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Truck Mounted Scrap Collector

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Abstract:
Indian roads are known to be dusty and full of trash which makes driving quite a bit difficult. This dust is the major cause of pollution and can reduce visibility in roads. Further the presence of iron nails and screws in roads can puncture the tyres of vehicles. The objective of our project is to develop a device which collects the trash from roads using vacuum pressure and electromagnetic induction. The main factors that differentiate our project from the conventional road sweeping vehicles are that the "TRUCK MOUNTED SCRAP COLLECTOR" can be mounted in the front or rear of heavy vehicles and can run on both battery and engine power. The device can run on the vehicle's battery for shorter durations and can be connected to the engine using belts and pulleys for longer durations. Further the device uses electromagnetic coils and rods which segregate the ferrous metals from other scraps. Existing vehicles and devices are of higher cost and are very difficult to maintain. Our project makes use of basic mechanical and electrical parts which can easily be maintained and replaced in case of breakdowns. The device is designed specifically keeping in mind the Indian roads. Unlike earlier models which collect only larger particles, this device collects the smaller particles which are the major cause of pollution these days.

KEYWORDS:
Scrap, electromagnet, vacuum, battery, engine, motor, etc.

INTRODUCTION:
The scrap collecting device is designed to remove scrap from roads with the help of electromagnetic coil, vacuum pressure and rotating brushes. The device can be clamped to vehicles for collecting scrap from roads.

The use of this scrap collecting system reduces human effort and the chances of hazard. The scrap collecting device consists of the following subsystems:

1. Sweeper brushes
2. Suction chamber
3. Electromagnetic rods
4. Disposal tank
5. Power source

The front sweeping brushes are operated by small motors which can be powered by the battery. These brushes rotate towards the inward direction (i.e., left brush rotates in the clockwise direction and right side brush rotates in the counter clockwise direction). This allows the scrap to be gathered towards the suction chamber. The suction chamber consists of a fan attached to the vacuum motor. This fan creates the necessary vacuum which causes the scrap to be sucked in. A narrow funnel shaped structure is placed in the inlet vent to allow efficient and easy working of the motor. An exhaust vent is provided for creating a partial vacuum in the suction chamber. The motor can either be powered by the vehicle battery or can use power from the engine rotation. Belts and pulleys can be used for this process. The suction pressure increases with the rpm (revolutions per minute) of the vacuum motor. Electromagnetic rods are placed in the suction chamber of the device. These separate the ferrous materials from the non-ferrous scrap. These rods work by the principle of electromagnetic induction. A current carrying wire circled around a thin soft iron strip induces a magnetic field around it. A small protruding plate serves to collect the ferrous and magnetic substances separately. For maximum magnetic field intensity, the rods are placed in an inclined position. The disposal tank is a rectangular box with one face open. It serves to collect the scrap sucked in by the vacuum motor.

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These suctioned scraps are brought away from the vacuum motor to the collecting tank through a pipe for further disintegration. The disposal tank can be loaded and unloaded when its full capacity is reached. Multiple tanks are used for maximum collection of trash. The power source can be classified into two types; the battery and the engine. The battery power source can be used for shorter durations and minimal suction force. For continuous usage and maximum output the rotating engine can be used to provide the necessary power. This is achieved by drawing the power through a series of belts and pulleys. For the drained power from the battery, it can be retained by connecting an alternator to the device which returns most of the power drawn.

LITERATURE REVIEW:

Chang Y, Chou C, Su K and Tseng C [1] say about earlier models of the street sweeper machine. C.S. Bishop is credited with the invention of the first street sweeping machine in 1849. This device had a mechanical broom with brushes attached which swept the dirt from the roads. This machine and the later to come British models were all horse-driven. However the first self-propelled street sweeper truck was invented by Charles B. Brooks in 1896. This machine was used more as a snow scraper. In 1911, the Elgin Sweeper Company was formed. John M. Murphy produced a motorized street sweeper after two years of experimentation, development and research. In 1913, a public demonstration of the Elgin street sweeper was held in the City of Boise, Idaho in front of Boise Street Commissioner Thomas Finegan. Murphy continued to perfect his design in the following years. Pitt R, Bannerman R and Sutherland R [2] says that the street sweepers until the 1970s were not able to collect the smaller debris. These sweepers were effective only in collecting larger debris and smaller particles were not seen as an issue because rain would wash them away. But now smaller particles are known to carry a substantial part in the rainwater pollution. Street sweeping must be effective in reducing pollutants in rainwater runoff. The Environmental Protection Agency considers street sweeping a best management practice in protecting water quality. PM-10 Efficient Street Sweepers [3] says about the working of modern street sweepers. These are capable of collecting small particles of debris. These are PM-10 certified meaning that they are able to collect and hold particulate matter with size less than 10µm. The mechanical broom type is the most commonly used in street sweepers. Nowadays the machines are equipped with water sprayers for loosening particles and reducing dust. The debris collected is vacuumed and pumped into a hopper or chamber. A regenerative air street sweeper uses forced air to create a swirling effect inside the chamber and uses negative pressure on the suction side to place the debris inside a hopper. These are AQMD certified by their manufacturers and can pick up particles as small as 10 micrometers or less. German J and Svensson G [4] is about the pollutant control measure of the street sweeping equipment. The composition of the debris consists of metals, non-metals, organic and inorganic wastes. The particle size distribution and heavy metal concentration in the sediments before and after sweeping were analysed. The results showed that the highest concentrations are found in the finest fractions. The largest amount of metals and sediment found in the sandy fractions is 0.125-0.5 mm. The street sweeper is more effective in removing coarse sediments than fine. This means that the street sediments after sweeping are finer than the sediments before. Donovan, Kevin [5] is about the failure of street sweepers in rough shape causing financial and air quality problems in Toronto, Canada. Due to improper maintenance and planning, these machines are struggling to remove dust and dirt but instead spewing debris on all sides. The regenerative technology blasts air on the pavement and sucks the debris back into a hopper. This process backfires often due to poor maintenance. Availability of spare parts and skilled technicians forced the officials to take them off service thus proving the in effectivity of the present systems.

WIREFRAME DIAGRAM:

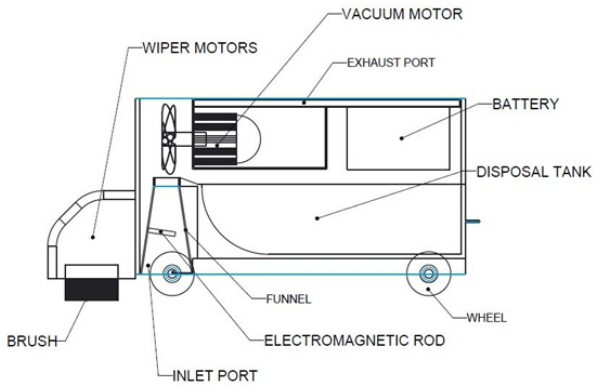

Figure 3.1 Wireframe diagram of scrap collecting device

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COMPONENTS REQUIRED:

S.NO	COMPONENTS	QUANTITY
1	Round brushes	2
2	Wiper motors	2
3	Vacuum motor	1
4	Soft iron rods	4
5	Battery 12V	2
6	Steel L rods 750 mm	4
7	Steel L rods 400 mm	4
8	Tin sheets	As required
9	Connecting wires	As required
10	Wooden board	1
11	Wheel mounts	4
12	Clamps	4

WORKING PRINCIPLE:

The device works basically on two principles: vacuum pressure and electromagnetic induction. Firstly the vacuum motor rotates causing air to be sent out of the device through the exhaust vent. This creates a partial vacuum inside the device causing air to be sucked in through the inlet along with the dust and debris. It is here that the principle of electromagnetic induction comes into play. The current flowing through the wires induces an electromagnetic field around the soft iron core. This causes the ferrous particles t0 be separated from the rest of the scrap.

CONCLUSIONS:

Thus by fabricating our scrap collecting device we test it for efficient working. It is found that the suction pressure can be achieved using either an external engine and or the inbuilt battery. Sufficient torque is available for starting and running the motors

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ADVANTAGES:

• The scrap collecting device reduces the human effort in collecting waste from roads.

• The device can be attached to any front engine or rear engine vehicle like trucks, mini vans and tractors.

•Separation of ferrous particles like iron from the other scraps is easy and convenient.

•The fabrication cost of this device is very cheap compared to the existing systems.

•The device can be controlled automatically without manual interference.

•Mass production of this device is highly feasible.

•The parts needed for manufacturing this device are easily available in the market.

•The device can be used in highways and smaller roads without interfering with traffic conditions.

•The maintenance costs are very much minimal.

•The scrap collected can be recycled and reused using waste management which can produce additional revenue.

FUTURE WORK:

Hybrid and solar powered vehicles are the new source of power in the upcoming future. Vehicles designed nowadays also implement hybrid and electrical systems in their top variant models. Hence the top of the device can be fitted with a solar panel. The price of solar panels may come down in the near future and hence the design can be plausible. Further lithium ion batteries which store maximum amount of energy can be used in the device.

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In future, the device may be entirely developed into a hovercraft like vehicle with the available technologies during that time.

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https://cleaningexec.com/resource/TIP_2008_CMAQ-Methodology-for-PM10-Street-Sweepers17106.pdf

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