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Using a Regenerative Braking system in the sewing machine

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Abstract
There is a need for a particular technology that recovers the energy, which is usually wasted, in the modern world, where there are energy crises and resources are depleting at a faster rate. An item is slowed using regenerative braking, an energy recovery technique, by having its kinetic energy (K.E.) changed into a form that may either be used right away or saved for later use. In the apparel industry, regenerative braking systems allow us to partially recover the sewing machine's K.E. that is lost during the braking process. The converted K.E. is either stored for later use. For later use, this energy is frequently stored in a battery or bank of capacitors. Another way to store energy is with the help of a revolving flywheel, which is one of the most popular, affordable, and efficient ways to store and generate electricity. To offer an energy-storing regenerative braking system, the current invention transmits the flywheel force as a torque that tends to oppose the forward rotation of the wheel when the brakes are applied.

Keywords
Garment Industry, Electricity, waste, Generator, Regenerative braking, energy recovery

OBJECTIVE
To create and develop a system that reduces energy use in the garment industry by providing economical generators without any fuel cost.

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I. Introduction

The power plant might be replaced by energy sources like those still being researched by a few small businesses, such as wind, solar, and ocean wave energy. While some types of power plants, such as hydroelectric power plants (HEPP), diesel power plants (DP), gas power plants (GP), nuclear power plants (NPP), and others, cannot be replaced. Fear of this energy became stronger with time and has employed all available methods to utilize natural resources and anything that might be used to produce power. fulfilments of electrical energy in off-grid, isolated locations.

One of the key components is the use of renewable energy. It enables the recovery of a significant portion of the kinetic energy lost during braking or decelerating for subsequent usage. Thus, energy recovery technology has the potential to dramatically reduce energy use. Regenerative Braking System and Boost Recuperation System are the two main regenerative energy approaches that have been used.

To recover the lost braking energy, a regenerative braking system is installed in the driven axle. To recover kinetic energy during slowing, the mechanical propulsion system is parallel-coupled with the boost recuperation system. With the help of these technologies, it is possible to significantly cut fuel consumption.

Working Principle

Regenerative braking is a braking technique that makes use of the motor's mechanical energy by turning kinetic energy into electrical energy and re-injecting it into the battery. Theoretically, the alternator-like regenerative braking system can use a significant portion of its kinetic energy to recharge the battery.

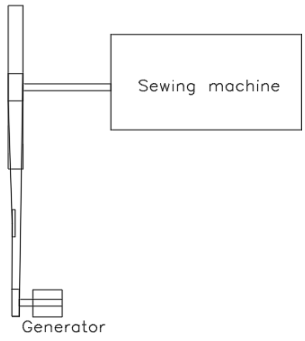

Fig 1.1: Normalcondition

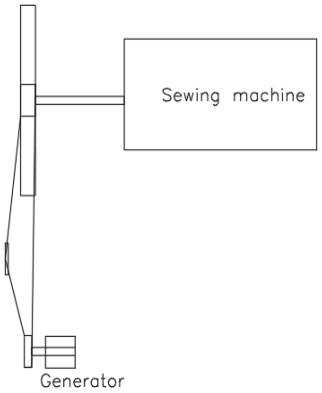

Fig 1.2.2: Regenerative action

When the operator is using the sewing machine, the belt has a loose connection, which prevents the generator from rotating as shown in Figure 1.1. However, when the operator is not using the machine, the spring expands, which causes the belt to have a tight connection, which causes the generator to rotate as shown in Figure 1.2.

Types of Regenerative Braking Systems (Lamichhane, M., Bhetal, N., & Yonjan, S. (2022, July 22). Design and Fabrication of Regenerative Braking System.)
The regenerative braking system utilizes several energy conversion techniques, including electromagnetic, hydraulic, flywheel, and spring. An electromagnetic-flywheel hybrid regenerative braking system has also become more popular recently. The efficiency and applicability of each type of regenerative braking system vary because they each use a different energy conversion or storage technique. The following are the Types:

- Electromagnetic
- Flywheel
- Electromagnetic flywheel
- Spring

Electromagnetic: -
The drive shaft in an electromagnetic system is attached to an electric generator, which uses magnetic fields to limit the drive shaft's rotation to slow down the machine and produce power.
Flywheel: -
The Flywheel Regenerative Braking System uses kinetic energy stored in the system to spin a flywheel attached to the motor shaft. The driving shaft can then be torqued by the flywheel's rotating, increasing the power.

