DESIGN AND FABRICATION OF FLOOR CLEANER USING PANTOGRAPH MECHANISM

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Abstract: A semi-automatic floor cleaning machine is developed keeping in mind the basic necessity of less energy consumption, less operational reduction and less the human effort. This is capable of performing cleaning of floor in dry as well as in wet conditions. The mop used follows a straight-line path on the surface of the floor. In this project pantograph and slider crank mechanisms are used. Slider and crank mechanism produce the straight line path but the length of stroke is very small, so a pantograph mechanism is attached to magnify the length so that the cleaning length per stroke is increased. Combining these two mechanisms a floor cleaner machine is developed for cleaning purposes. It is driven by a D.C wiper motor for easy movement of the machine. The wheels used can rotate 360˚ and are provided with lock for keeping the machine stationary.

Index Terms **- Floor Cleaning Machine, Pantograph Mechanism and Slider Crank Mechanism.**

I. INTRODUCTION

Traditionally floor is cleaned by hand using different handmade cleaning tools and the floor is washed by using different reed brushes. As the time passed new scientific era begins a lot of new methods are used to clean the floor. The first among those was the reciprocating action of brush actuated by muscular force. Floor cleaning machine is very much useful in cleaning floors of hospitals rooms, rooms of houses, auditoriums, porticos of different buildings, bus stands and public places etc. In modern days inside as well as outside cleaning are becoming an important part in our day to day life. Cleaning of dust is a very important for good health conditions. So cleaning is very essential for the current and future generations. Basically floors of houses are cleaned regularly manually. Different techniques are used to clean the different types of surfaces. In this project we are using pantograph mechanism for floor clearing purpose. The advantages of floor cleaning are,

- To avoid injuries or even death of human beings because of slip on the floor due to wrong practices of floor cleaning which are major causes of such accidents.
- To beautify the floor.
- To remove debris and obstructions.
- To remove allergens and dusts.
- To make the environment sanitary (kitchens).
- To maintain traction at optimum level, so that no slip will occur.

Floor cleaning can be done by different techniques and of different kinds. Various types of floors need different kinds of treatment. The floor should be totally dry after the cleaning process. Otherwise it may result in hazards. On some floors sawdust is used to absorb all kinds of liquids. This ensures that there will be no need of preventing them from spill of from the containers. The sawdust has to be swept and replaced every day. This was common in the past in pubs and is still used in some butchers and fishmongers. Tea leaves are also used to collect dirt from carpets and also for odor removing purposes. Different types of floor cleaning machines are available today such as floor buffers, automatic floor scrubbers and extractors that can clean almost all types of hard floors or carpeted flooring surfaces in very less time than it would have taken using traditional cleaning methods. Again the cleaning would be different for different floors.

Here in this work a mechanized scrubbing is introduced using pantograph mechanism. This helps to clean more length in a stroke so that the power and time requirement for cleaning operations is minimized. In addition a slider crank mechanism is added to give a particular path of motion, which is driven by a wiper motor. For easy movement of the machine360˚ rotatable wheels are provided having a breaking system in it. So that it does not move from rest position.

Ⅱ.THEORETICAL ANALYSIS

There are many types of cleaning machines or equipment on the market today for both commercial and residential use. Here is a brief overview of the type, power sources and uses of floor cleaning equipment's. For effective cleaning results of any floor or surface, following are the four basic and simple parameters which are to be studied.

- Time
- Agitation
- Chemical

- Temperature

1. Types and uses:

1.1 Commercial and Residential Type:

1.1.1 Single Disc Floor Machines – Commercial & Residential: These machines operate by a single motor that turns a pad driver installed on the bottom of the machine. Either brushes or floor cleaning pads are installed. It is the brushes or pads that provide the agitation while the motor provides a circular motion. These machines were some of the first on the market and run between 175 to 350 RPM. These machines were also used to spray on floors. This versatile machine could be used to clean all hard floors (resilient and non-resilient) as well as crapes.

