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Semi Automatic Material Carrier for Mining & Tunneling Applications

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Abstract - *The machine designed here can be used for many mining and tunneling applications. The main task of this machine is to transport the material from lower level (underground) to the upper level i.e., surface of the earth that is the general case in the shaft mining technique. The machine is constructed with Electro-mechanical components and is driven by the motors. Various fields of technologies are used to drive this comprehensive machine. After filling the container inside the mine, someone has to activate the toggle button, there by the container travels through sliding mechanism in horizontal direction*

Key words- *toggle switch, relay*

1. INTRODUCTION

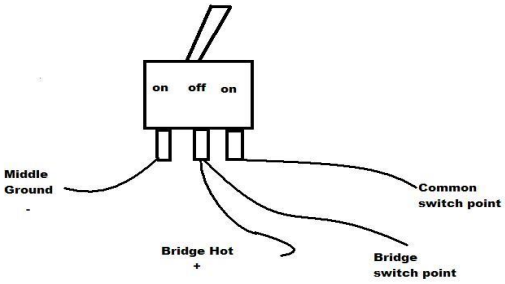
The machine designed here can be used for many applications; the main task of this machine is to transport the material from lower level to the upper level. In lower level, the collected material from one place is dumped in to the container and is carried up to a specific reference point. As this research work falls under the subject of Mechatronics, various fields of technologies must be included to full-fill the target. The integration of electronic engineering, mechanical engineering, electrical engineering and control technology is forming a crucial part in this design.

1.1 FUNCTIONAL DESCRIPTION AS PER THE DIAGRAMS

This part of the project work is intended to explain the block diagram in step by step, i.e. block wise. By studying this block diagram carefully, one can understand the fundamentals of this project work. The complete block diagram provided at the end of this chapter shows the technology that is aimed to meet the demand of heavy industries by exploring the self-propelled carriers.

1.2 TOGGLE SWITCH

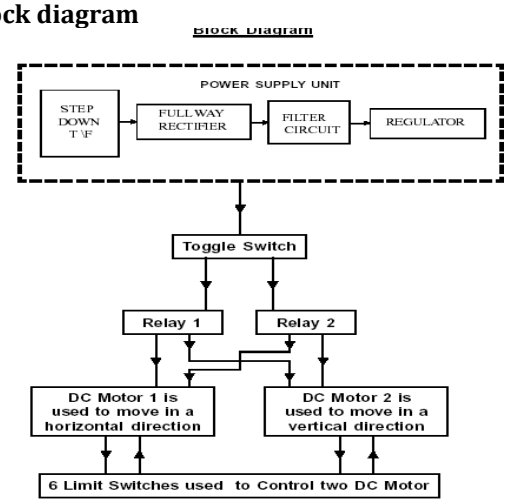
The process begins from this switch, whenever this switch is activated, the material container coupled to the horizontal moving mechanism travels in 'X' direction and reaches to the reference point. This switch is interfaced with the relays at input side, when this switch is activated, the relay gets activated and supply is provided to the DC motor. This motor carries the container up to the destination through mechanical transmission section and dumps the material into other container.



1.3 MECHANICAL TRANSMISSION SECTION

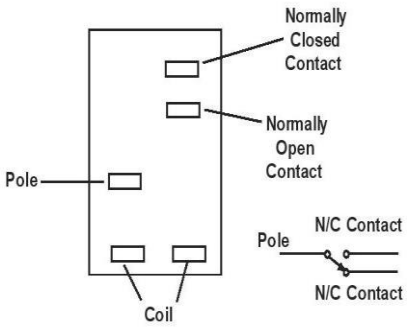
The mechanical system is considered as motion converter, this can be created by implementing electro-mechanical techniques. The concept is to transform the motion from one form to some other required form by using suitable mechanical and electrical devices. In this project work the technique of transform the rotational motion into linear motion is implemented. For this purpose two DC motors are used to create the motion for the material carrier in horizontal as well as vertical directions.

Fig-1: Block diagram



1.4 RELAYS

A relay is an electrical switch that opens and closes under the control of another electrical circuit. The object of a relay is generally to act as a sort of electric magnifier, that is to say, it enables a comparatively weak current to bring into operation a much stronger current



1.5 DC MOTORS

An electric motor is a machine, which converts electrical energy into mechanical energy. It is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Fleming's Left-hand rule and whose magnitude is given by

Force, F = B i L Newton Where
'B' is the magnetic field in weber/m2.
'i' is the current in amperes and
'L' is the length of the coil in meter.

The force, current and the magnetic field are all in different directions.

