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Role : Lead Mechanical Designer & Fabricator

Organization : Robotics Association of Nepal (RAN)

Sponsorship : UNDP Nepal

Skills & Tools : SolidWorks, Mechanism Design, Fabrication, Technical Training, Field Implementation

MAIN COMPONENTS

1. Frame

The frame was made of L bar 45 x 45 x5mm. Its main job is to support all parts. The dimensions of machines are 1000 mm height 720 mm width measured from front x 500 mm width measured from side. The cover was made of a 1.4 mm thick BI sheet.

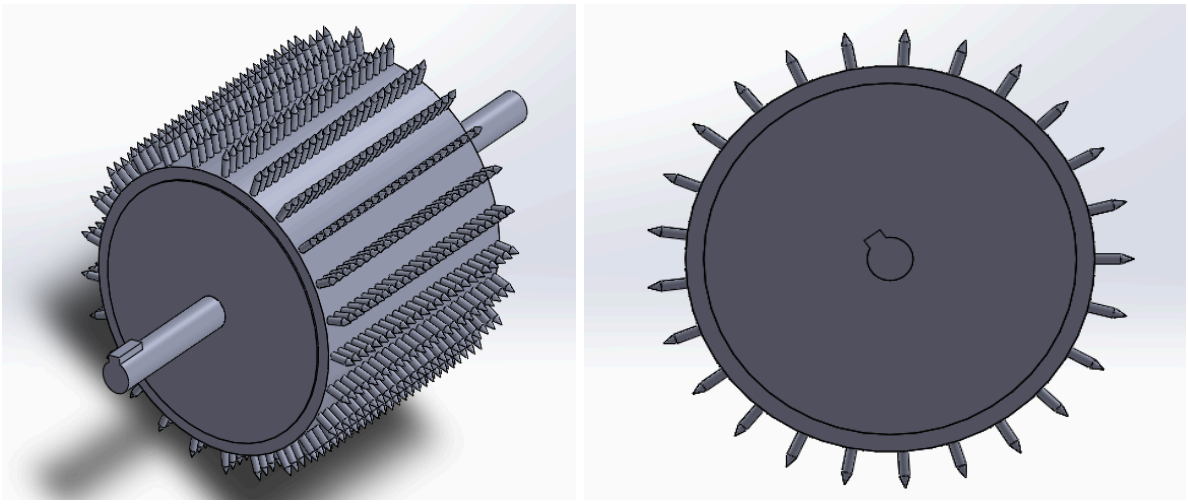
2. Pulley

We use two pulleys for power transfer mechanisms. We use a smaller pulley at the motor and a larger pulley double the size connected to the shaft of the scrapper.

3. Roller

The roller drum is the most significant part of the machine as it provides the necessary force for the fiber to comb.

1. The speed of the roller cannot be 500 rpm or near that, this simply throws away your stem so fast that it does not even enter the scraper for beating.
2. For good combing the speed of the roller should be kept near 100 rpm.
3. The distance between rollers should not be too small this will allow crushing but your stem will stick to the roller if it has thin size.
4. There are pins on the roller of 8 mm diameter and 15 mm length so that the fiber can be properly combed.
5. The diameter of the roller drum is 480 mm including pins and excluding pins the inner diameter is 400mm. Its length is 420 mm.



4. 1.5 HP Motor for Power

The combing process involves a setup powered by a 1.5 HP motor. This motor is crucial as it drives the machinery required to process the banana fiber. The power is sufficient to operate the rotating drum with pins and maintain the necessary speed and force for effective fiber combing. The motor provides the mechanical energy needed to rotate the drum, which in turn, processes the banana fiber against the roller, facilitating the fiber combing.

PRODUCTION CAPACITY

The production capacity of a banana fiber combing machine depends on factors such as machine design, motor power, and the type of banana pseudostem fiber being processed. Main factors affecting production capacity are drum design and size, fiber roughness, thickness and length, etc. The motor power, typically ranging from 1 to 2 HP, plays a key role in determining the drum's speed and efficiency, with optimal speeds around 200-500 RPM to ensure consistent fiber combing without damaging the fibers.

