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Planetary Mixer

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ABSTRACT: The project compares traditional and modern mixing technologies in the food industry. It proposes a 3D stirrer motion to improve mixing quality by creating turbulent flow, resulting in a more homogeneous mixture.
Keywords: Homogeneous mixture, 3D stirrer motion, Turbulent flow, Mixing technology, Food processing.

I. INTRODUCTION

Mixing is a fundamental operation in industries like chemical, food processing, and paint manufacturing, where uniformity and product quality are critical. It involves combining powders, semi-solids, or fluids to produce a consistent mixture. While solid-solid mixing is straightforward, mixing high-density powders into liquids presents challenges due to particle settling. To counter this, a bidirectional mixer utilizing a crank and fork mechanism is employed to create turbulence and achieve a homogeneous blend.

II. LITERATURE REVIEW

Dattatraya P. Patil,Amod P. Shrotri, Vishal P. Patil &Nikhil S. Mane,done work on, Design and Development of a Special Purpose Bidirectional Mixer to Maximize Agitating Performance,according to his work, Mixing is very important operation in any process industry. All operations involving liquid phase reactions, blending homogenization, emulsion preparation, dissolution, extraction, etc., need mixing in one form or the other. Mixing of powders, pastes, paints jellies and many other products is needed to be done in many industries for many applications; it can be done by the rigorous shaking and creatingturbulence in the contents. The process is called as agitation for which directionally reversible mixtures are utilized. These reversible mixers Can give partial homogenization for more effective homogenization it is needed to design of a special purpose machine which gives cyclic reversal of the rotor and create more effective agitating turbulence. This project is about such a special purpose dynamic mixer designed and developed for a paint manufacturing industry. In this paper, the design and developmentof this machine is discussed in details, the results of this work are encouraging and giving better agitating performance over conventional method.[1]

III. PROBLEM STATEMENT

Traditional planetary mixers with fixed settings limit flexibility in small-scale food production, making it hard to handle diverse mixing tasks. This often leads to compromised quality or the need for multiple machines. A versatile mixer with adjustable settings and interchangeable parts is needed to improve efficiency, maintain consistency, and reduce costs for small and home-based food producers.

IV. OBJECTIVES

To design a planetary mixer with adjustable mixing speeds and interchangeable attachments suitable for various mixing tasks.
To ensure the design is cost-effective, compact, and user-friendly, especially for small-scale and home-based food producers.
To fabricate a working prototype demonstrating the adjustable speed and attachment mechanism.
To test the prototype under controlled conditions for performance, ease of use, and durability.

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To analyze the efficiency and versatility of the developed mixer in comparison to conventional fixed-function planetary mixers.

VI. METHODOLOGY

Methodology Summary:

1. Problem Identification – Analyzed issues in existing mixers.
2. Research & Concept Design – Studied mixer types and designed a suitable planetary mechanism.
3. Component Selection – Chose durable, hygienic, cost-effective parts.
4. Design & Analysis – Created CAD models and performed basic analyses.
5. Fabrication & Assembly – Built and assembled all mixer components.
6. Testing – Assessed performance, efficiency, and noise levels.
7. Documentation – Recorded all processes and compared with conventional mixers.

VII. CONSTRUCTION

Components are used for manufacturing the mixer are:

Table. Material Requirement.

SR. NO.	COMPONENTS	QUANTITY
1.	Frame Structure	1
2.	12 Volt Motor	2
3.	Ball Bearing	2
4.	Shaft	1
5.	Rotor Blade/stirrer	1
6.	V-Belt	1
7.	Pulley	2
8.	Transformer 12 Volt	1
9.	Drum	1
10.	Nut and Bolt	-

7.1. Frame:

The frame is of MS material. The frame of our machine is basically used to support all the components mounted on it. That is motor, transmission components, Shaft & bearings etc. are mounted on frame.

7.2. DC Motors:

An electric motor is an electrical machine that converts electrical energy into mechanical energy. A motor controller a device that serves to govern in some predetermined manner the performance. The motor rotates in clockwise as well as in anti-clockwise direction. Motor needs electricity for its functioning.

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Table No. 7.4. Specification of motor.

Type	Gear motor
Frequency	50/60 Hz
Voltage	12 V
Speed	60 r.p.m.
Power	50 watt

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore so is its current. The current in the rotor is switched by the commentator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque. DC motors have a rotating armature winding (winding in which a voltage is induced) but non-rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux) or permanent magnet. Different connections of the field and armature winding provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems called DC drives.

