DEDICATION

I dedicate this piece of work to the engineering family

ENGINEERING FAMILY

ACKNOWLEDGEMENT

- thanks to the engineering family of the HIGHER TECHNICAL TEACHERS TRAINING COLLEGE (HTTTC) .

ABSTRACT

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This project aims to design a faster, more efficient, and cheaper machine compared to other state-of-the-art designs, capable of producing reusable electrical energy from Human bike pedalling, which can then be employed for mobile phone charging. Our fabrication process involves steel sheets and metal tubes, which are first marked using a ruler and a vernier calliper and then manually divided using a cutting disc. Furthermore, the tubes were welded together to from a frame while the sheets produce were bended into a table with the help of a welding machine and a baguette. The next step in the process involves incorporating to the frame, the supports which had been drilled onto the bicycle and holding it erect with the help of screw and nuts. The dynamo was later welded on the frame just below the tire with its head touching the tyre and the electrical circuit which comprises a stabilizer, rectifier, capacitor, regulator, power bank and USB cable was then mounted. The mounting phase starts with creating the connection between the dynamo and the stabilizer, and then binding the stabilizer with rectifier using connection cables, then followed by uniting the double alternation rectifier with the capacitor. Moreover, the regulator was also connected to the capacitor which was then mapped to the power bank and then to the USB cable, then finally to the phone charging port. The results obtained from experimentation shows our proposed prototype achieves a back wheel average speed of 107RPM, a mechanical power of 1.504KW, an electrical power of 6W, a current of 1A, and a 5V voltage hence accounting for 81% efficiency. Results of experimentation also shows that our model is capable of effectively charging about 5 phones within a period of 1h30mins, hence proving that the effectiveness and versatility of our system which meets our expectations of charging multiple mobile phones within a short period of time

Keywords

Reusable energy, Biking energy transformation, mobile phone charging, Mechanical design

RÉSUMÉ

Ce projet a pour but, la fabrication d'une machine capable de produire assez d'énergie électrique nécessaire pour recharger des téléphones portables. Notre prototype s'avère plus rapide, moins couteuse puisqu'il provient d'Energie musculaire produite par des pédaleurs de vélos. Le processus de fabrication de la machine commence par l'achat des différents matériaux qui sont voir page 40-41 Sur les tôles d'acier et les tubes métalliques, nous effectuons un marquage à l'aide d'une règle et d'un pied à coulisse, coupé à l'aide d'une machine à découper avec un disque de coupe et meulé les pièces aux dimensions requises à l'aide d'une machine à meuler fournis d'un disque de meulage. Plus tard, les tubes sont soudés ensemble pour former le cadre et les tôles soudées pour former la table à l'aide d'une machine à souder et d'une baguette. Ensuite, nous soudons sur le cadre, les supports qui avaient été percés et puis le vélo à l'aide de vis et d'écrous. La dynamo est ensuite fixée sur les rayons de la roue arrière du vélo à l'aide de supports s assurant que la tête de la dynamo touche le pneu. Le vélo, le cadre et la table sont ensuite peints. A la fin, le circuit électrique, qui comprend le redresseur, le condensateur, le régulateur, la banque d'alimentation et le câble USB, a est monté. Le montage commence par la connexion entre la dynamo et le redresseur à l'aide de câbles de connexion, suivi de la connexion entre le redresseur à double alternance et le condensateur, puis le régulateur a été connecté au condensateur qui est ensuite connecté à la banque d'alimentation et de la sortie USB qui est donc finalement connecté à la banque d'alimentation et au téléphone. Les résultats obtenus à partir de nos calculs sont les suivant ; Une vitesse moyenne de la roue arrière de 107RPM, une puissance mécanique de 1.504KW, une puissance électrique de 6W, un courant de 1A, une tension de 5V et un rendement de 81% et ça peut charger 5 téléphones dans 1H30. Une fois l'essai terminé, nous suivons nos recommandations, le résultat obtenu est satisfaisant car il répond à notre attente de recharger plusieurs téléphones portables dans un délai court.

Mot clé : Energie Re utilisable, Transformation d'énergie de cycliste, recharge de téléphone portable, Prototype Mécanique.

Specifications

In this part it is a question for us of presenting the context of our study and the problem, the objectives, the methods and materials necessary, the expected result and the provisional plan of our work.

1. Context of study and problem

This study is carried for the purpose of education. the main interest of this work is to obtain electricity from our pedal power mobile phone charger. This energy can be used for the social or industrial community to charge their various electrical components. It can also be noted that the electrical energy produced by the pedal power mobile phone charger can be commercialised. The project we want to carry out is of great importance both socially, in our households and industrially. Indeed, it allows the various operators to save time and get access to electrical energy even when the national electricity provider is unavailable. In addition, it will allow us to use our physical efforts and to obtain energy hence enabling us to do some sport which a primary human need without however degrading or cluttering the surrounding environment.

2. Objectives

To carry out this study, started by setting a general objective and specific objectives.

2.1 General objective

To make a machine which can produce electrical energy.

2.2 Specific objectives

- Obtain a good return of more than 70%;
- Save time;
- Guarantee health and safety conditions;
- Facilitate after-sales maintenance.

3. Methods and materials needed

3.1 Methods

- Carry out field visits and identify the problems encountered by communities during energy shortage;
- Browse books dealing with electrical energy production techniques;
- Carry out the conceptual study of the machine;

- Carry out the manufacturing analysis study;
- Build the machine.

3.2 Necessary materials

- Internet;
- Computer-aided design and word processing software;
- Books;
- Raw material;
- Mechanical manufacturing workshop of HTTTC Douala.

4. Expected results

With a view to finding a solution to the problem of electricity shortage we have proposed to make a machine in order to obtain easy electrical energy at a very short time. However, to achieve the objectives that, we have set ourselves some specifications, namely: to produce a quantitative amount of electricity, qualitative (without short-circuiting electrical devices connected to it), hygienic and safe way; we are also counting on the support of our supervisors, our respective families and our friends.

5. work plans

We propose the following work plan:

- Literature review on mobile phones charging and the various existing charging methods;
- Formulation of the problem by study of the solutions;
- Machine design study;
- Machine manufacturing analysis study;
- Cost estimate.

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LIST OF ABREVIATIONS

- **RFID :** Radio Frequency Identification
- **PSTN :** Public Switched Telephone Network
- **GSM :** Global System for Mobile Phones
- **MMS :** Multimedia Messaging Service
- **USB :** Universal Serial Bus
- **IC :** Integrated Circuit
- **QC :** Quality Control
- **PF** : Principal Function
- **CF :** Constraint Function
- **F.A.S.T :** Function Analysis System Technique
- **Z_1 :** number of teeth of the pinion
- **Z_2 :** number of teeth of the gear
- **R_1 :** radius of the pinion
- **R_2 :** radius of the gear
- **D_1 :** diameter of the pinion
- **D_2 :** diameter of the gear
- **τ :** torque
- **N_1 :** rotatory speed of the pinion
- **N_2 :** rotatory speed of the gear
- **P :** power
- **Pc :** corrected power
- **ω :** angular speed
- **F :** force
- **p :** pitch
- **a :** center distance
- **v :** linear speed of the chain
- **L_p :** length of chain in mm
- **L_m :** length of chain in links
- **T_p :** principal tangential force
- **V :** speed of the gear

- **s:** security coefficient
- **k:** % of chain resistance to charge

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GENERAL INTRODUCTION

A telephone which is an electrical device is used almost everywhere in the world both by children and adults. It is designed for the transmission and the reception of human voice through calls. It has become the most widely used means of communication in the world. People can communicate using a telephone through calls, messages, voice-notes, etc. a telephone converts sound, typically and most efficiently the human voice, into electronic signals that are transmitted via cables to another telephone which produces the sound of the receiving user. Given that it is an electrical device means it has a battery and should be charged when the battery is low or dead. Many sources of energy are being used today to generate electricity that can charge a phone and also run electrical appliances [1].

Fossil fuels have been used for centuries to generate electrical power. Although it is a very good source of energy, it is non-renewable and unsustainable, not only does it pollute the environment but the drilling process is very dangerous [2]. Another source of electrical engineer which is the solar panel that produces electrical energy from sunlight has been replacing fossil fuels. It also has its limitations such as, high cost of manufacturing and installation. Since it generates electrical energy from sunlight means that little or no energy will be produced on cloudy and rainy days and even at night [3].

Pedal power is the act of getting energy from human being. It can be described as the transfer of energy generated through the movement of human feet and strengthens the muscles and the energy generated in this process is used to produce electricity which is less costly and pollution free [4]. In rural areas where electricity is absent or in cities when the national grid supply is not available, people find it difficult charging their phones. It is with regard to this problem that we came up with the theme **CONCEPTION AND REALISATION OF A PEDAL POWERED MOBILE PHONE CHARGER** which will help people to charge their phones through pedalling.

This work will be presented in two parts, part I made up of one chapter and part II made up of two chapters. Chapter I which is the literature review will contain a little review on a mobile phone, existing methods of charging a mobile phone, types of phones, a functional analysis that will permit us to analyse the problem and give propositions of solutions. In chapter II study the materials used in the mechanism, dimensioning, graphical study, fabrication analysis, maintenance and cost. In chapter III, we will present our results.

PART ONE : GENERALITIES

This part of the work is made up of one chapter I which is the literature review will contain a little review on a mobile phone, existing methods of charging a mobile phone, types of phones, a functional analysis that will permit us to analyse the problem and give propositions of solutions.

CHAPTER I : LITERATURE REVIEW

I.1) HISTORY AND DESCRIPTION OF A MOBILE PHONE

I.1.1) History of a mobile phone mobile

Phones were invented in the early 1940s when engineers working at AT and T developed cells for mobile phone base stations. The very first mobile phones where not really mobile phones at all. They were two ways radios that allowed people like taxi drivers and the emergency services to communicate. Motorola on April 3th 1973 were the first company to mass produce the first handled mobile phone. These early phones were often referred to as Og phones. The first mobile phone mentioned were early used to make and receive calls, and they were too bulky, it was impossible to carry them in a pocket. These phones used primitive RFID and wireless systems to carry signals from a cabled PSTN end point. Later, mobile phones belonging to the global system for mobile communication (GSM) network became capable of sending and receiving text messages. As these devices evolved, they became smaller and more features were added, such as multimedia messaging services (MMS) which allowed users to send and receive images, along with the texting and camera features, cell phones started to be made with a limited capability to access the internet, known as data services. [5]

I.1.2) Description of a mobile phone

A mobile phone typically operates on a cellular network, which is composed of cell sites scattered throughout cities, country sites and even mountainous regions. However, the cellular network used for mobile phones now called smart phones when they encompass modern design, have also evolved. At the same time the network used by the smart have also evolved.