This motor is sufficient to operate the machine which can accommodate trunks up to 320mm length, 15 mm in width for this the average time for fiber combing is recorded at 25 seconds .The fiber recovery rate(ie Fiber after processing/Fiber prior to processing) is 13 to 25%.

QUALITY

The quality of the extracted banana fiber is influenced by the setup's design and operational efficiency:

1. **Pins in Rotating Drum**: Sharp and well-maintained pins in the rotating drum are crucial for high-quality fiber extraction. Dull or improperly aligned pins can lead to incomplete fiber separation and lower quality fibers.
2. **Process Control**: The consistency in processing, including the speed of the rotating drum and the pressure applied by the roller, affects the fiber's fineness and strength. Properly controlled processes yield fibers with better mechanical properties and uniformity.
3. **Banana Fiber Quality**: The quality of the banana fiber used as raw material also impacts the final fiber quality. Dried and well-prepared fibers generally produce good quality fibers after combing.

Expected quality of single banana stem fiber is strain at rupture to be 2.715%. The 1120mm resp stem fiber ruptured at 9.272N.

METHOD OF COMBING

1. The banana fibers are initially fed into the machine via a small opening on the frame, which assists in guiding and helps the fibers enter at an angle towards the drum. This opening is strategically positioned to keep the fibers aligned and moving in the direction of the drum.
2. The motor provides the necessary power to rotate the drum. This power is transmitted from the motor to the drum through a system consisting of two pulleys and a belt.
3. As the motor operates, it drives the drum to rotate.
4. When the fibers enter the drum, they encounter the rotating pins.
5. These pins, mounted on the drum, comb the fiber and make them aligned and smooth. The drum's rotation ensures that the pins consistently engage with the material. The design of the pins enables them to comb off the fibers by applying pressure.
6. The rotating motion of the drum continuously feeds new sections of the fibers into the pins, allowing for efficient fiber extraction.
7. During this process, the small unwanted fibers are removed, leaving only the smooth aligned fibers behind.