7.5. Ball bearings:

This type of bearing consists of i) a cast iron pedestal, ii) gun metal, or brass bush split into two halves called “brasses”, and iii) a cast iron cap and two mild steel bolts. The detailed drawing of a pedestal bearing is shown in image below. The rotation of the bush inside the bearing housing is arrested by a snug at the bottom of the lower brass. The cap is tightened on the pedestal block by means of bolts and nuts. The detailed part drawings of another Plummer block with slightly different dimensions are also shown in image below.

Fig.7.5. Ball bearing

7.6. Shaft:

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission.

Material for Shafts:

The ferrous, non-ferrous materials and nonmetals are used as shaft material depending on the application.

Fig.7.6 Shaft.

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7.7. Washer:

A washer is a thin plate (typically disk-shaped) with a hole (typically in the middle) that is normally used to distribute the load of a threaded fastener such as a screw or nut. Other uses are as a spacer, spring (wave washer), wear pad, preload indicating device, locking device, and to reduce vibration(rubber washer).Washers usually have an outer diameter (OD) about twice the width of their inner diameter (ID).Washers are usually metal or plastic. High quality bolted joints require hardened steel washers to prevent the loss of pre-load due to Brinelling after the torque is applied. Rubber or fiber gaskets used in taps (or faucets, or valves) to stop the flow of water are sometimes referred to colloquially as washers; but, while they may look similar, washers and gaskets are usually designed for different functions and made differently. Washers are also important for preventing galvanic corrosion, particularly by insulating steel screws from aluminum surfaces.

Fig.7.7 Washer.

7.8. Nut and Bolt:

As nuts and bolts are not perfectly rigid, but stretch slightly under load, the distribution of stress on the threads is not uniform. In fact, on a theoretically infinitely long bolt, the first thread takes a third of the load, the first three threads take three-quarters of the load, and the first six threads take essentially the whole load. Beyond the first six threads, the remaining threads are under essentially no load at all. Therefore, a nut or bolt with six threads acts very much like an infinitely long nut or bolt.

Fig.7.8. Nut and Bolt

7.9. Belt Drive:

A belt drive is a frictional drive that transmits power between two or more shafts using pulleys and an elastic belt. In most cases, it is powered by friction but it may also be a positive drive. It can operate at wide ranges of speed and power requirements. It is also highly efficient. **belt drive**, in machinery, a pair of pulleys attached to usually parallel shafts and connected by an encircling flexible belt (band) that can serve to transmit and modify rotary motion from one shaft to the other. Most belt drives consist of flat leather, rubber, or fabric belts running on cylindrical pulleys or of belts with a V-shaped cross section running on grooved pulleys. To create an effective frictional grip on the pulleys, belts must be installed with a substantial tension. Because of the wedging action of the belts in the grooves, V belts require less tension than do flat belts and are particularly suitable for connecting shafts that are close together.

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Fig.7.9. Belt Drive.

7.10. 12 Volt transformers:

Voltage transformers (VT), also called potential transformers (PT), are a parallel-connected type of instrument transformer. They are designed to present a negligible load to the supply being measured and have an accurate voltage ratio and phase relationship to enable accurate secondary connected metering.

Fig.7.10. 12 Volt transformer.

VIII. ADVANTAGES, LIMITATIONS & APPLICATIONS.

8.1. Advantages:

1. Stirrer has spital rotation i.e. it rotates in all over the tank; this gives uniform mixing.
2. Quality of mixing is very high.
3. Low cost of mixing.
4. Fast production rate.

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5. Compact size so minimal space requirements.

8.2. Limitations:

1.The machine develop by us is having capacity only 20 liters, which can be made only to prove models reliability or change in functionality for model synthesis. It is not an actual production model, but fulfills all basic requirements given by the company.

2.The machine develop by us is having small capacity of motor, so that it cannot be use large quantity of chemicals or liquid.

3.The machine develop by us is having low speed of motor which give less speed of chemical or liquid mixing.

4.The machine gearbox made by us may have misalignment while working.

8.3. Applications:

1. Mixing of multiple color paint in paint industry.

2. Dairy applications with suitable change in stirrer material.

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IX. CONCLUSION

In conclusion, we are satisfied with the successful completion of our project, which provided valuable practical experience and enhanced our mechanical aptitude. Despite several design challenges, we overcame them through diligent effort and the use of quality reference materials. Careful selection of raw materials and precision machining enabled us to maintain close tolerances and minimize balancing issues. Throughout the process of machining, fabrication, and assembly, we put in our utmost effort to achieve the desired outcomes. The developed mixer system effectively reduces human effort and time, and with future automation upgrades, it holds great potential for integration into modern automated plants.

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