The batteries in mobile devices are miracles of chemical engineering, holding huge amounts of energy that can keep your devices running for hours. Most modern mobile devices use lithium ion (sometimes called LI-ions) batteries, which consist of two main parts, a pair of electrodes and the electrolyte between them [6]. The capacity of a battery is measured in mill ampere hours (mAh) which indicates how much energy the battery can delivers over time, and hence higher battery capacities, higher phone user times.

I.1.3) Uses of a mobile phone

Mobile phones are used for a variety of purposes, such as;

- Keeping in touch with family members, for conducting business and in order to have access to a telephone in the event of an emergency.
- Some organisations assist victims of domestic violence by providing mobile phones for use in emergencies. These are often refurbished phone
- The advent of widespread text-messaging has resulted in cell phone novel, the first literary genre to emerge from the cellular age via text messaging to a website that collects the novel as a whole
- Mobile phones also facilitate activism and citizen journalism
- The Tv industry has recently started using mobile phones to drive live tv viewing through mobile apps, advertising, social and mobile tv
- Mobile phones are also used for mobile banking and payment;
- A study of Motorola found that one in ten mobile phone subscribers have a second phone that is often kept secret from other family members. These phones may be used to engaging such activities as extramarital affairs or clandestine business dealing [7].

I.2) TYPES OF CELL PHONES

a) Feature phones

Feature phones is a term typically used as a necronym to describe mobile phones which are limited in capacities in contrast to a modern smartphone. Feature phones typically provide voice calling and texting messaging functionality in addition to basic multimedia and internet capabilities, and other services offered by the user wireless service provider. A feature phone has additional functions over a basic mobile phone which is only capable of voice calling and text messaging.

Feature phones and basic mobile phones tend to use a propriety custom designed software and user interface.by contrast, smartphones generally use a mobile operating system that often shares common traits across devices [8]. View figure I.1

Figure I.1 : Feature phones [9]

b) Smart phones

Smartphones are the most advanced mobile phone technology available to the masses today. The international telecommunication union measures those with internet connection, which it calls active mobile broadband subscriptions (which includes tablets …).in the developed world, smartphones have row over taken the usage of earlier mobile system. However, in the developing world they account for around 50% of mobile telephony. View photo

Figure I.2 : smart phones [10]

I.3) CHARGING OF A CELL PHONE

A battery charger or recharger is a device that provides electricity to convert into stored chemical energy for storage in electrochemical cell by running an electric current through it. The charging protocol depends on the type and size of a battery being charged. Some battery types have high tolerance for over charging (i.e., continued charging after battery have fully charged) and can be recharged by connection to a constant voltage source or a constant current source depending on battery type. Simple chargers of this type must be manually disconnected at the end of the charge cycle. Some battery types use a timer to cut off when charging is complete. Other battery types cannot withstand over charging, becomes damaged (reduced capacity, reduced lifetime), overheating or even exploding. The charger may have temperature or voltage sensing circuits and a microprocessor controller to safely adjust the charging current and voltage the state of charge, and cut off at the end of charge [11].

I.3.1) Factors affecting the charging of a mobile phone

Some people have discovered that after using the mobile phone for a period of time, the cell phone battery power of the mobile phone will drop very fast. Sometimes the charging of the mobile phone is getting slower and slower. Before charging was very fast, why is it getting slower and slower now? This is because many users do not develop good habits when using mobile phones. What factors will affect the charging speed of mobile phones?

a) Mobile phone charging protocol

The phone itself supports fast charging, which is the charging protocol for mobile phones. Of course, power delivery is the best agreement. But the agreement itself is not important, the focus is on power. First determine what agreement is on his mobile phone. Generally, the current is below 2A, and the data cable can be as long as it is not a poor-quality product [11].

b) Data line

A good data line must be equipped. The fake data line not only has an impact on speed, but also has security risks. The data cable is connected to the charger and the mobile phone. Because the data line has resistance, there will be a voltage drop on the data line. If the resistance is too large, the power will be lost to the data line. The speed of the mobile phone charging and the data line have a great relationship [11].

c) Power Adapter

The adapter that matches the phone's charging protocol will get the best charging speed if the output power of the power adapter can meet the needs of the mobile phone. According to the different battery capacity, the charging current requirements are different, generally 0.5C-0.8C, for example, 05C of 2000mAH battery, the current is 1A, 0.8C is 1.6A, and his charging current is 1A to 1.6A. In the meantime, the mobile phone generally sets a value for this value, 1A or 2A, to meet the output standard of the power adapter (charger) on the market [11].

d) Good power supply environment

The charging environment is also very important for the charging speed. In a low temperature environment, the low temperature protection mechanism of the lithium battery will cause the battery activity to decrease, causing the charging speed to slow down or even not to charge. It is best to charge your phone at room temperature. The mobile phone interface will not be cleaned for a long time, and dust may cause poor contact between the charging port and the data cable [11].

I.4) METHODS OF CHARGING CELL PHONES

When your cell phone battery runs out, you need to charge it and you need to choose the best method to charge it. New generations of smart phones are emerging one after another. At the same time, cell phone battery charging demands more than before, not only of the charging speed, but also the charging capacity. Intelligent cell phones cost more power because of various newly built-in mobile apps like games, shopping apps, cell phone camera software, etc. Therefore, a fast and efficient cell phone battery charging method is as important as a life straw for both the smart phone itself but for the cell phone owner [12].

I.4.1) Traditional cell phone charging methods

Dating back to 10 years ago when cell phones were still in an initial phase, we could see Nokia cell phones and other keyboard phones anywhere. If you had a cell phone then, you must charge your cell phones with a long cable connected with a socket, or remove cell phone battery and charge it with a universal battery charger. The universal charger is so functional that it can charge almost all batteries. Before the popularity of USB charger, almost all electronics were supported by batteries and there are still many battery electronics at present. It is easy to charge battery with universal charger by just removing the cell phone battery and holding it with two sheet metals correctly. But the battery life will be lost and become shorter or even scrapped if charged by universal charger frequently. So that is why traditional charging methods must be replaced [12].

Figure I.3: traditional charging method [12]

Advantages:

- It charges rapidly due to direct contact between the battery and the charger;
- It is less cumbersome and bulky hence can be carried easily.

Disadvantages:

- It easily damages the battery cause the battery charges over and over due to direct current;
- Doesn’t adapt to moderate consumption of energy;
- Can cause battery explosion due to high internal heat added directly to the battery;
- Cannot charge in absence of electricity.

I.4.2) Modern cell phone charging methods

A series of newly cell phone chargers, including corded USB charger, external battery charger and wireless charger, are flourishing and are sold easily.

a) Corded USB charger

Almost all smart phones come with a corded USB charger, usually 5V 1A or higher. The USB charger makes it easier to charge your cell phones by just connecting it and plugging it into the AC socket. USB cell phone chargers have adopted advanced QC technology or smart IC technology, to finish charging in a short time. Built-in full safety guards can protect cell phone battery against damages. Moreover, the long USB cable allows you to charge it anywhere, plug and play. This is the first cell phone charging innovation and is still widely used at the moment [13].

Figure I.4: corded USB charger [13]

Advantages;

- High speed charging;
- Less cumbersome and bulky hence con be transported easily.

Disadvantages;

- Prolonged skin contacts with the charging cable and connector when charging cable is connected can cause harm or injury;
- Can't charge in absence of electricity.

b) External battery pack

Though, corded USB charger realizes quick charging without removing battery, it is somehow messy to take it out when you're going for traveling, camping or business and you can do nothing if your cell phones run out. External batteries or power banks are quite powerful for outdoor use. The mobile battery pack has large capacity that allows for several times of charging. Designed with more than one USB ports, some power banks can supply power for not only cell phones but iPad, digital cameras and other USB mobile electronics. External batteries are compact and portable, ideal for any outdoor activities [13].

Figure I.5: external battery pack [13]

Advantages;

- No risk of battery damage cause charging is smooth;

➢ Charge even in the absence of elecctricity.

Disadvantages;

➢ It needs to be recharged before usage;
➢ Slow charging method.

c) Wireless charging

Wireless cell phone charging is the latest battery charging method to allow you to charge your cell phones without any cables. There are mainly two charging methods today including QI charging pad and battery case. The wireless charging pad realizes power transmission though magnetic field induction and magnetic resonance. And the battery case is an upgraded extended battery that is also used as a protective cell phone case. It can provide extra battery for cell phones like a power bank but without cable [13].

Figure I.6 : Wireless charging [9]

Advantages;

➢ Very fast charging;
➢ No risk of battery damage cause charging is smooth.

disadvantages

➢ Does not charge all types of phones i.e before using these charging method the phone most be compatible with the wireless charging system (it must hare a wireless charging fonctionality);
➢ Does not charge in the absence of elctricity;
➢ It emits radiations.

The newly charging method opens a new era of cell phone charging. Up to now, Apple, Samsung, MOTO and other leading cell phone brands, all tend to embrace the newest wireless power technology. In the future, wireless cell phone charging will be the leading charging method [13].

I.5 ANALYSIS OF NEED

The aim of this analysis is to list, characterise, order and value the functions of the machine to be designed in order to make the best choice of its functions. It equally helps to define the need in a more precise manner.

I.5.1 The beast horned diagram

It helps in formulating the need of a product by responding to the questions of table II.1 below;

Table I.1: Analyse of need

NO	Pedal powered mobile phone charger	
	Questions	Answers
1	To whom is it useful	Homes, sporting halls (every structure)
2	On what does it act	Phone
3	What purpose	To charge the phone

The Fig. II.1 below is the graphical representation of the need of the machine.

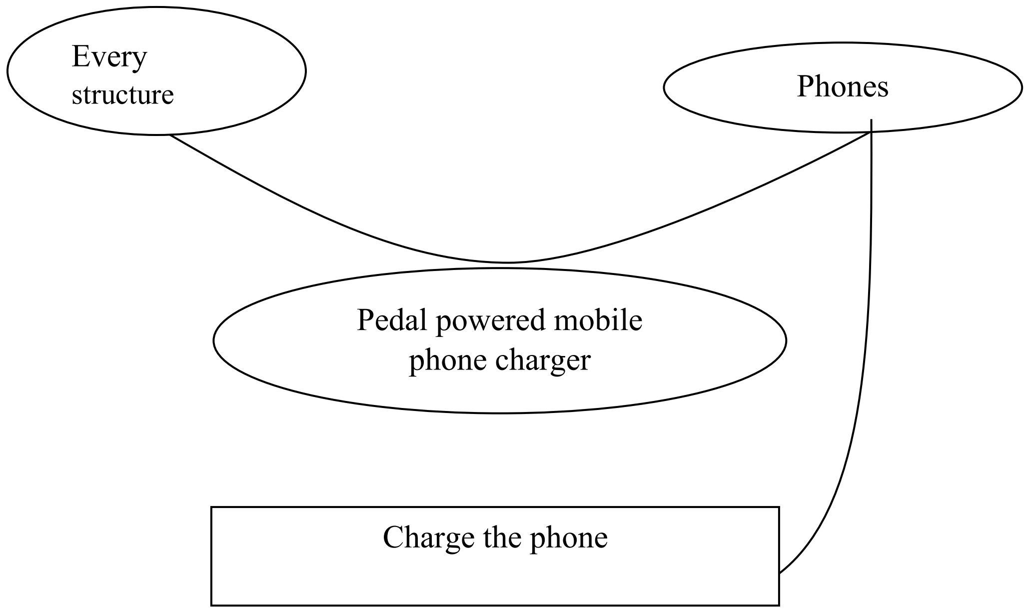

Figure I.7: The Beast Horned Diagram

I.5.2 Formulation of the need

The Pedal powered mobile phone charger is used by everybody everywhere to charge a mobile phone.