Electromagnetic flywheel: -
Similar to an electromagnetic system, it uses the same fundamental power generation techniques, but instead of using batteries to store energy, it uses a flywheel. The flywheel functions in this way as a mechanical battery that can store and release electrical energy. Electric flywheel regenerative braking systems are more economical ways to store electricity due to the longer lifespan of flywheel batteries compared to lithium-ion batteries.
Spring: -
Bicycles and other human-powered vehicles frequently employ spring-loaded regenerative braking technology. To store energy as elastic potential during braking, a coil or spring is wound around a cone in a spring regenerative braking system. The potential can then be used again to support the driver as they travel upwards or through tough terrain.
Technology Used
Bicycle power generator (Kannan Megalingam, R., Veliyara, P. S., & Prabhu, R. (n.d.). Pedal Power Generation**)**

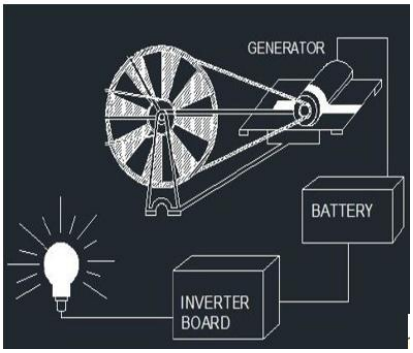

Fig 1.3Bicycle power generator

The alternator is larger in size compared to the dynamo and it would seize more space. One way to connect the alternator with the bicycle is to place it behind the seat by removing the carrier. The shaft of the alternator should be connected to the A tire with a belt that rolls over the shaft on one end and the other end Rolls over a cylindrical structure attached to its rear tire's hub. In this way when the bicycle moves, the structure rotates Thereby facilitating the rotation of the alternator's shaft. The other way to connect the alternator with the bicycle is by making the shaft directly rolls over the tire.

Clutch mechanism(Nice, K., Bryant, C. W., & Hall-Geisler, K. (2021, July 30). How Clutches Work.)

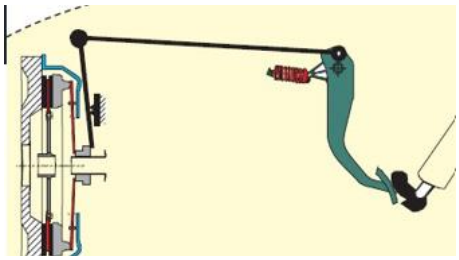
Fig 1.4 Clutch mechanism

A clutch is necessary for a car because, unlike the wheels, the engine rotates continuously. The wheels must be somehow separated from the engine for an automobile to stop without destroying the engine. By regulating the slippage between them, the clutch enables us to smoothly engage a spinning engine to a transmission that is not spinning.

Pirn winding mechanism (Sayed M. A. (2020, January 18). A Guide to Pirn Winding)

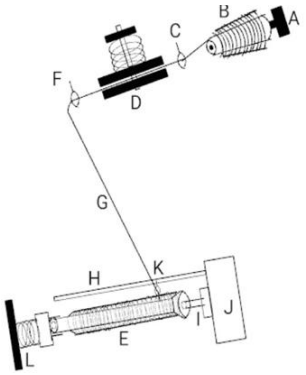

Fig 1.5

These systems work automatically, so when the quill is loaded, it is off and an empty quill is automatically placed on the spindle. Quill winding is also going away as a result of the abandonment of shuttle looms.

II. Literature Review

Research papers on Bicycle power generation

Sr no	Paper name	Year	Source	Objective	Findings
1	Generation of Electrical Power using Bicycle Pedal	2014	International Journal of Recent Research and Review	To generate the electricity using bicycle pedal	pedaling can produce power that can used to transform mechanical energy into electrical energy the alternator or the dynamo.
2	Power Generation Using Bicycle The mechanism as an Alternative Energy Source	2018	IRJET Journal	To understand the Early Development and Recent Development for electricity generation	This paper discusses energy scavenging apparatus made from recycled, independent materials focused on elements and energy used while Exercise is offered. The quantity of energy harvested is more than enough to push us to prevent its waste into heat or other wasteful kinds of energy. when constructing The authors of the scavenging system noted a few issues involving both links between interaction of mechanical and electrical systems between the electrical network and the scavenging system. These issues' solutions are reviewed
3	DESIGN AND DEVELOPMENT OF HUMAN ENERGY HARVESTING SYSTEM FOR POWER GENERATION	2020	Research gate	To study various electricity generation methods	The battery may be charged by the pedal-powered generator, providing individuals in some places with a fantastic opportunity to access telecommunication services. It may provide light for free and save a lot of electricity at the same time. The gadgets, including a photocopier, printer, computer, laptop, television, water pump, and mixer, may be run by a pedal-powered generator that people can exercise with.

