MECHANICAL AND ELECTRICAL PORTABLE CHARGER

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ABSTRACT
This paper proposes a modern and an easy way to charge any electronic devices. The circuit is designed in such a way that it can charge the device by rechargeable cell types found in power bank or by hand crank low voltage geared dc generator. When using in electrical mode, the lithium-ion cells are charged through main supply and the stored charge is used to charge the device. In mechanical mode, the crank will rotate the shaft of dc motor to generate same amount of power. This technique is versatile since power is generated by human power and also from main supply.

Key words: hand crank, geared dc generator.

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1. INTRODUCTION
Once through Community Polytechnic Visit, which was arranged by our college, we had visited a small village near Virar to understand their problems and to somehow fulfil the needs of the villagers. Through this survey, we got to know that most of the concerns were related to the electricity, we also observed that most villagers have cell phones but power supply was hardly available to them so that they could charge their cell phones. So we decided to make such a device which will charge their devices even when power supply is not available and help them in case of emergency during the night during power cuts. Hence we came up with an idea to make a PORTABLE CHARGING DEVICE which will fulfil their cell phone needs as well as their emergency lighting needs in case of power cut in the night. Thus, mechanical mode can be used in case of power cut where one can rotate the crank connected to gear train which can rotate the motor shaft at 300-400rpm. We also observed that it was not feasible to rotate crank for old people and decided to add electrical charging mode from battery when switch is changed to electric mode.
2. PROBLEM STATEMENT
To eliminate the need of mains supply to charge electronic devices making it convenient to charge devices while travelling.

3. DESIGN AND SPECIFICATION

3.1. Lithium-Ion Cells
Lithium-Ion and Lithium-Polymer batteries are the most common rechargeable cell types found in Power Banks. Lithium-Ion cells are generally cheaper and limited in mAh capacity, while Lithium-Polymer cells can be larger and don't suffer from a memory effect over time. The energy density of lithium-ion is typically twice that of the standard nickel-cadmium. There is potential for higher energy densities. The load characteristics are reasonably good and behave similarly to nickel-cadmium in terms of discharge. The high cell voltage of 3.6 volts allows battery pack designs with only one cell. Most of today's mobile phones run on a single cell. A nickel-based pack would require three 1.2-volt cells connected in series. Lithium-ion is a low maintenance battery. There is no memory and no scheduled cycling is required to prolong the battery's life. In addition, the self-discharge is less than half compared to nickel-cadmium, making lithium-ion well suited for modern application.

3.2. Gear Train

![Gear Train Diagram]

We have used compound train of gear. We know that the idle gears in a simple train of gears do not affect the speed ratio of the system. But these gears are useful in bridging over the space between the driver and the driven. But whenever the distance between the driver and the driven or follower has to be bridged over by intermediate gears and at the same time a great (or much less) speed ratio is required, then the advantage of intermediate gears is intensified by providing compound gears on intermediate shafts. In this case, each intermediate shaft has two gears rigidly fixed to it so that they may have the same speed. One of these two gears meshes with the driver and the other with the driven or follower attached to the next shaft. Gear ratio is assumed to be 1/6 to achieve 300-400rpm to motor shaft compared to Crank rotation.
Gear Ratio $= \frac{1}{6}$

**FORMULA**

$$\frac{N_1}{N_2} \times \frac{N_3}{N_4} = \frac{T_2}{T_1} \times \frac{T_4}{T_3}$$

RPM of N2 and N3 will be equal since they are on same shaft.

$$\frac{N_1}{N_4} = \frac{T_2}{T_1} \times \frac{T_4}{T_3} \quad [\text{Equation-1}]$$

Assumed as per Standard 48 diametral Pitch Spur gear.

T1=36 teeth
T2=12 teeth
T4= 12teeth
T3=?

Substituting above values in equation-1

$$\frac{1}{6} = \frac{12}{36} \times \frac{12}{T_3}$$

$$T_3 = \frac{144 \times 6}{36}$$

T3=24 teeth

Specification for 48 diametral pitch spur gears:

**1] 24 Teeth**

Pitch diameter=0.5 inch
Bore diameter=0.1875 inch
Addendum=0.042 inch
Pressure angle=14$\frac{1}{2}$ degree
Thickness=0.125 inch

**2] 12 Teeth**

Pitch diameter=0.250 inch
Bore diameter=0.125 inch
Addendum=0.042 inch
Pressure angle=14$\frac{1}{2}$ degree
Thickness= 0.125 inch

**3] 36 Teeth**

Pitch diameter=0.750 inch
Bore diameter=0.185 inch
Addendum=0.042 inch
Pressure angle=14$\frac{1}{2}$ degree
Thickness=0.125 inch.
4. DC MOTOR
300 RPM Side Shaft Heavy Duty DC Gear Motor is suitable for large robots / automation systems. It has sturdy construction with gear box built to handle stall torque produced by the motor. Drive shaft is supported from both sides with metal bushes. Motor runs smoothly from 4V to 12V and gives 300 RPM at 12V. Motor has 8mm diameter, 17.5mm length drive shaft with D shape for excellent coupling.

Specifications:
- RPM: 300 at 12V.
- Stall torque: 23Kg-cm at stall current of 8.4A@12V
- Shaft diameter: 8mm.
- Shaft length: 17.5mm.
- Gear assembly: Spur.
- Brush type: Carbon.
- Motorweight: 280gms.

5. VOLTAGE REGULATOR(IC 7805)
7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.

Features:
- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V.
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection.

6. LED
A light-emitting diode (LED) is a semiconductor light source. An LED is mounted on the PCB to indicate the output is being produced when hand crank is rotated.

7. OUTPUT PIN
Output pin is used to connect PCB to device. It acts as a connector to transfer the output produced.

8. WORKING
Working Principle:
Power will be generated due to the magnetic flux created due to the rotation of the generator shaft & current will be obtained at the output of the generator which is connected to the charging cable. Attach the cable to the device & the mobile or any compatible application will get charged. Also, Main supply connected to portable charger will charger lithium-ion batteries which will charge the device when required. The 220 volts AC obtained from main supply is converted to 9v by step down transformer and bridge rectifier is used to convert AC voltage to DC voltage.
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9. CIRCUIT DIAGRAM

10. CONCLUSION
An efficient methods to charge devices is been explained. Each mode is used as per convenience; one mode is driven by human effort and other by main supply. Thus, in absence of electric source portable charger satisfies the need. Portable charger has wide scope in rural areas and also while long travel. Since nowadays everything is being developed or produced meticulously with no harm to the environment. This is a good example of eco-friendly application.
REFERENCES