I.6 FUNCTIONAL NEEDS ANALYSIS

After carrying out surveys around us (i.e., in homes, sporting clubs etc), we were able to list their different needs that we will later represent in function of services.

I.6.1 Identification of elements of the external environment

In a normal usage phase, the machine interacts with,

- The user ;
- The telephone ;
- The external environment ;
- Safety standard mesures ;
- Congestion ;
- Source of energy.

I.6.2 The octopus diagram

It is a graphical representation that consists of presenting the different interactions between the machine and the elements of the external environment. Fig II.2 presents the octopus diagram of a Pedal powered mobile phone charger in its usage phase.

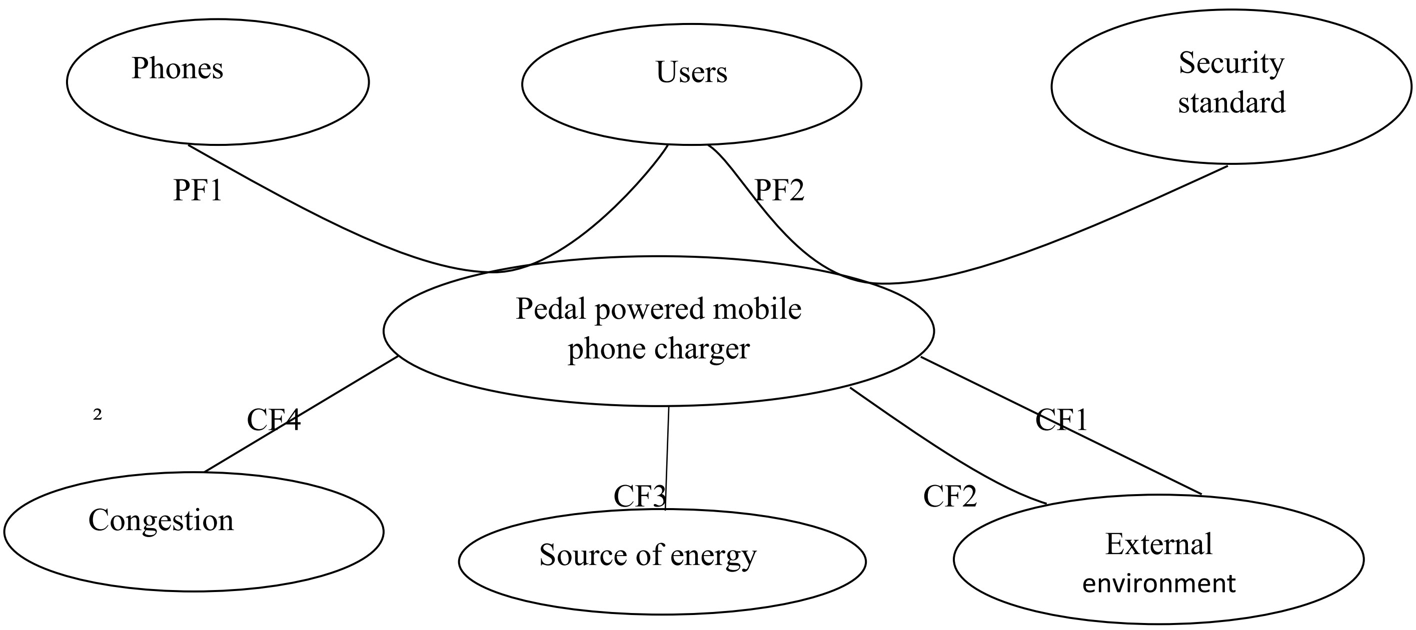

Figure I.8: Octopus diagram

I.6.3 formulation of service function

A service function is either a principal function (PF) or a constraint function (CF). We can list for our machine 02 PFs and 04 CFs;

- PF1; permits the user to charge his phone;
- PF2; easy manipulation by the user and guaranties his security;
- CF1 ; respects his environment ;
- CF2; resist to attacks from the external environment;
- CF3; adapts to a moderate consumption of energy;
- CF4; adapt to a less congested environment.

I.6.4 Characteristics of the service functions

The table I.2 below gives a characterisation of its functions.

Table I.2: Characteristics of the service functions

Service Function	Elements to characterise		Application criterion	Level of evaluation and flexibility
PF1: permits the user to charge his phone	User		Age (A)	$A \geq 10$
			Sight	Normal
			Height (H)	$H \geq 1000$ mm
	Charger		Time to charge a phone to 100% (T)	$t \leq 90$min
			Yield (ŋ)	ŋ≥80%
	Phone		Variaties	None
PF2: easy manipulation by the	Security	Machine	Wounds	None
			Toxicity	None
		User	Dressing	None

user and garanties his security			
CF1 ; respects his environment	Surrounding environment	Garbage management	Cleanliness around the machine
		Release of toxic gases	Nul
		Noise	Lesser
CF2; resist to attacks from the external environment	Sensibility to attacks	Corrosion	Average
		Termites/weevil	Nul
		humidity	Average
CF3; adapts to a moderate consumption of energy	None	None	None
CF4; adapt to a less congested environment	Space	Size of the space (s)	$S \leq 1.5m^2$

I.7 TECHNICAL FUNCTIONAL ANALYSIS

This analysis will be done with the help of the FAST diagram, which will present our way of thinking, acting and talking.

The fast diagram is constructed from left to right in the logic of "why and how". We are going to develop service functions of the machine in terms of techniques, we will choose solutions to finally construct the machine. The fast diagram is made up of a set of essential data permitting us to have a better knowledge of any complex machine. Hence, we have the fast diagram represented by Fig I.9 below.

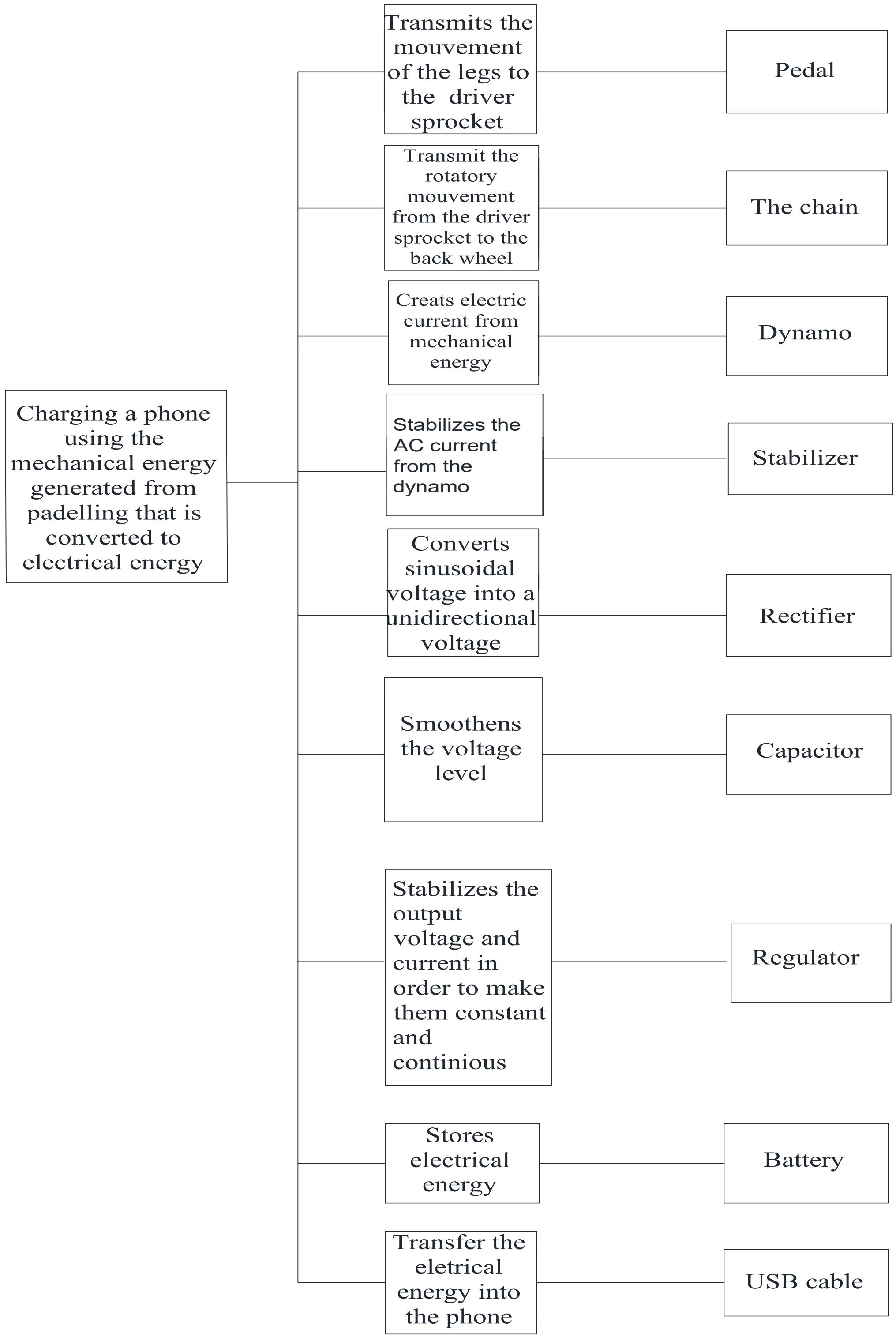

Figure I.9: F.A.S.T. Diagram

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I.8 PROPOSITION OF CONSTRUCTIVE SOLUTION

The aim of this part is to propose some solutions and to analyse critically each of these solutions in other to make a comparative study which will permit us to choose the optimal solution.