1.1.2 Automatic Scrubbers – Commercial: Battery or Electric Powered, these machines normally run between 110 to 175 RPM. Units with slightly higher RPM are on the market. This equipment combines to include several steps in one operation like:

- Application of the cleaning solution.
- The agitation principle utilizing either pads or brushes.
- Pick up the cleaning solution.

1.1.3 Wet/Dry Vacuum cleaners – Commercial & Residential: This simple and effective machine may not be classified as a floor cleaning machine, but it has increased efficiency for manual floor cleaning and cleaning with Single Disc Floor Machines. This equipment picks up dust from the floor which Speeds up the cleaning operation. These units are normally electric powered but there are some mechanical operations for which no power source is required (Aztec‘s Guzzler). These units are also greatly used when hard to reach and small areas are being cleaned. This versatile machine could be used to clean all types of hard floors (resilient and non-resilient).

1.1.4 Grout Cleaning Machines – Commercial: These units are normally Electric powered and the most effective performance units which use a cylinder brush system that allows the brush bristles to get into the grout lines of the floor. These units are used on all types of Non-Resilient tile floors that use grout lines.

1.1.5 Cleaning Machines with steam – Residential: These units generate steam or hot water to provide the cleaning action to the floors. They are primarily used in the residences and generate temperature to clean the floor instead of agitation. They are light weight, relatively inexpensive and built for the soil levels found in the residential market. This machine can be used to clean all types of hard floors.

1.2 Floor Scrubber: Floor scrubber is a floor cleaning device. It can be a simple tool such as floor mops or floor brushes used in a form of walk-behind or ride-on machines to clean large floor areas. It can inject water for cleaning. It can also scrub, and lift the residuals from the floor. With the advancement in robotics, autonomous floor-scrubbing robots are also made available.

1.3Automatic Floor Scrubbers: Automatic floor scrubbers, also known as auto scrubbers, are a type of floor cleaning machine that are used to scrub a floor, clean light debris, dust, oil, grease or floor marks. These machines have either rotary (disk) or cylindrical scrubbing head and an automated system for dispensing cleaning solution and then vacuuming it up.

1.4Floor Buffers and Polishers: With advent of floor scrubbing machines with many types of facilities, there was a need to have a protective cover for different types of flooring. Floor buffers were invented to scrub and polish the floor with linoleum surface. The machines use rotary brushes with soft material to clean and make the floor shine. For marble and wood floors, floor polishers may be used to apply protective coating to floor.

1.5 Floor-Scrubbing Robots: With the advancement in technologies used in autonomous robots, floor-scrubbing robots were created by combining the features of automatic floor scrubbers with self-control operations without an operator.

1.6 Rotary Floor Cleaning Machines: Along with vacuum cleaners, rotary cleaning machines are the most common machines used by cleaning operatives throughout the industry. They could be accurately described as the work horses of the industry, given the range of tasks they can be used to perform.

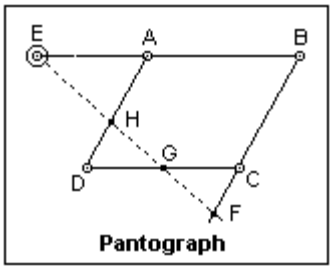
2. Pantograph mechanism:

When one of the links of a kinematic chain is fixed, the chain is known as a mechanism. It may be used for transmitting or transforming motion e.g. engine indicators, typewriter etc.

A mechanism with four links is known as simple mechanism, and the mechanism with more than four links is known as compound mechanism. When a mechanism is required to transmit power or to do some particular type of work, it then becomes a machine. In such cases, the various links or elements have to be designed to withstand the forces (both static and kinetic) safely. A little consideration will show that a mechanism may be regarded as a machine in which each part is reduced to the simplest form to transmit the required motion. Different mechanisms can be obtained by fixing different links in a kinematic chain which

is known as inversion of the mechanism. It may be noted that the relative motions between the various links is not changed in any manner through the process of inversion, but their absolute motions (those measured with respect to the fixed link) may be changed drastically.

