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Macs of Traction

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Abstract

Traction is a physical process in which a tangential force is transmitted across an interface between two bodies through dry friction or an intervening fluid film resulting in motion, stoppage or the transmission of power. Traction system is classified into electric and non-electric. Electric traction satisfies most of the requirements of an ideal traction system which are not met by the use of non-electric traction. Electric traction consists of both AC and DC supply systems. Generally traction motors used are Dc series motors.

Railways are the world's second-largest railway. Safe transportation of passengers is the key business objective of any transportation system. Railways are recognized as the safest mode of mass transportation and Safety has been recognized as the key issue for the railways and one of its special attributes. ACD is 'self-acting' microprocessor-based data communication equipment patented by KRCL that works 'round-the-clock'. Different variants of ACDs when installed on Locomotives (along with their Auto-Braking Units), Guard Vans/SLRs, Stations and at Level Crossings (both manned as well as un-manned), form an 'ACD Network'.

Keywords:-anti-collision device(ACD),LM324 chip, driver

INTRODUCTION

In present days traction is an idea of development of any country .in fact it is an index as essential requirement of a man in the modern days to travel and transport goods in a fastest, safest and economical way. All this led the invention of electric traction. From the owner's point of view an ideal traction system should have the following characteristics.

- The unit or the locomotives must be compare and self-contained.it should be possible to run it on any route. In other word its movement should not be restricted to any guided track.
- The unit should develop high starting torque which will provide high acceleration and in turn will increase the schedule speed.
- The system should be in a position to with stand the sudden temporary loads.
- Initial cost and running cost of the system should be low if possible. If it is not possible, then overall cost should be comparatively low.
- The system of braking should not cause extensive wear and tear on the brake shoe or track in case of railway traction. The economical braking system generally used is of regenerative type.
- Efficiency should be high.
- The wearing of the track should be minimum.
- The system should not interface with existing telephone and telegraph lines.

It has been observed that no single system is ideally suited, however their suitability can be compared to assess the system to be adopted.

MACS OF TRACTION

In this study, MACS refer an acrobatic name which we will completely discussing aboutPerformance and speed control of ACand DC motors in Traction and also one of the technology presently using in protecting the locomotives using Anti-collision system in locomotives.

Traction is defined as a physical process in which a tangential force is transmitted across an interface between two bodies through dry friction or an intervening fluid film resulting in motion, stoppage or the transmission of power. Today there are two main sources of power for a locomotive.

- Non-electric Traction
- Electric Traction

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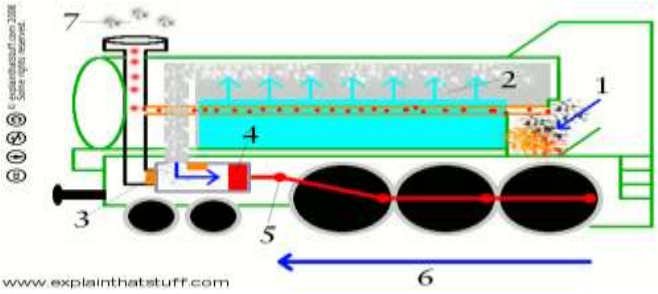
Steam, the earliest form of propulsion, was in almost universal use until about the time of World War II; since then it has been superseded by the more efficient diesel and electric traction. The steam locomotive was a self-sufficient unit, carrying its own water supply for generating the steam and coal, oil, or wood for heating the boiler. The diesel locomotive also carries its own fuel supply, but the diesel-engine output cannot be coupled directly to the wheels; instead, a mechanical, electric, or hydraulic transmission must be used. The electric locomotive is not self-sufficient; it picks up current from an overhead wire or a third rail beside the running rails. Third-rail supply is employed only by urban rapid-transit railroads operating on low-voltage direct current.

STEAM LOCOMOTIVE

A steam train is a railroad train that delivers its energy through a steam motor. These trains are energized by smoldering some burnable material, generally coal, wood or oil, to deliver steam in a kettle, which drives the steam motor. Both fuel and water supplies are conveyed with the train, either on the train itself or in wagons hauled behind.

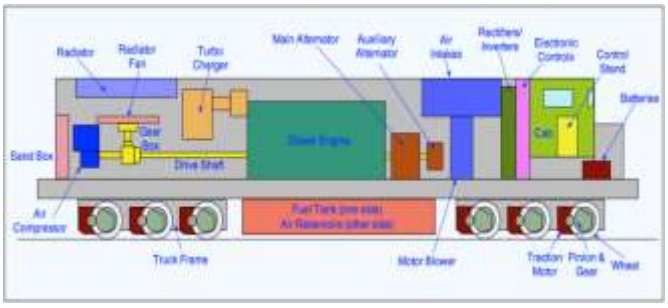
Steam motors are outside burning motors, where the working liquid is particular from the ignition items. Non-ignition warmth sources, for example, sun based force, atomic force or geothermal vitality may be utilized. Water swings to steam in a kettle and achieves a high weight. At the point when extended through cylinders or turbines, mechanical work is finished.



DIESEL LOCOMOTIVE

A diesel motor is a kind of inside burning motor. Burning is another word for smoldering, and inward means inside, so an inner ignition motor is just one where the fuel is blazed inside the principle piece of the motor (the barrels) where force is created. That is altogether different from an outer burning motor, for example, those utilized by dated steam trains. In a steam motor, there's a major flame toward one side of an evaporator that warms water to make steam. The steam streams down long tubes to a barrel at the inverse end of the evaporator where it pushes a cylinder forward and backward to move the wheels. This is outer ignition in light of the fact that the flame is outside the barrel (surely, normally 6-7 meters or 20-30ft away). In a gas or diesel motor, the fuel smolders inside the barrels themselves. Inward ignition squanders a great deal less vitality in light of the fact that the warmth doesn't need to spill out of where its delivered into the chamber: everything happens in the same spot. That is the reason inward ignition motors are more productive than outside burning motors (they create more vitality from the same volume of fuel).