I.8.1 Solution 1 : Solar mobile phone charger

a) Circuit diagram

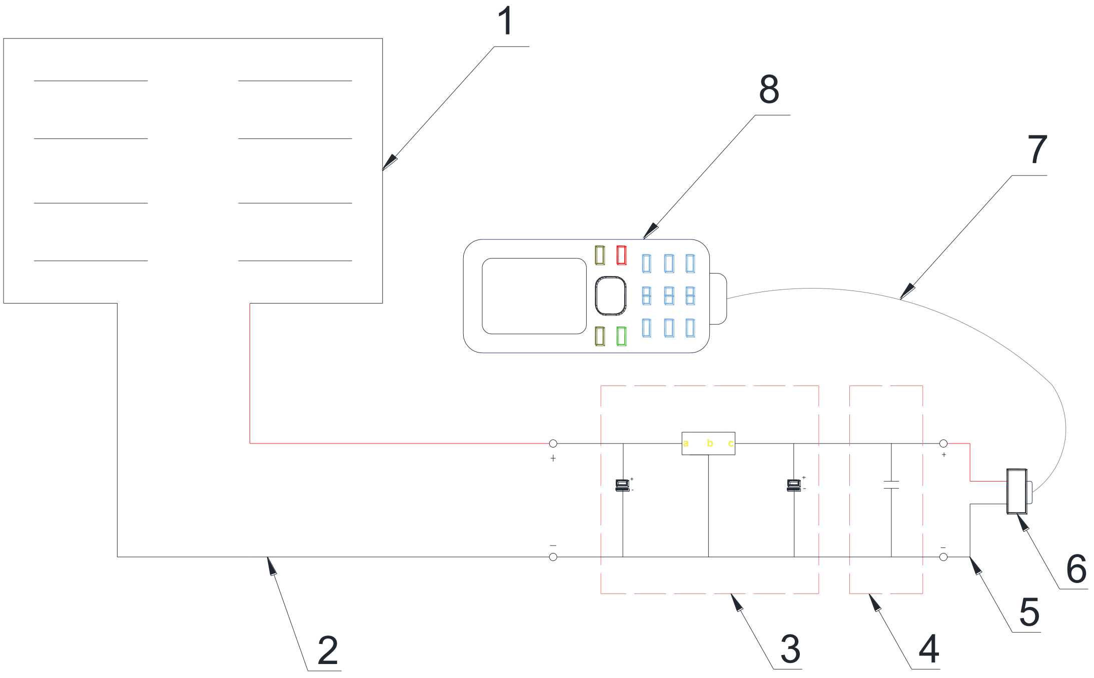

Figure I.10: circuit diagram of a solar

b) Nomenclature

1- Solar panel

2- Input cables from solar panel

3- Regulator

4- 100nF capacitor

5- Output cables to USB

6- USB port

7- Data cable

8- Mobile phone

c) Description and functioning

The Solar panel **1** gain energy from the sun during day time and send this energy through the input cables **2**, this current passes through the Regulator **3**. The regulator **3** is there to smoothen the current and confine it to move in one direction (direct current). The regulator consists of a 10µF capacitor which ensure that the direct current leaving the rectifier to reach the 100nF capacitor is steady. The current passes the 100nf capacitor **4** to an output cable **5** and the USB port **6** then through the data cable **7** to the mobile phone **8**.

d) Advantages

- It is pollution free and no greenhouse gases are emitted after installation
- Renewable clean power is available every day of the year even on cloudy days
- Can be installed virtually everywhere
- Safer than traditional electric current

e) Disadvantages

- High cost for materials and installation
- No solar power at night or rainy days

I.8.2 Solution 2: Hand crank mobile phone charger

1. Kinematic and circuit diagrams

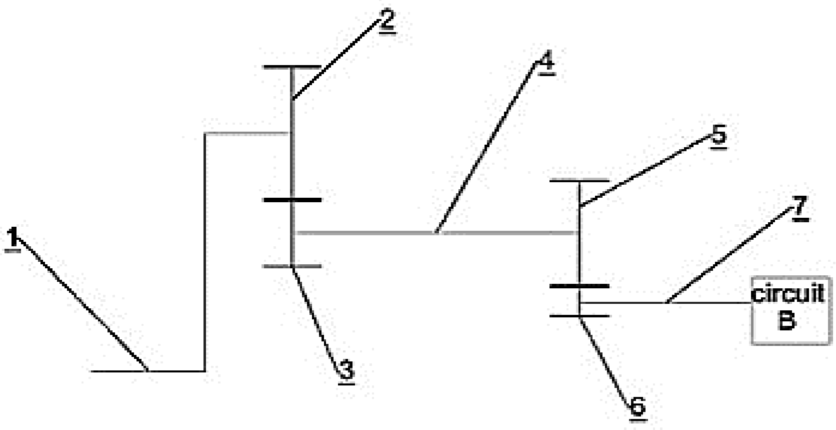

Figure I.11: kinematic diagram of a hand crank

Nomenclature

1- Handle	**2**- Gear 1
3- Pinion 1	**4**- Shaft
5- Gear 2	**6**- Pinion 2
7- Shaft to circuit B	

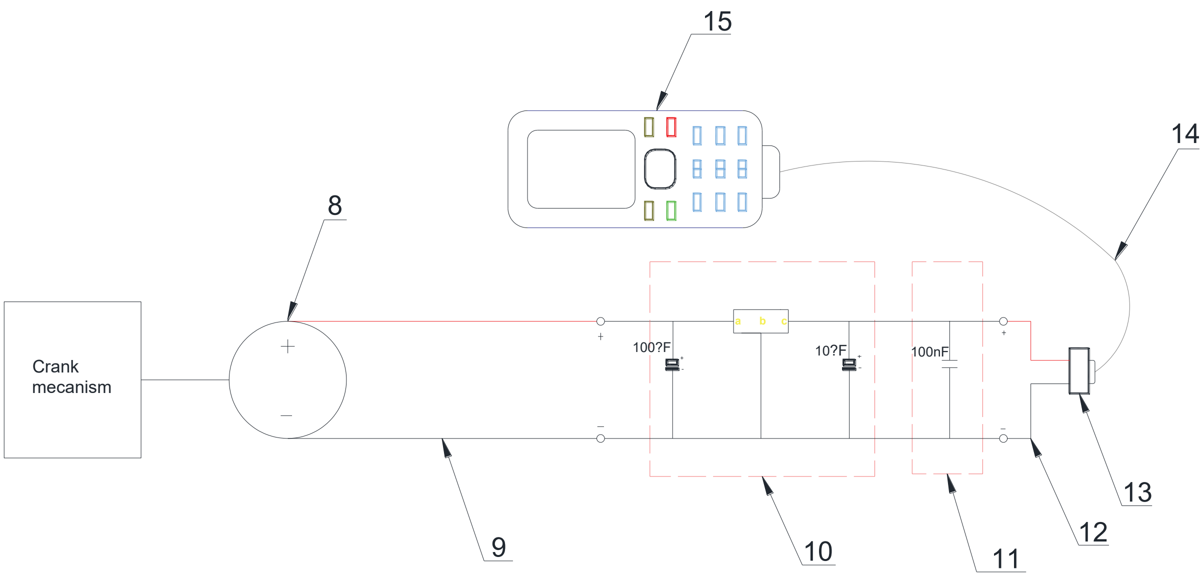

Figure I.12: circuit diagram of a hand crank

Nomenclature

8- Generator	**9**- Input cables from generator
10- Regulator	**11**- 100nF capacitor
12- Output cables to USB	**13**- USB port
14- Data cable	**15**- Mobile phone

a) Description and functioning

When a force is applied on handle **1**, it makes handle **1** to rotate. This rotation causes the wheel **2** to go in rotation with pinion **3** and hence transferring this movement through the shaft **4** to wheel **5**. This rotation movement between gear train (**2**,**3**) is transferred to the gear train (**5**,**6**) produces kinetic energy which is then transfer to circuit B through shaft **7**. In circuit **B** the generator **8** gain kinetic energy from the crank mechanism during cranking and send this energy through the input cables **9**, this current reaches the regulator **10**. The regulator **10** is there to smoothen the current and confine it to move in one direction (direct current). The regulator consists of a 10µF capacitor which ensure that the direct current leaving the rectifier to reach the 100nF capacitor is steady. The current passes the 100nf capacitor **11** to an output cable **12** and the USB port **13** then through the data cable **14** to the mobile phone **15**.

b) Advantages

- Generates emergency power for phones;
- Can be carried everywhere;
- Small in size.

c) Disadvantages

- Phone stops charging immediately cranking stops;
- It takes a longer time to charge the phone.

I.8.3 Solution 3: Pedal powered mobile phone charger

1) Kinematic diagram.