1.6 POWER SUPPLY

The power Supply is a Primary requirement for the project work. The required DC power supply for the total electronic circuit including motors is derived from the mains line. For this purpose center tapped secondary of 12V-0-12V transformer is used. The power supply unit is designed to generate DC voltage of +12V is derived using rectifiers and filters. In this circuit design, +12V supply is used to drive the DC motors and buzzer, these devices can operate effectively even if the voltage varies from +10V to +15V, hence this output is not regulated.

1.7 RACK AND PINION

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion

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1.8LIMIT SWITCHES

They are used for controlling machinery as part of a control system, as a safety interlocks, or to count objects passing a point. A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection.

1.9 BALL BEARING SLIDES

Also called "ball slides," ball bearing slides are the most common type of linear slide. Ball bearing slides offer smooth precision motion along a single-axis linear design, aided by ball bearings housed in the linear base, with self-lubrication properties that increase reliability.

Fig-2: Circuit diagram

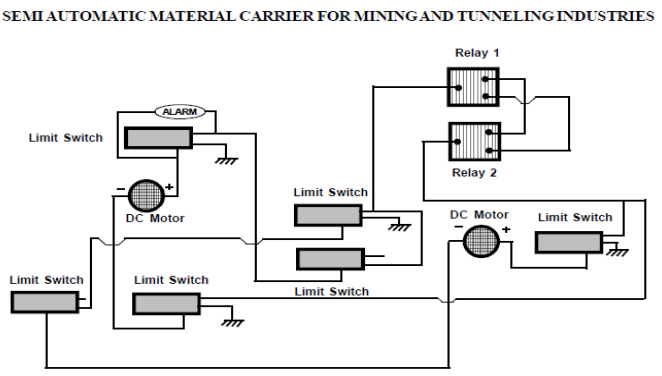
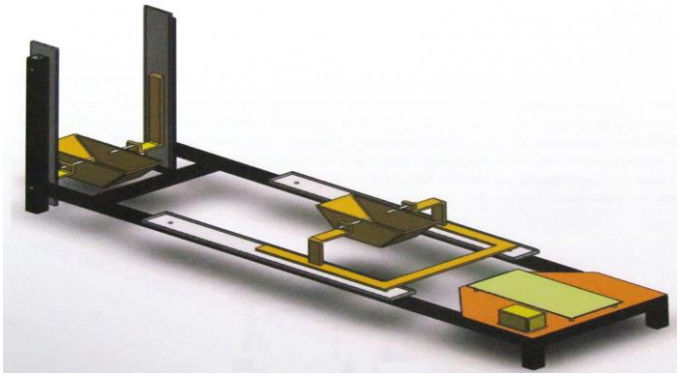


Fig -3: Semi Automatic Carrier



CALCULATIONS

ABOUT RACK AND PINON

Horizontal length of the rack =42cm

=42*10=420mm

Horizontal time =13.78sec

Diameter of pinion (D) =12.75mm

Circumference (P)

=πD =3.14*12.75

=40.035mm

One revolution of pinion =420/40.035

=10.492rev

=10.492/13.78

=0.761rps

=0.761*60rpm

Speed of horizontal motor (N1) =45.68rpm

Vertical length of the rack =38cm

=38*10=380mm

Vertical time =26.62sec

Diameter of pinion (D) =12.75mm

Circumference (P) =3.14*12.75

=40.035mm

One revolution of pinion =380/40.035rev

=9.49rev

=9.49/26.62

=0.35rps

=0.35*60 rpm

Speed of vertical motor (N2) =21rpm

$T/J = \tau/R$

T= Torque (N-m)

J=Polar moment of inertia (mm^4)

τ= shear stress (N/mm^2)

R=Radius of pinion (mm)

Module (M) =D/ T

D=diameter of pinion (mm)

T=number of teeth

P=V*I

12*0.15=1.8

Horizontal torque

$P=2\pi N_1 T/60$

$T=P*60/2\pi N_1$

T=1.8*60/2*3.14*48.68

T=0.35

Vertical torque

$P=2\pi N_2 T/60$

$T=P*60/2\pi N_2$

T=1.8*60/2*3.14*21

T=0.81

3. CONCLUSION

The system designed here can be used for mining activities; the advantage of using this system is that the material collected from the mine can be transported directly to the surface of the earth. The same system also can be used in big industries for carrying and accumulating huge raw material at one place. Generally at these places trippers are used, thereby man power is essential and in addition a lot of fuel is required. Therefore this method is not proved economically; hence this system can be used for saving the man power and fuel.

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