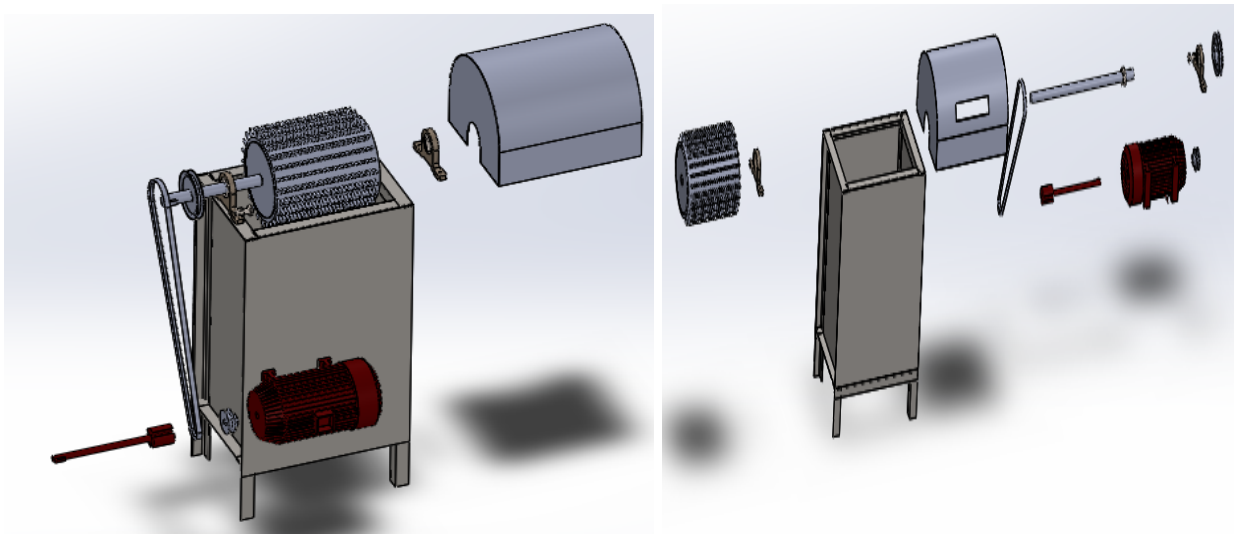


Fig: Exploded Views

COMPONENTS SPECIFICATIONS

1. 1.5 hp single phase asynchronous motor to rotate the drum
2. The rotary drum has a 35mm shafting and 8 mm thick pins while spinning at approx. 400 rpm.
3. The diameter of the drum is 480 mm including the pins and 400 excluding the pins.
4. The frame was made of L bar 45 x 45 x 5 mm measuring 1000 mm (height) x 720 mm (width measured from front) x 500 mm (width measured from side), the cover was made of a 1.4 mm thick BI sheet.
5. The drive pulley has a diameter of 75 mm while the driven pulley has a diameter of 150 mm, v-groove type pulley.
6. By literature review and expert consultation, it was decided to keep the roller tangential velocity as 0.3 -0.4 m/s, above which combing of the fiber becomes inefficient. In order to reach this speed from the driver we need a series of speed reductions.

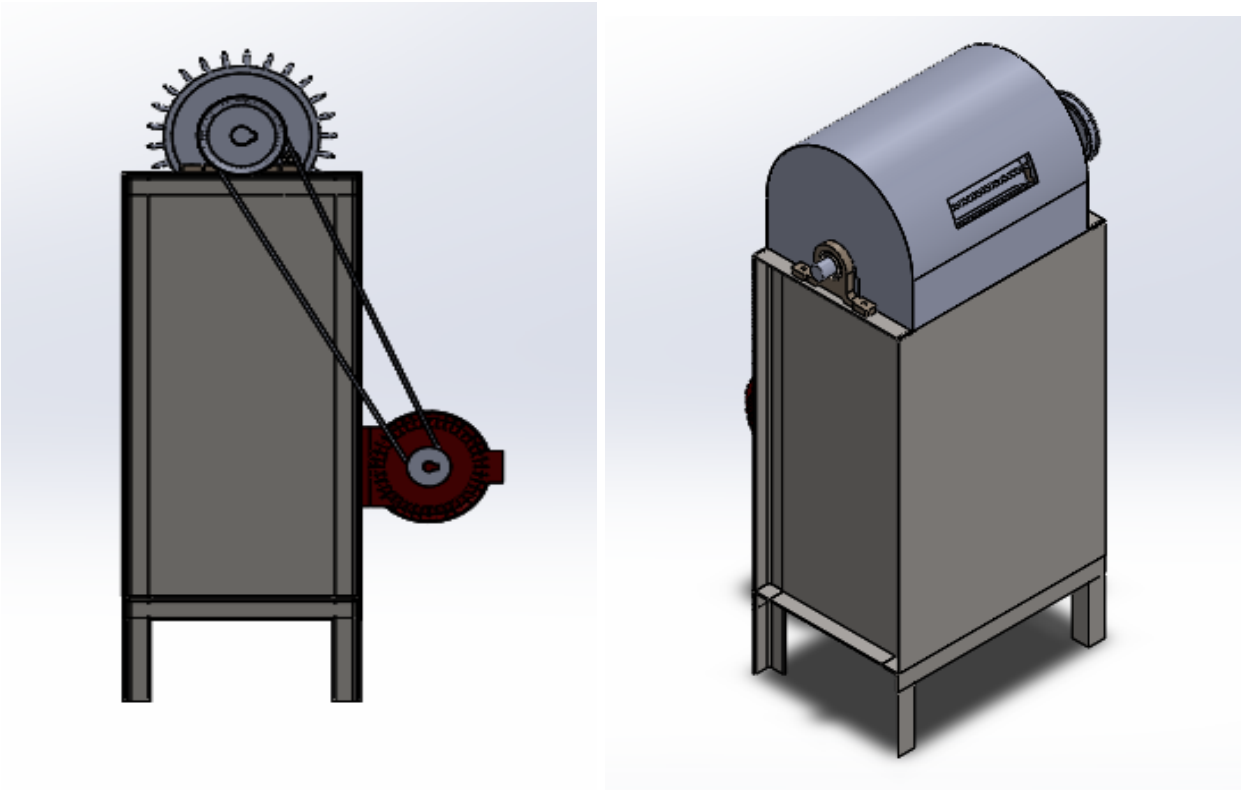


Fig: Isometric and Side view of Banana Fiber Combing Machine.