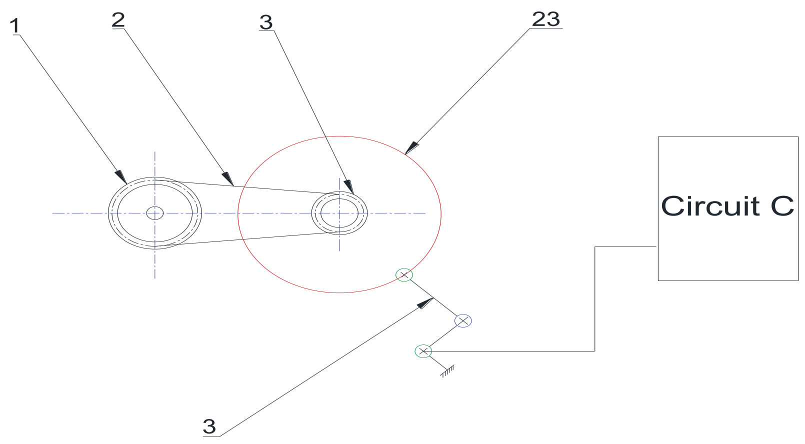

Figure I.13: kinematic diagram of a Pedal powered mobile phone charger

a) Nomenclature

1-Driver sprocket

2-Chain

3- Driven sprocket

4- Dynamo

23- wheel

2) circuit diagram

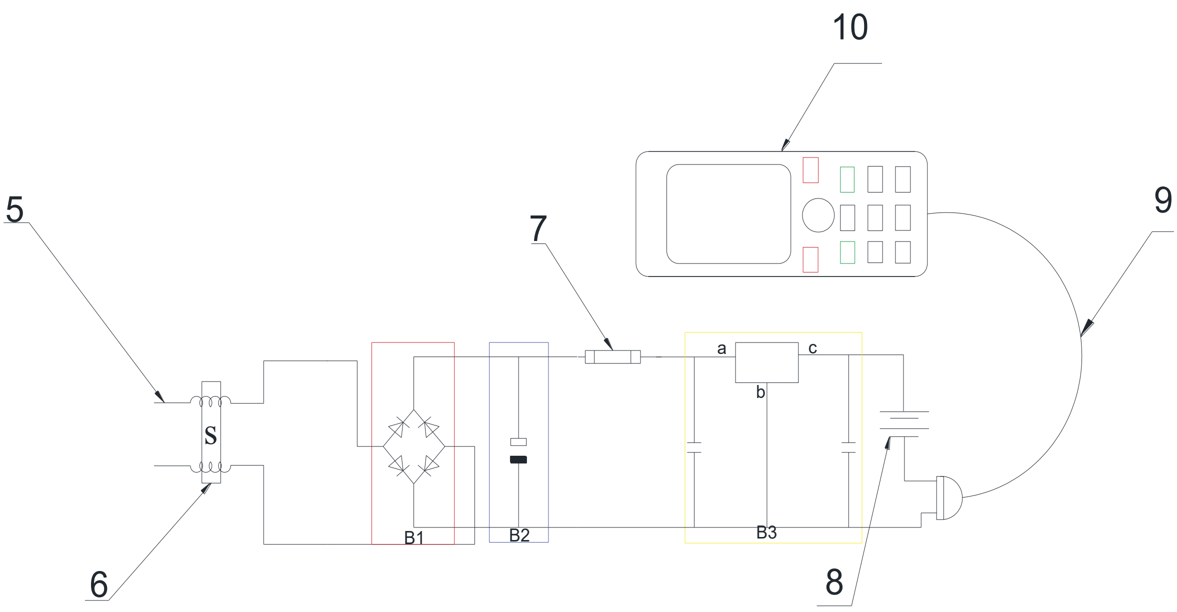

Figure I.14: circuit diagram of a Pedal powered mobile phone charger

a) **Nomenclature**

5- Cables

6- Stabilizer

7- Fuse

8- Battery

10- Mobile phone

B1- Rectifier

B2- Capacitor

B3-Regulator

9- USB cables

3) Description and functioning

When a force is applied on the paddles, it makes the driver sprocket **1** to rotate. This rotation causes the chain **2** to go in rotation with driven sprocket **3** and hence transferring this movement through the shaft to wheel. On the wheel is connected the dynamo. During the rotatory movement of the wheel, the dynamo **4** which is in contact with the wheels get in motion and start rotating too. During this rotation, the kinetic energy produced is converted to electrical energy by the dynamo **4** which is then transfer to **circuit C** through cables **5**. In **circuit C** the electrical energy leaving the dynamo passes through the stabilizer **6** stabilizes the AC current from the dynamo.from the stabilizer the current passes through the rectifier **B1**. The rectifier

B1 convert the AC current leaving the dynamo to DC current. The DC current leaves and reaches the capacitor **B2** which smoothens the voltage passing through it and stores extra charge entering the circuit and liberate this charge when the charge entering the circuit is low, this is to ensure steady current flow in the circuit. From the capacitor **B2** this current reaches the regulator **B3**. The regulator **B3** is there to give out a steady voltage of 5V and current of 1A (direct current) necessary to charge a mobile phone. The steady current is then stored in the battery **8**. From the battery **8**, the charge passes through the USB charger **9** to the phone**10**.

3) Advantages

- Generates quick energy for phones
- Takes a shorter time to charge a phone
- Helps maintain fitness when pedalling.
- It can be used to generate income

4) Disadvantages

- Too bulky, so can't be carried along when traveling
- The cost is very high compared to other methods.

I.9 CHOOSING THE OPTIMUM SOLUTION

Given the above proposed solutions, it is necessary to choose an optimal solution according to the pre-defined criteria studied in the functional need analysis.

Choice criteria

- Ability to charge a phone faster
- Duration of life
- Numbers of phones it can charge with a power 1.052kw.
- Hygiene conditions
- Machine performance

These criteria are attributed as follows;

- 1 =Bad
- 2 = Fair

- 3 = Good
- 4 = Very good
- 5 = Excellent

The table below shows the comparison of the 3 proposed choices. It will help us to choose the optimum solution.

Table I.3: Criterion for the choice of the optimum solution

CRITERIA	MACHINE		
	Solar mobile phone charger	Hand crank charger	Pedal powered mobile phone charger
Ability to charge a phone faster	3	2	4
Duration of life	3	3	4
Numbers of phones it can charge with a power 1.052kw.	1	1	4
Hygienic conditions	4	4	4
Machine performance	2	2	4
TOTAL	**13/25**	**12/25**	**20/25**

- **Justification of the Criterion for the choice of the optimum solution**

- Ability to charge a phone faster: a hand crank charge takes 16hrs to charge to completion [14], while the solar mobile phone charger 2.5-3hrs to charge from a 10W panel [15] while the pedal powered mobile phone charger takes 1.30min to charge from dead to fully charged [16]
- A solar panel will produce in general between 1.4 kWh and 1.9 kWh of electricity on average, per day, in the United States - which is enough to run a few small electrical

loads like a TV, lights, and device chargers.so the solar panel need a battery in other to store the charge it has receives. On average every 5h a solar panel produces 370 watts electricity which in average can charge just at most 1 phone [17]. A hand crank is designed to charge just one appliance at the time and with it 230watts electrical energy produced every 4hr it is just perfect for the net charging of a mobile phone [18]. While a pedal powered mobile phone charger produces (1.052kw every mins) (determined experimentally) a power of 0.880kw per min ideal to charge more than 3 phones.

- The pedal powered mobile phone charger performs more than the hand crank charger and the solar mobile phone charger [19].

I.10) NOTION OF MAINTENANCE

Machine maintenance is the work that keeps mechanical assets running with minimal downtime. Machine maintenance can include regular scheduled service, routine checks and emergency repairs. It also includes replacement or realignment of parts that are worn, damaged or misaligned. Machine maintenance can be done either in advance of failure or after failure occurs. Machine maintenance is critical at any plant or facility that uses mechanical assets. It helps organizations meet production schedules, minimize costly downtime and lower the risk of workplace accidents and injuries [20].

I.10.1) Types of machine maintenance

1. **Reactive maintenance**

It refers to repairs done when repairs done when a machine has already reached failure. Since it’s unexpected, unplanned and usually leads to rushed emergency repairs.

2. **Routine maintenance**

Consists of basic maintenance task such as checking, testing, lubrication and replacing with or damaged parts on the planned and ongoing basis.

3. **Corrective maintenance**

It is any work that gets assets back into proper working order. For example, realigning a part during a routine inspection.

4. **Preventive maintenance**

Refers to any regular scheduled machine maintenance intended to identify problems and repair them before failure occurs.

5. **Condition-based maintenance**

Depends on monitoring the actual condition of assets in order to perform maintenance when there is evidence of decreased performance or upcoming failure.

CONCLUSION

Having reach the end of this chapter which dealt with the literal review of the telephone, types of telephones, functional analysis of a pedal power mobile phone charger, it should be noted that in the design of the machine, we have identified, analysed and formulated the need. Once the need was identified, we identified the different functions to be provided by the machine that we characterised, then we carried out a technical functional analysis which enabled us to identify solutions, including the must optimal and the notion of maintenance. The pedal power mobile phone charger was retained for its dimensioning and design study

PARTN TWO : REALISATION

This part is made up of two chapters. Chapter II which is the study the materials used in the mechanism, dimensioning, graphical study, fabrication analysis, maintenance and cost. In chapter III, we will present our results.

CHAPTER II : MATERIALS AND METHODS

II.1 MATERIALS

II.1.1 Names, Function, Image of materials

a) Bicycle

Here during riding, the wheels of the bicycle which carry the chain and sprockets system plays the role of a small generator. The main role of the bicycle here is to turn the wheel which will hence turn the dynamo to produce electrical energy [21].

Figure II.1: bicycle [22]

b) Dynamo

The role of a dynamo is mostly on the production and dissipation of electrical energy. Here the dissipation of electrical energy depends on the wheel size [23]. The dynamo here will be the main component for the production of electricity on our design [23].

Figure II.2: Dynamo [24*]*

c) Stabilizer

The main function of a stabilizer is to make the output voltage that supplies the equipment connected to it as much as possible equivalent to the ideal power supply, ensuring so that the oscillations of the electrical power are offset, and its output maintains a stable value, protecting them.

Figure II. 3: Stabilizer [25]

d) Rectifier

The role of a rectifier is to convert AC to DC power supply. Here we will use a double alternation rectifier (Bridge of diodes) [5]. The AC current leaving the dynamo will directly be converted to DC. Changing the AC current to DC is because DC power is significantly more energy efficient than AC power [26].

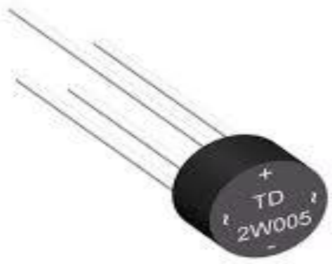

Figure II.4 : Double alternation rectifier [27]

e) Capacitor

A capacitor is an integral component of electrical equipment and is thus, almost always found in an electronic circuit. The primary purpose of capacitors is to store electrostatic energy in an electric field and where possible, to supply this energy to the circuit [27]. The use of a capacitor here is to store charge when there is extra charge entering the circuit and to liberate theses charge when the charge entering the circuit is low, in other to compensate [28].

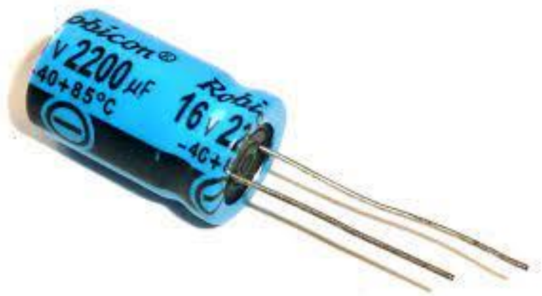

Figure II.5: Capacitor [28]

f) Regulator

A regulator is any electrical or electronic device that maintains the voltage of a power source within acceptable limits [29]. The role of the regulator here will be to ensure that a steady and constant current passes through the circuit [29].

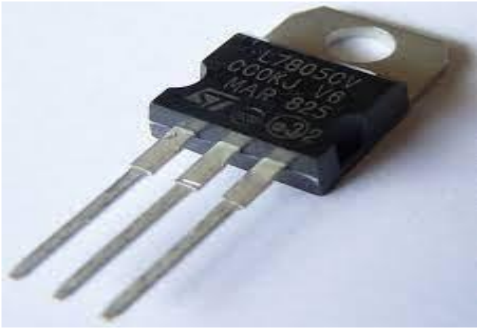

Figure II.6: Regulator [29]

g) Battery

A battery is a device that stores chemical energy and converts it to electrical energy [30]. The main role of the battery here will be storing charge [30].

Figure II.7: Battery [30]

h) USB cable

A power adapter that generates the 5-volt DC standard required by USB. The amperage varies, typically from 07A to 2.4A. The charger plugs into an AC outlet, and a USB cable plugs into the charger [31].

