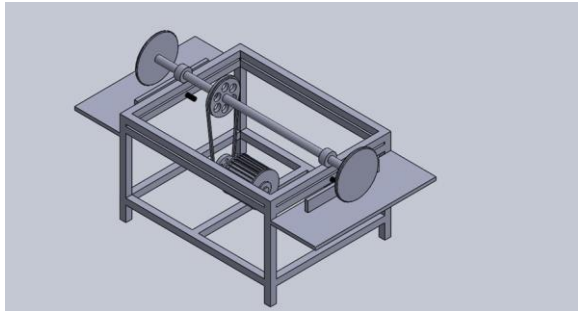


Fig. 4. 3D top view

3. Formula Used for Design

The values that need to be calculated while designing this product are driven pulley diameter, the rpm of the blade and the belt length for a smooth and efficient transmission and working of the thus manufactured machine.

Formula to find the diameter of the driven pulley

$$d2 = n1 d1 / n2$$

$n1$ = speed of motor

$d1$ = diameter of pulley attached to the motor,

$n2$ = speed of the shaft

We already know that the speed of the blade required to cut the fish smoothly is in the range of 350-550rpm. Hence we take the value of $n2$ to be 400 rpm. The speed of the motor is 1440 rpm and the diameter of the pulley connected to the motor is 25mm.

By applying all the values,

$$d2 = 1440 * 25 / 400$$

$$d2 = 36000 / 400$$

$$d2 = 90mm$$

Therefore we have found out the diameter of the pulley that is to be fitted at the shaft for the required speed.

The belt length required for efficient transmission of power

$$L = (d1 + d2) * 0.5 + (2 * x) + ((d2 - d1)^2) / (4 * x)$$

$d1$ = pulley1.

diameter,
 $d2$ = pulley2,
 diameter,
 x = center distance between pulleys,
 L = belt length

$$L = (25 + 90) * 0.5 + (2 * 325) + ((90 - 25)^2) / (4 * 325)$$

$$L = (115) * 0.5 + (650) + (4225 / 1300)$$

$$L = 833.5mm$$

Thus the length of the belt required for efficient transmission is 833mm. All the other dimensions are as follows,

Length of the machine = 645mm

Height of the machine = 625mm

Breadth of the machine = 400mm

Diameter of the blades = 125mm

Distance between the blades = 750mm.

Driver pulley diameter = 25mm

Driven pulley diameter = 90mm

Distance between the pulleys = 325mm.

Bearing calculation:

The Radial load = 700 N

Thrust load = 300 N

Service factor(s) = 1.2

Usage time = 35 hrs/week

usage = 3 years

n = 500 Rpm

Shaft diameter = 15mm

Bearing Life:

Bearing life = $35 \times 3 \times 52 = 5460$ hrs.

Equivalent Load = $P = (X Fr + y F a) S$

Factor of load = 0.56

Factor of thrust = 1.4

(FROM PSGDB 4.4 AND 4.6)

$P = (0.56 \times 700 + 1.4 \times 300) 1.2 = 812$ N

Loading ratio = C/P (FROM PSGDB 4.14)

$= 6.2 \ C = 6.2 \times P = 6.2 \times 812$

$= 5034$ N $C = 880$ Kg $f = 8800$ N

Since $C = 8800 > 5034$, the Selected bearing is suitable.

Selected bearing = SKF6302.

A. Construction

The base frame which acts a bed of machine is fabricated with the help of square tubes and channels by metal cutting and metal joining process called welding. An AC motor is mounted rigidly to the base frame, whose output shaft is connected with pulley. At the top portion of frame an operational shaft is fixed with the help of bearing supported ends in order to attain friction free rotation. At the ends of this operational shaft, two separate cutter blades are fixed, this operational shaft is also connected with a larger pulley at its center portion. The pulley at operational shaft and AC motor is connected with each other

through belt drive. Below the cutter blade a work tables are provided, stock adjusting setup is placed on the table which is operated with the help of lead screw arrangement.

Table 1
Materials used

S. No.	Description	Qty.	Material
1.	Ac motor	1	Electrical
2.	Belt	1	Cloth
3.	Bearing	8	Stainless steel
4.	Frame	As per requirement	Mild steel
5.	Shaft	As per requirement	Mild steel
6.	Metal strip	As per requirement	Mild steel
7.	Pulley	1	Cast iron
8.	Lead screw	1	Mild steel
9.	Sheet metal	1	Mild steel
10.	Cutting blade	1	Stainless steel

B. Working Principle

Initially a stock adjuster is adjusted to the required position by adjusting the lead screw. Based upon the stock adjuster position the thickness of fish pieces which has to be cut is decided. Once this presetting operation is inspected, an AC motor is turned on. This causes an operational shaft linked with AC motor through belt drive to rotate about its fixed axis. The rotation of operational shaft tends to activate the blade which is directly linked with it. Thus by loading the raw fish manually against the cutter blade, required thick piece are obtained as an output of machine. The final product has been manufactured from the components as per the required dimensions.

Advantages:

- Construction is simple, components used are easily available.
- User friendly, increases comfort ability during operation.
- Labour charges is reduced.
- Production rate is increased.
- Time consumption for performing cutting operation is also decreased.
- Quality on the fish meat is improved.
- Less maintenance is enough for its better performance.

4. Conclusion

The final design procedure is the fabrication of the machine which consists of hardware units. The automatic fish descaling cum cleaning machine will be an aid to the fish sellers, small scale industries and for domestic purpose as it reduces manpower. It is developed to increase the hygienic handling of fish and reduces drudgery. Hence the Automatic machine fulfills the increasing demand for selling of fish in the market.

The main defects identified were;

- Initial adjustments for the workers.
- Adjusting the cutting size for each type of fish takes time.
- Even though the need of skilled labor was not required the labor had to be extremely careful while operating the machine.
- And some other technical difficulties like some fish required more speed to be cut while some required low speeds.

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