The pantograph is a four-bar mechanism used to enlarge or reduce drawings. Its basis is a parallelogram of four links with joints ABCD, as shown in the figure. Link AB is extended to E, which can be a fixed point. Link BC may be extended to a point F. The line EF intersects two links AD & CD at points H and G respectively. F may be anywhere on BC extended, and points H and G will lie on the corresponding links or on their extensions. The key for understanding how the pantograph works is that wherever the point F moves, the line FE will always pass through H and G. This is certainly not obvious, but a model of the mechanism will demonstrate that it is true. The proposition can be proved by considering similar triangles. If it is true, then it is clear that the motions of F, G and H will be proportional to their distances from the fixed point E. If F moves to F', then H will move to H', for example, and FF' and HH' will be parallel and in the ratio of FE to HE. In fact, this ratio will also be that of EA to EB. Therefore, if F traces out a figure, H will trace out a similar, but reduced, figure. If H traces out a figure, then F will trace out a similar, but enlarged figure.



Pantograph

3. Components Required:

- D.C Motor
- Dry Mop
- Battery
- Crank Wheel
- Rivets
- Links
- Connecting Rod
- Wheels

Wiper Motor:

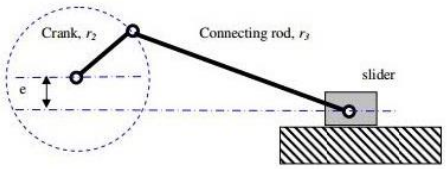
The motors used in windscreen wipers are also known as Ferrite magnet type motors as permanent magnets are used in them. These motors contain gears to control the speed of the wiper and three brushes are used according to the speed of the wiper.

Sealed Maintenance Free (SMF) Battery:

SMF battery is designed to offer reliable, consistent and low maintenance power for uninterrupted power supply applications. These batteries can be subjected to deep cycle applications and requires minimum maintenance in rural and power deficit areas. These batteries are available from 12V onwards.

Slider Crank Wheel:

Slider crank mechanisms are used for translating rotational motion into reciprocating linear motion or conversely, translating linear motion to rotational motion. Some common examples are piston in car engine, which moves upward & downward, but it has crankshaft to translate the up/down movement (linear) to rotating motion.



Caster Wheel:

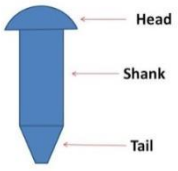
A caster is a wheeled device typically used for mounting a larger object that enables relatively easy for moving it by rolling movement. Casters are essentially special housings that include a wheel, facilitating the installation of wheels under the objects. Casters are found virtually everywhere, from office desk chairs to shipyards, from hospital beds to automotive factories. They range in size from the very small furniture casters to massive industrial casters, having individual load capacities from 100 pounds (45 kg) or less to 100,000 pounds (45 t).

Dry Mop:

Also called dust control mops, these are designed to remove soil from floors, walls and ceilings without raising and dissipating dust. These mops generally consist of a handle to which a metal frame is attached. The mop head is either inserted into the frame or stretched over it, according to the type.

Rivet:

A rivet is a permanent mechanical joint which are broadly used to joint structure, ships, barrels etc. These joints are widely used in ship and boiler industries to join the structure members.



Rivet

III. EXPERIMENTAL INVESTIGATION:

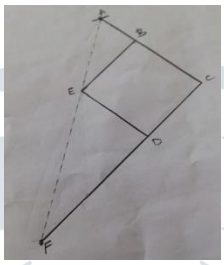
Automated floor cleaning machines are commonly used in developing countries since many years because of high cost of labor, time, efforts and affordability. Our project is an innovative design, development and manufacturing of semi-automatic

floor cleaning machine which will work on solar energy, battery or electricity. A semi-automatic floor cleaning machine is developed by keeping basic consideration for less energy consumption by the machine as well as less operational cost, less human effort, environment friendly and easy to handle. It is very useful for cleaning wet as well as dry floors. The floor cleaners reduce the effort required for cleaning. Hence this project is very useful in our day to day life. The purpose of cleaning of floor is used to remove moisture and dust particles, excess piles, and chemicals from the surface of the floor. It needs to perform a rubbing action to remove the moisture or dirt contents.