Figure II.8: USB cable [31]

II.2) METHODS

II.2.1) Dimensioning

II.2.1.1) Determination of the characteristics of the chain and sprocket system

Hypotheses

- We will adopt a chain with one row of links
- Mode of lubrication; periodically with a brush or burette

Data

- Speed of the gear V = 1.5m/s
- Average force F = 588N
- Z_1 = 18teeth
- Circular velocity of the pinion N_1 = 240rpm

- Calculation of the torque of the gear

$\boldsymbol{\tau = F \times R_2}$

AN: $= \mathbf{588 \times 0.169 = 99.372Nm}$

- **Calculation of the power**

P = $\boldsymbol{\tau \times \omega}$ **where** $\boldsymbol{\omega = 2\pi N_2}$ **and** $\boldsymbol{N_2 = \frac{V}{\pi D_2} \rightarrow P = \frac{2\times\tau\times V}{D_2}}$

AN: P $= \frac{2\times 99.372\times 0.9}{0.170} = \mathbf{1052.17W = 1.052KW}$

- **Calculation of the service power or corrected power**

Pc = K1.K2. K3.K4.P

K1: Function of number of rows **(Annexe 1)**

K2: Function of the nature of motor and receptor organs **(Annexe 1)**

K3: Function of the number of links (**Annexe 1)**

K4: Function of the number of teeth of the pinion **(Annexe 2)**

K1=1, K2=1, K3=1.3, K4=1.1

Implies,

$\mathbf{Pc = 1 \times 1 \times 1.3 \times 1.1 \times 1.052 = 1.504}\boldsymbol{KW}$

❖ **Choice of the chain**

From the corrected power Pc = 1.504KW and the rotatory speed of the pinion N1 = 240rpm, le graph of abacus relative to type A chains in the annexe permits us to choose the chain of type 50-10A. (**Annexe 3**)

This permits us to choose a pitch of **15.87mm**

❖ **Calculation of the pitch diameter of the pinion**

D1 $= \frac{P}{sin^{\pi}/Z_1}$

AN: D1 $= \frac{15.87}{sin\,(^{180}/_{18})} = \mathbf{91.39mm}$

❖ **Calculation of the pitch diameter of the gear**

D2 $= \frac{P}{sin^{\pi}/Z_2}$

AN: D2 $= \frac{15.87}{sin^{180}/_{40}} = \mathbf{202.27}\boldsymbol{mm}$

❖ **Calculation of the number of teeth of the gear**

K $= \frac{N_2}{N_1} = \frac{Z_1}{Z_2}$ => Z2 $= \frac{N_1 Z_1}{N_2}$

AN: Z2 $= \frac{240 \times 18}{108} = \mathbf{40}\boldsymbol{teeth}$

❖ **Calculation of the linear speed of the chain**

$v = \frac{N_1 \times p \times Z_1}{60} \rightarrow AN: v = \frac{240 \times 15.87 \times 18 \times 10^{-3}}{60} = \mathbf{1.15}\boldsymbol{m/s}$

❖ **Calculation of the center distance**

We have: $\frac{D_2}{D_1} = \frac{202.27}{91.39} = \mathbf{2.2}$ $=> \mathbf{1} \leq \frac{D_2}{D_1} \leq \mathbf{4}$

We take: $a \geq \frac{1}{2}(D_2 + D_1) + D_1 \rightarrow a_{min} = \frac{1}{2}(202.27 + 91.39) + 91.39 = \mathbf{238.22}\boldsymbol{mm}$

$a < 3(D_2 + D_1) \rightarrow a_{max} = 3(202.27 + 91.39) = \mathbf{880.98}\boldsymbol{mm}$

For the reason of bulkiness, we will choose: a **= 248mm**

❖ **Calculation of the angle of rolling-up of the chain**

$$\theta = 180° - 2sin^{-1}\left[\frac{Z_2+Z_1}{2}\right]$$

AN: $\theta = 180° - 2sin^{-1}\left[\frac{202.27-91.39}{2\times248}\right] = 158.16°$

❖ **Length of the chain in mm**

$$L_p = 2a + \frac{p(Z_1+Z_2)}{2} + \frac{p^2}{a}\left[\frac{Z_2-Z_1}{2\pi}\right]^2$$

AN: $L_p = 2\times248 + \frac{15.87(18+40)}{2} + \frac{15.87^2}{248}\left[\frac{40-18}{2\pi}\right]^2 = 956.23mm$

❖ **Length of the chain in links**

$$L_m = 2a + \frac{p(Z_1+Z_2)}{2} + \frac{(Z_2-Z_1)}{4\pi^2({}^{a}/_{p})}$$

AN: $L_m = 2\times248 + \frac{15.87(18+40)}{2} + \frac{40-18}{4\pi^2\left({}^{248}/_{15.87}\right)} = 81.25$

We will take $\mathbf{L_m = 82links}$

❖ **Determination of forces acting on the chain**

- T_p : principal tangential force

$$T_p = \frac{60\times P}{\pi\times D_2\times N} = \frac{60\times1753.6}{\pi\times202.27\times108} = 1533.12N$$

$$T_p = 1533.12N$$

On the dimensioning of our chain, we took 60% of the chain resistance to charge. Since we had a charge of 1533.12N acting on the chain, so k=0.6.

s: coefficient of security

Since s = 1/k

s = 1/0.6

s = 1.7≈ 2.

So, our coefficient of security **s = 2**

SYNTHESIS OF THE RESULTS

✓ Type of chain: **chain of one row of type 50-10A.**

- ✓ Diameter of the sprockets: **D_1 = 91.39mm, D_2 = 202.27mm**
- ✓ The pitch**: P =15.87**
- ✓ Number of teeth of the sprockets: **Z_1 = 18teeth and Z_2 = 40teeth**
- ✓ Length of the chain: **L_p = 956.23mm**, which implies **61links**
- ✓ Tension in the stretched and un-stretched chain: **T_p =1533.12N and t =0N**
- ✓ Coefficient of security **s = 2**
- ✓ Efficiency **η_1 = 94%**

II.2.1.2) Choice of the electrical components

- ❖ A connection cable of a very small section will be used
- ❖ A dynamo of characteristics: **5V and 1A**
- ❖ A double alternation rectifier (bridge rectifié)
- ❖ A regulator with characteristics; **5V and 1A**
- ❖ A battery with a storage capacity of **10000mA**
- ➢ **Choice of the capacitor**

For an output voltage of 5V and 1A,

We know that **Q = CV** $\rightarrow$ $\mathbf{C = \frac{Q}{V}}$ **but, Q = IT**

$$\rightarrow \quad \mathbf{C = \frac{I \times T}{V} = \frac{1 \times 1}{5} = 0.2F = 0.2\mu F}$$

- ❖ From the calculations, we will use a capacitor with a capacitance of $\mathbf{0.2\mu F}$.
- ➢ Efficiency

$$\eta_2 = \frac{P_{out}}{P_{in}} = \frac{5}{6} \times 100 = 84\%$$

η_2 = 84%

Overall efficiency = 81%

II.2.2) Graphical study

In this part of the chapter, it is a question of presenting the 3D drawing and the overall drawing of the pedal power mobile phone charger as well as the definition drawings of certain parts of the machine. To this presentation is added the calculation of several operating conditions.

II.2.2.1) 3D drawing of the pedal power mobile phone charger and 3D drawing of some parts.

Here we will present the overall appearance of the pedal power mobile phone charger in space, as well as that of some parts that we deemed useful to show. Thus, figure II.8 presents the 3D drawing of the pedal power mobile phone charger, figure II.9 presents the 3D drawing of the frame and figure II.10 presents the 3D drawing of the dynamo, the electric board and the bicycle.

Figure II.9: pedal powered phone charger

Figure II.10: Frame

a) b)

Figure II.11:3D drawing of a): dynamo; b) bicycle

II.2.3) Assembly drawing

In this part, we will present the mechanism in 2D in two views;

- A front view
- A top view
- The different details

These different views are accompanied by a nomenclature (see Manufacturing drawings)

II.2.4) Functional dimensioning

We highlight in this part, for each gap that we judged important for the proper functioning of the pedal power mobile phone charger, the rib chain followed by the calculation of the gap relating to this chain.

II.2.4.1 Calculation of the clearance *Ja*

This is the functional clearance between the screw **5** and the stand **1** which ensures the blocking of the bicycle to permit it to stay on top of the ground**.**

- Cotation chain: the drawing in Figure II.11 shows the layout of the cotation relative to *Ja*.

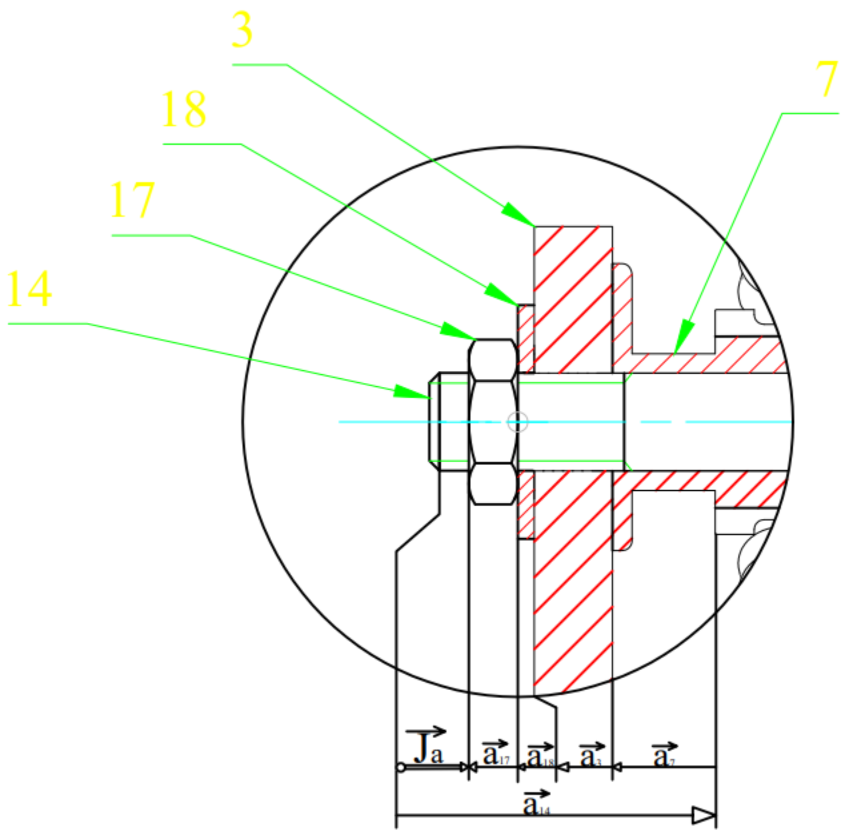

Figure II.12: cotation relative to Ja

Role: Space which permits the fitting of the special bolt 14 with the stand 3

Data

$Ja = 2^{\pm 0.2}$, $a_{17} = 5^{\pm 0.1}$, $a_{18} = 1^{\pm 0.1}$, $a_3 = 30^{\pm 0.3}$, $a_7 = 50^{\pm 0.2}$, $a_{14} = ?$

- Calculation of Ja

$\vec{J}_a = \vec{a}_{17} + \vec{a}_{18} + \vec{a}_3 + \vec{a}_7 + \vec{a}_{14}$

- Functioning condition

$\vec{J}_{amin} = -(\vec{a}_{17max} + \vec{a}_{18max} + \vec{a}_{3max} + \vec{a}_{7max}) + \vec{a}_{14min}$

$\vec{a}_{14min} = \vec{a}_{17max} + \vec{a}_{18max} + \vec{a}_{3max} + \vec{a}_{7max} + \vec{J}_{amin}$