Research papers on alternators to be an alternative electricity

Sr no	Paper name	Year	Source	Objective	Findings
1	Electric Car Charging System by Alternator	2017	International Journal of Engineering Research in Electrical and Electronic Engineering (IJEREEE)	To understand the self-charging process of electric cars	The functioning of electric vehicles with self-charging from the alternator to the battery is the subject of this study article. The alternator may move with the friction of the wheel by generating power while the wheel is rotating. This document examines all the The motor, battery, controller, and DC-DC converter are all alternator components. Friction drives the alternator. Here The battery's DC-DC converter is directly connected to the alternator, which can produce 14V DC. Four batteries that are attached to the DC-DC converter can be charged using the 50V that the converter can step up to. that creates the 48V supply in series. The battery, the motor, and another connection are connected to the controller.
2	Design and generating energy as a car alternator to be an alternative electricity	2019	IOP Conference Series: Materials Science and Engineering	To design a generator for electric cars	The results of this study will demonstrate how to apply and utilize existing power sources used by the car's alternator. Researchers adopted the title for the aforementioned causes. "Design of Alternator Car for Alternative Electrical Energy Generation" describes this research. The engine AC generator, which is the main driving power and can be a manifold turbine engine, a diesel engine, or a propeller engine, is where electricity is produced from the electrical energy

					conversion method that is often employed. Two or more generators are run with continuous duty, reserve, and turns to the generator in the operation of power plants with a generator due to reliability fluctuations, load size, and other factors.
3	Alternator Charging System for Electric Motorcycles	2017	International Research Journal of Engineering and Technology (IRJET)	To understand the self-charging process of electric motorcycle	The alternator uses the battery to produce 12V to 14V. the wheel's rotating force under forward movement DC-DC converter increases the power source ranges from 12 to 54 volts, and results in the batteries being charged

Research papers on the Pirn winding mechanism

Sr no	Paper name	Year	Source	Objective	Findings
1	Mathematical Modelling of Weft yarn Tension in Pirn Winding	2013	Asian Transactions on Engineering (ATE ISSN: 2221-4267) Volume 03 Issue 03	To understand how the pirn winding mechanism works	The tension variation in the yarn route of the pirn winding machine was attempted to be theoretically analyzed by the author. The experimental data gathered at various points along the yarn route helped the author confirm the precision and validity of the created model.
2	PIRN WINDING PROCESS OR WEFT PREPARATION PROCESS OR WEFT WINDING PROCESS	2020	Textile advisors	To understand how the pirn winding mechanism works	Knowing the course of the pirn winding process and how the pirn stop motion functions, we can predict that when the pirn is full, the machine will shut off on its own.

Research papers on the servo motor

Sr no	Paper name	Year	Source	Objective	Findings
1	Technical Explanation for Servomotors and Servo Drives	2018	CSM_Servo_TG_E_1_1	To understand servomotor working	A servo drive is used with a servo motor, which is a structural component of a servo system. The motor that powers the servomotor is included. the weight and a device for detecting position, like an encoder. According to the predetermined target value (command), the servo system modifies the controlled quantity, such as position, speed, or torque. value) to carefully regulate how the machine works.

Books

Sr no	Book name	Year	Publisher
1	Fundamentals of yarn winding	2018	WOODHEAD PUBLISHING INDIA PVT LTD
2	Garment Manufacturing Technology	2015	WOODHEAD PUBLISHING INDIA PVT LTD

Videos

1-Clutch how does it works?
https://youtu.be/devo3kdSPQY
2-open view of sewing machine
https://youtu.be/ao-o_ZNGnzc

3-Weft Feeler Mechanism
https://youtu.be/RSfv91piDTI

Material Used

- Bike alternator
- 2 gears
- Housing & attachments
- Belt drives
- Two Shafts
- Generator

- Battery

Methodology

Connecting the Belt drive between the machine wheel and alternator

⬇

Attaching the spring mechanism between the belt drive

⬇

Attaching the Generator on the shaft of the alternator

⬇

Connecting the generator with battery

III. Result

Sr.No	Voltage (Volt)	Current (Ampere)
1	0.70	154.4
2	0.71	155.4
3	0.71	155.4
4	0.72	156.4
5	0.73	157.4
Avg	0.71	155.8

Calculation

Ps=VxI
=0.72x156.4
=112.608watts/machine

$\frac{T1f}{T2f}$=4x$\frac{T1}{T2}$ (T1=32, T2=28, T1f=168,T2f=40)

Pf=4xPs
=4x112.608
=450.432watts/machine

800 machines on the sewing floor
P=800x450.432
=360,345.6watts
Sewing floor efficiency 60%
Therefore generated power=$\frac{40x360345.6}{100}$
=144138.24watt
=144kW
1kw cost in India is 7rupees=144x7=1008rupees
3 floors for the sewing operation
Power generated=144x3
=432kW=3024rupees

Costing

- Bike alternator-230
- 2 gears-350
- Housing & attachments-300 Belt drives-100
- Two Shafts-150
- Generator=400
- Battery=600
- Total=2000

IV. Conclusion

The goals which will be achieved in this task are as follows:

- Low-cost electricity bill.
- Sustainable energy, the energy saved is used by the generator, hence loss of energy is curbed.
- Use of electrical and mechanical engineering along with textile engineering.

Future Scope

However, in the future, technologies like ultra-capacitors, flywheels, and hydraulic systems might have much higher power capacities, which might allow for a greater reliance on the regenerative braking system, even for high-speed stops, and the possibility to scale back or even do away with the friction-braking system.

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