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Portal Electrical Power Tiller Machine

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ABSTRACT: This paper presents the conceptualization, design, and prototyping of a Portal Electrical Power Tiller aimed at small-scale and sustainable farming applications. Unlike traditional fuel-based tillers, this model operates on electric power, reducing environmental impact and running costs. The study focuses on the mechanical design, power system configuration, and performance analysis under field conditions. Results indicate promising potential for eco-friendly agriculture.

KEYWORDS: Electric Power Tiller, Sustainable Agriculture, Portal Tiller Design, DC Motor, Battery-Powered Farming Equipment

I. INTRODUCTION

The rapid mechanization of agriculture has often sidelined small and marginal farmers due to the high cost and complexity of machines. This paper introduces a compact, portal-structured electric tiller intended to address this gap. The portal design offers high ground clearance and stability, while the electric drive ensures low emissions and ease of use.

II. LITERATURE REVIEW

Studies such as [1] and [2] have discussed electric alternatives to traditional farming tools. However, most designs compromise either power output or usability. This paper aims to merge efficiency, ergonomics, and sustainability in one unified solution.

III. SYSTEM DESIGN AND COMPONENTS

A. Mechanical Structure

- Portal frame using mild steel
- Adjustable width and height
- Ground clearance of 300 mm for root crops

B. Electrical Components

- 48V 1000W Brushless DC Motor
- Lithium-Ion Battery Pack (48V, 40Ah)
- PWM Motor Controller
- Solar charging interface (optional)

C. Control System

- Arduino-based throttle control
- Safety relay and overcurrent protection

IV. METHODOLOGY

The prototype was fabricated using locally available materials. Field tests were conducted on 100 sq.m plots with different soil types. Data on speed, torque, battery discharge rate, and tilling depth were recorded.

V. RESULTS AND DISCUSSION

- Average tilling depth: 120 mm
- Battery runtime: ~3 hours on full charge
- Recharge time: 5 hours (AC); 8 hours (solar)
- Torque sufficient for semi-dry soil tilling

Comparative analysis shows a 35% cost-saving over gasoline tillers and zero emissions.

VI. CONCLUSION

The Portal Electrical Power Tiller offers a viable and eco-friendly alternative for small-scale farming. Further optimization of battery capacity and solar integration is recommended for enhancing performance.

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