$= 1.8 + 5.1 + 1.1 + 30.3 + 50.2$

$\vec{a}_{14min} = 88.5$

$\vec{J}_{amax} = -(\vec{a}_{17min} + \vec{a}_{18min} + \vec{a}_{3min} + \vec{a}_{7min}) + \vec{a}_{14max}$

$= 2.2 + 4.9 + 0.9 + 29.7 + 49.8$

$\vec{a}_{14max} = 87.5$

$a = 88^{\pm 0.5}$

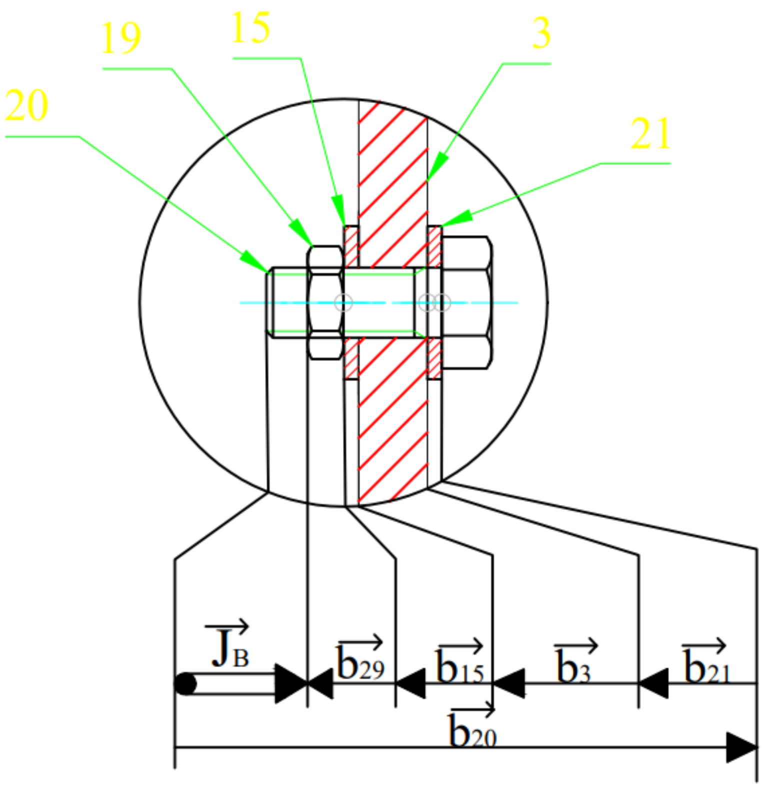

Figure II.13: cotation relative to Jb

Role: Permits the fitting of the dynamo 15 with the stand 3

Data

$Jb = 3^{\pm 0.2}$, $b_{29} = 4^{\pm 0.1}$, $b_{15} = 1^{\pm 0.1}$, $b_3 = 10^{\pm 0.3}$, $b_{21} = 2^{\pm 0.2}$, $b_{20} = ?$

- Calculation of Jb

$\vec{J}_b = \vec{b}_{29} + \vec{b}_{15} + \vec{b}_3 + \vec{b}_{21} + \vec{b}_{20}$

- Functioning condition

$\vec{J}_{bmin} = -(\vec{b}_{29max} + \vec{b}_{15max} + \vec{b}_{3max} + \vec{b}_{21max}) + \vec{b}_{20min}$

$\vec{b}_{20min} = \vec{b}_{29max} + \vec{b}_{15max} + \vec{b}_{3max} + \vec{b}_{21max} + \vec{J}_{amin}$

$= 4.1 + 1.1 + 10.3 + 2.2 + 2.8$

$\vec{b}_{20min} = 20.5$

$\vec{J}_{amax} = -(\vec{b}_{29min} + \vec{b}_{15min} + \vec{b}_{3min} + \vec{b}_{21min}) + \vec{b}_{20max}$

$= 3.9 + 0.9 + 9.7 + 1.8 + 2.8$

$\vec{b}_{20max} = 19.1$

$b = 20^{+0.5}_{-0.9}$

II.2.2.2) Definition drawings

(see Manufacturing drawings)

II.2.3) Fabrication analysis

(see Manufacturing drawings)

II.2.4) Maintenance and Cost

II.2.4.1 Maintenance

Preventive methods such as routine maintenance (RM), corrective maintenance (CM) and preventive maintenance (PM).

1. The chain should be checked and lubricated when it becomes noisy
2. Check the wiring of the circuit every week
3. Realigning the chain in case of misalignment noticed during the routine control
4. When either of the layers of the chain gets bad, the chain should be replaced
5. Each electrical component should be checked at least once every week

II.2.4.2) Cost

It is a question here of highlighting all the expenses that we had to make during the realisation of the pedal powered mobile phone charger.

Table II.1: cost of the realisation of the pedal powered mobile phone charger.

N°	DESIGNATION	QTY	UNIT PRICE	TOTAL PRICE
1	Bolt H M14- Nut H	5	400	2000
3	Nut H M14	5	100	500
5	Grinding disc	6	1000	6000
6	Cutting disc	5	800	4000
7	Steel sheet metal	2	30000	30000
10	Square steel tubes 40x40x2.6 6m	2	8000	16000
12	Bicycle	1	30000	30000
	Welding stick	20	500	10000
	Dynamo	2	8000	16000
	Stabilizer	1	2000	2000
	Rectifier	1	2000	2000
	Capacitor	1	2000	2000
	Fuse	1	2000	2000
	Accumulator	1	2000	5000
	Regulator	1	6000	6000
	Battery	1	5000	5000
	Cables		3000	3000
	USB Cables	5	1000	5000
	Electric board	1	3000	3000
	Total for materials			149500
	Manufacturing cost			50500
	Transport and others			10000
	Labour	05	20000	100000
	Price without tax			308,375
	TVA		19.25%	96,000
	Price with tax			404,375
	LARGE SCALE Selling price			103,862FCFA

CONCLUSION

Having reach the end of this chapter which dealt with the study of the various materials used, dimensioning, graphical study, fabrication analysis, maintenance and cost.

CHAPTER III: PRESENTATION OF RESULTS AND DISCUSSION

III.1: PRESENTATION OF RESULTS

Given all the calculations that were involved in the realisation of this pedal powered mobile phone charger, the information below is result of test carried out on the realised machine.

Table III.1: result obtained from the realised machine

Speed of the tire	Developed Power P	Current I	Voltage V	Time to charge	Efficiency	Coefficient of security s
107RPM	$1.052KW$	1A	5V	1h30	81%	2

III.2: DISCUSSION

From the calculations did in the dimensional analyses, for a circular speed of 107RPM, a power of 1.504KW, a current of 1A, voltage of 5V and an efficiency of 81%. After the trial done on the machine, we can testify that it takes 1h30mins to charge a mobile phone compared to the hand crank mechanism which takes 16hrs to charge to completion [14], while the solar mobile phone charger 2.5-3hrs to charge from a 10W panel [15]. From trails it is confirmed that the mechanism can charge 5 telephones.

III.2.1 User's guide

For correct use and long life of the machine, the following instructions must be observed.

III.2.1.1 How to use the machine

For proper use of the machine, the following steps must be followed:

- Make sure beforehand that you are properly seated and your back well positioned;
- Place your legs on the pedals and gradually start pedalling;
- Make sure to ride at at least 90RPM for fast charging;

- Once the operation is finished, stop pedalling and clean the machine.

III.2.1.2 User safety

For user safety, safety measures must be observed, namely:

- Avoid using the machine for purposes other than those for which it was designed
- Never insert your hand into the wheels while pedalling:
- In the event of blockage or intrusion of particles (stones or other objects) please stop first the machine before attempting any repairs.

IV.2.2 Manufacturing difficulties

During the realisation of the prototype of the Pedal Powered Mobile Phone Charger, we encountered practical difficulties. Here are listed some of them:

- Looking for a dynamo which can produce exactly 5V and 1A which is needed to recharge a mobile phone
- Looking for a bicycle with exact gear ratio as calculation during our dimensioning.
- Electricity outage
- Bad internet connection when doing research

GENERAL CONCLUSION

It is in regards to the problem of lack of electricity in rural and urban areas when the national grid supply is not available or completely absent that makes it very difficult or impossible for people to recharge their phones that we came about with this idea. A telephone which is an electrical device is used almost everywhere in the world both by children and adults. It is designed for the transmission and the reception of human voice through calls. It has become the most widely used means of communication in the world. People can communicate using the telephone through calls, messages, voice-notes, etc. Given that it is an electrical device means it has a battery and should be charged when the battery is low. it was a question of making a machine that will recharge the batteries of the mobile phones through pedalling and which won't use energy resources like fossil fuels, sunlight etc. A part from the size and cost, the pedal power mobile phone charger meets the requirements set for charging a mobile phone. This work was not a piece of cake, because we encountered many difficulties, among others the high cost of the stainless-steel sheets, finding a dynamo which can produce exactly 5V and 1A to charge a mobile phone, the search for a bicycle with the exact gear ratio as calculated during our dimensioning, electricity outage, bad internet connection when doing research. We propose that, interested students who will want to work on this project could try to make it able to charge a laptop, run a TV, fridge and if possible, run a house by using more which will produce a higher voltage (by pedalling for a longer period of time, using a higher voltage regulator, using a storage device of higher capacity)

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ANNEXES

ANNEXE 1

ROUES ET CHAÎNES SÉDIS 6.22

Nous n'avons considéré ici que les pignons, roues et chaînes de la série européenne, conformes à NF E 26-100, 26-101, 26-102.

1 — LUBRIFICATION

V (m/s)	P (kW)	Procédé
$V < 1$	$P < 3{,}5$	Burette ou pinceau
$1 < V < 2$	$3{,}5 < P < 15$	Compte-gouttes (carter)
$2 < V < 7$	$P < 15$	Barbotage (carter étanche)
$7 < V$	$7{,}5 < P$	Sous pression (carter étanche)

Nous n'avons considéré ici que les transmissions « de classe 2 » (lubrification convenable avec un produit de bonne qualité). Avec une réalisation et une lubrification très soignées (« classe 1 ») V et P peuvent parfois être majorés de 50 %.

2 — PAS ET NOMBRE DE BRINS (voir 6.22 b)

Pas	N max. (t/mn)	V max. (m/s)
9,525	5 000	15
12,7	5 000	20
15,875	3 000	15
19,05	2 500	15
25,4	2 000	16
31,75	1 200	12
38,1	1 000	12
44,45	800	11

Puissance	Vitesse	Pas	Brins
Faible	Grande	Petit	1
Grande	Grande	Petit	2 ou 3
	Faible	Grand	1, 2 ou 3

3 — RAPPORTS DE TRANSMISSION

Il est recommandé d'utiliser :

— un pignon de : 17, 19, 21, 23 ou 25 dents
— une roue de : 38, 57, 76, 114 ou 122 dents } voir 6.22 d

Pour les rapports au-delà de 1/8, prévoir 2 étages de réduction.