The machine uses slider crank mechanism for transforming rotational motion into reciprocating motion. Here the slider link is connected to the rod that guides the pantograph. Pantograph is a four bar mechanism used to reproduce enlarged or reduced size of any geometry. With the used dimensions of the links the stroke length created by the slider to the pantograph is magnified 2.4 times for the chosen pantograph mechanism.

Based on practical considerations the dimensions of links of the pantograph mechanism are:

AB = 102mm
BE = BC = CD = DE = 2.4 × AB = 244 mm
AC = AB + BC = 346mm
CF = AC × 2.4 = 830mm



The diameter of the crank wheel used is 32 mm and the length of crank rod is 14 mm, therefore the stroke length produced by the crank is 14 mm and by adding this to the pantograph mechanism the final stroke length of 33 mm is achieved which is 2.4 times of the stroke length provided by the slider crank mechanism alone. Thus by giving small length of stroke we obtain more stroke length for cleaning. This saves time and power usage to rotate the crank wheel for which a wiper motor is mounted with a range of 48 wipes / min. The machine is expected to ease the manual scrubbing process in less time. By changing the distances between the pivot points you can change the enlargement of the stroke. This pantograph floor cleaner is of very simple construction and is very easy to operate so that any person can operate it without any prior training. This requires low maintenance cost and less space for occupation and requires small force to operate.

Pantograph is a simple mechanical linkage in which links are connected in parallelogram manner. This mechanism reduces the time consumed for preparing similar shapes in enlarged or reduced scales. There is monitoring of deviations in dimension as scaling is done simultaneously. It simplifies the operation and provides safety.

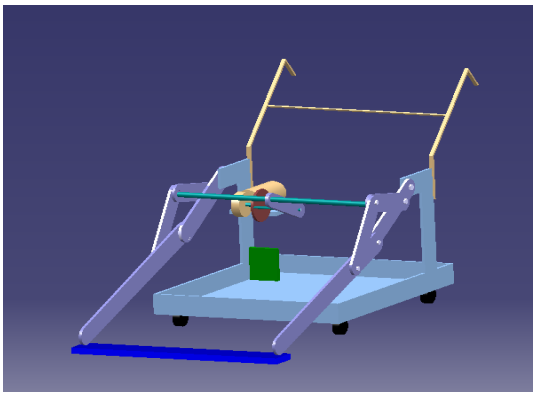
1. Advantages of the Machine:

- Net weight is less.
- Maintenance cost is less.
- Smoother task.
- Portable and cost effective.
- It is possible to get more cleaning work done in less time with less power consumption.
- Dry and Wet cleaning can be done.
- Easy to handle for unskilled persons too.

2. Applications of the Machine: This machine can be used in

- Hospitals
- Auditoriums & Malls
- Domestic applications
- Medium scale industries
- Theatres
- Educational institutions

IV. PROJECT VIEWS:

V. CONCLUSION:

The floor cleaning machine is manufactured using D.C Wiper Motor, Pantograph and Slider Crank Mechanism. Pantograph may be old mechanism, but is used in many machines in present days. It has many uses and many other advantages. Pantograph is a mechanism which is used to generate straight line motion. Our model of pantograph floor cleaning machine is having low weight, portable and easy to handle even by unskilled persons than other complicated machines. It is powered by a 12V DC battery. It saves times and provided efficient cleaning and any fault in this machine can be easily identified and can be corrected on the spot.

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