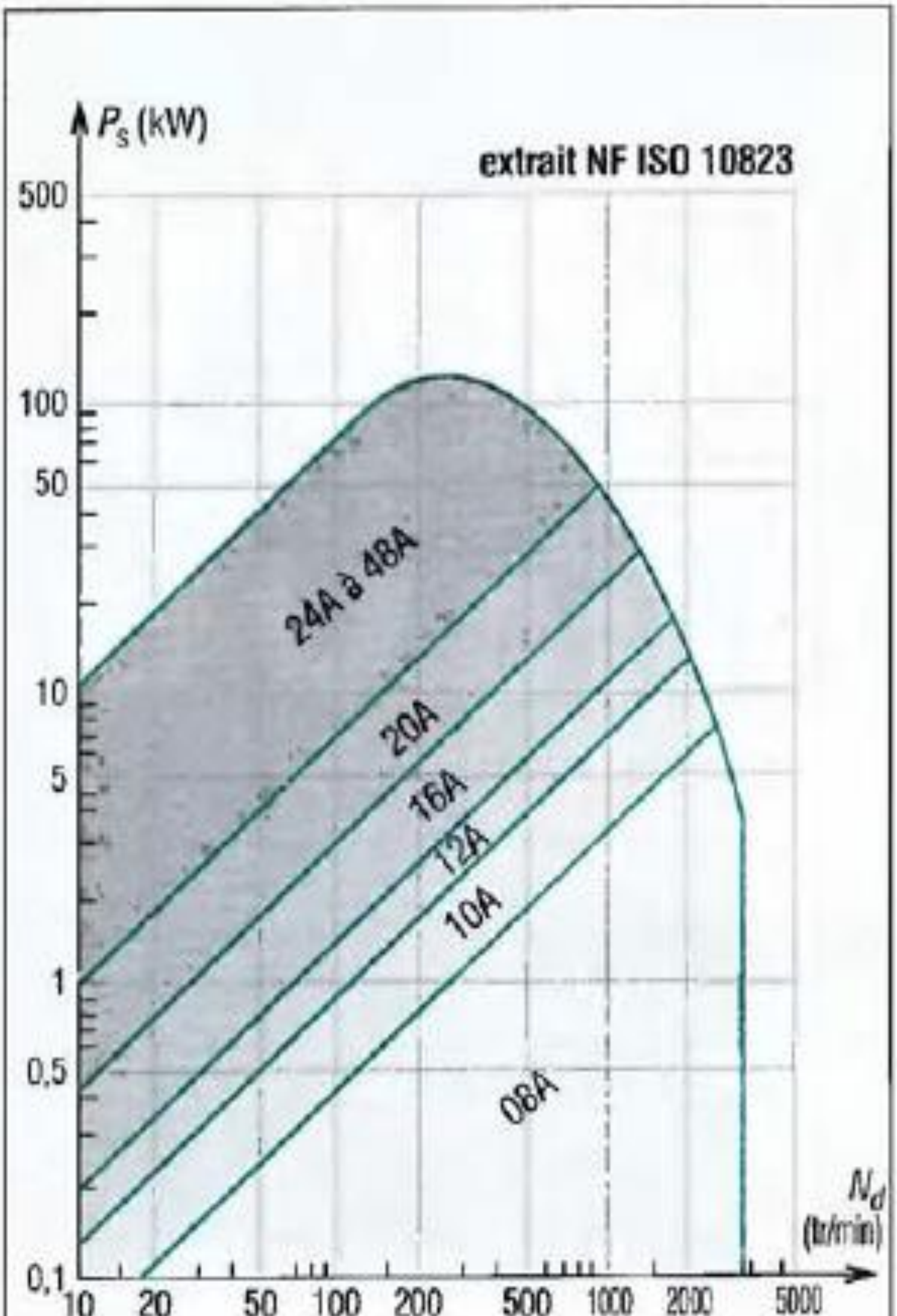
4 — PUISSANCE TRANSMISSIBLE

- **A vitesse faible ou nulle**, admettre un effort réel = 0,2 R (voir 6.22 b).
- **En charge dynamique**, calculer la « puissance corrigée » : $P_c = P \text{ réelle } \dfrac{K_2 K_3}{K_1}$

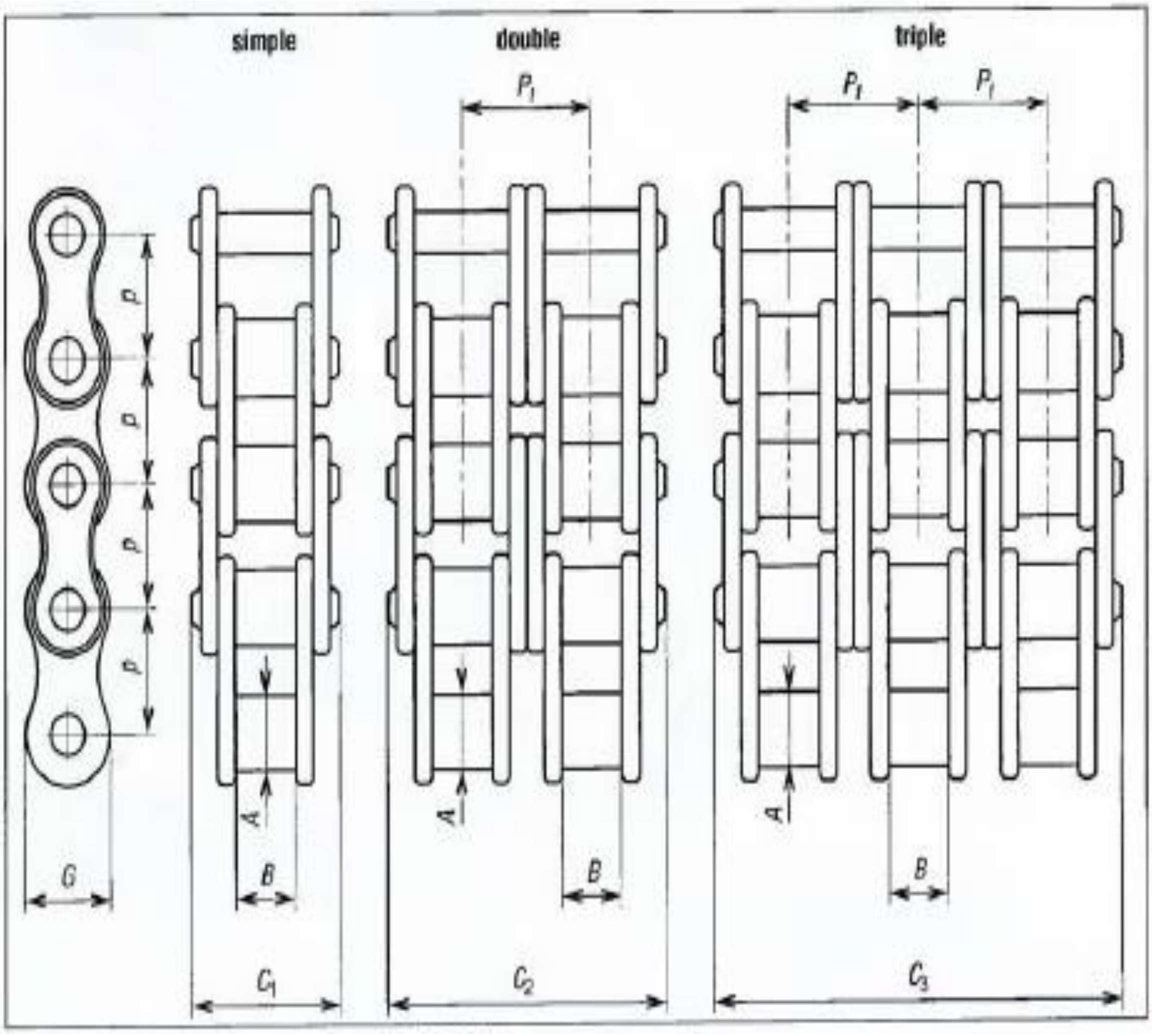
K_1 = 1 (chaîne à 1 brin) — 1,7 (2 brins) — 2,5 (3 brins).
K_2 = 1 à 2,2 selon la régularité du moteur et du récepteur, et la durée quotidienne de fonctionnement.
$K_3 = \dfrac{110}{n}$ (n : nombre de maillons de la chaîne).

Consulter alors le tableau 6.22 c, qui donne les courbes de puissances corrigées transmissibles, en fonction du type de chaîne (simple), du nombre de dents du pignon et de sa vitesse de rotation.

ANNEXE 2



P_s (kW)
extrait NF ISO 10823
500
100
50
10
5
1
0,5
0,1
24A à 48A
20A
16A
12A
10A
08A
N_d
(tr/min)
10
20
50
100
200
500
1000
2000
5000



23b. Dimensions des chaînes à rouleaux (NF ISO 606).

Caractéristiques des principales chaînes à rouleaux											
symbole	pas p mm	A mm	B mm	P_1 mm	G mm	C_1 mm	C_2 mm	C_3 mm	charge de rupture (daN)*		
									simple	double	triple
05B	8	5,00	3,00	5,64	7,11	8,6	14,3	19,9	440	785	1 110
06B	9,52	6,35	5,72	10,24	8,26	13,5	23,8	34,0	895	1 700	2 490
08B	12,7	8,51	7,75	13,92	11,81	17,0	31,0	44,9	1 785	3 115	4 450
10B	15,87	10,16	9,65	16,59	14,73	19,6	36,2	52,8	2 225	4 450	6 675
12B	19,05	12,07	11,68	19,46	16,13	22,7	42,2	61,7	2 890	5 780	8 670
16B	25,40	15,88	17,02	31,88	21,08	36,1	68,0	99,9	6 000	10 600	16 000
20B	31,75	19,05	19,56	36,45	25,20	43,2	79,7	116,1	9 500	17 000	25 000
N° 40 ou 08A	12,7	7,92	7,85	14,38	12,07	17,8	32,3	46,7	1 385	2 770	4 155
N° 50 ou 10A	15,87	10,16	9,40	18,11	15,09	21,8	39,9	57,9	2 175	4 350	6 540
N° 60 ou 12A	19,05	11,91	12,57	22,78	18,08	26,9	49,8	72,6	3115	6 230	9 345
N° 80 ou 16A	25,4	15,88	15,75	29,29	24,13	33,5	62,7	91,9	5 555	11 110	16 680
N°100 ou 20A	31,75	19,05	18,90	35,76	30,2	41,1	77,0	113,0	8 670	17 350	26 020

* Les charges indiquées peuvent varier sensiblement d'un fabricant à l'autre

Some ameliorations that could be done on the pedal power mobile phone charger

- Add a two-way chain
  Which will permit the bicycle to have two additional dynamos on the front wheel
- Add an alternator
  Which will generate more energy hence the pedal power mobile phone charger will charge more phones at the same time

Figure A: Amelioration of the pedal power mobile phone charger

a)

b)

c)

figure a,b and c shows the modified frame, the alternator and the two way chain bicycle.

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