The current diesel train is an independent adaptation of the electric train. Like the electric train, it has electric commute, as footing engines driving the axles and controlled with electronic controls. It additionally has a hefty portion of the same assistant frameworks for cooling, lighting, warming, braking and inn power (if needed) for the train. It can work over the same courses (typically) and can be worked by the same drivers. It contrasts basically in that it conveys its own particular creating station around with it, as opposed to being associated with a remote producing station through overhead wires or a third rail. The creating station comprises of a substantial diesel motor coupled to an alternator delivering the fundamental power. A fuel tank is additionally vital. It is intriguing to note that the cutting edge diesel train delivers around 35% of the force of an electric train of comparable weight.



ELECTRIC LOCOMOTIVE

An electric train is a train fueled by power from overhead lines, a third rail or an on-board vitality stockpiling gadget, (for example, a substance battery or energy component). Electrically pushed trains with on-board fuelled prime movers, for example, diesel motors or gas turbines, are classed as diesel-electric or gas turbine electric trains in light of the fact that the electric generator/engine blend just serves as a force transmission framework. Power is utilized to dispense with smoke and exploit the high effectiveness of electric engines; notwithstanding, the expense of railroad jolt implies that generally just intensely utilized lines can be energized.

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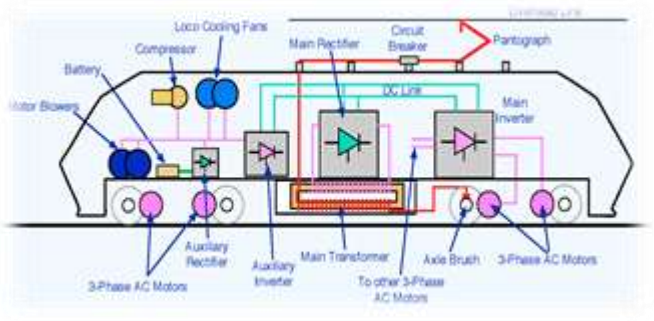

MOTOR SELECTION PROCEDURE

For a motor to be employed in traction it must satisfy the following constraints

- High starting torque..
- Robustness.
- compact size.
- Constant Horsepower Operation.
- Parallel operation must be supported.
- High efficiency.
- Easy of control.
- Over load capability

Based on this above constraints we are widely using only three types of motors in traction viz.,

1.Dc series motor

2. Ac series motor

3.3-phase induction motors.

NEED OF SPEED CONTROL

For many years the motor controller was a box which provided the motor speed control and enabled the motor to adapt to variations in the load. Modern controllers may incorporate both power electronics and microprocessors enabling the control box to take on many more tasks and to carry them out with greater precision. These tasks include:

- Controlling the dynamics of the machine and its response to applied loads. (speed, torque and efficiency of the machine or the position of its moving elements.)
- Providing electronic commutation.
- Enabling self-starting of the motor.
- Protecting the motor and the controller itself from damage or abuse.

Matching the power from an available source to suit the motor requirements (voltage , frequency, number of phases).

This is an example of "Power Conditioning" whose purpose is to provide pure DC or sine wave power free from harmonics or interference. Although it could be an integral part of a generator control system, more generally, power conditioning could also be provided by a separate free standing module operating on any power source.

Here power electronic integrated circuits play a major role in controlling the speed for our requirement and also present we focused on dc motor seep control. few of them are mentioned below:

- Rectifier drives.[AC & DC motor]
- Inverter drives.[AC & DC motor]
- Chopper drives.[AC & DC motor]
- volts/hertz control drives.[AC motors]
- vector control drives.[AC motor]

DRIVE IMPLEMENTATION FOR DC MOTOR

Block diagram:

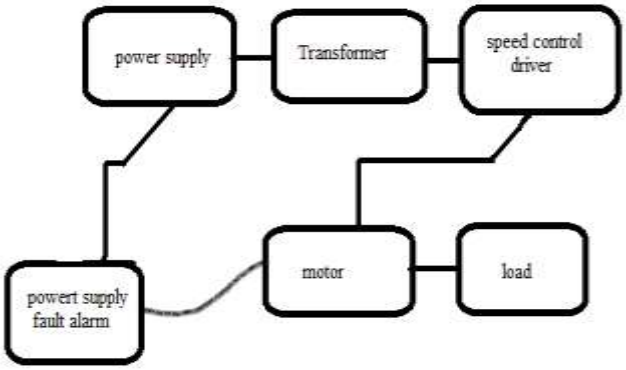

Fig: bi-direction speed control drive overview

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Commonly, transformers are used to increase or decrease the voltages of alternating current in electric power applications

Adjustable speed drive (ASD) or variable-speed drive (VSD) describes equipment used to control the speed of machinery. Many industrial processes such as assembly lines must operate at different speeds for different products. Where process conditions demand adjustment of flow from a pump or fan, varying the speed of the drive may save energy compared with other techniques for flow control.

Where speeds may be selected from several different pre-set ranges, usually the drive is said to be adjustable speed. If the output speed can be changed without steps over a range, the drive is usually referred to as variable speed.

Hardware implementation

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The circuit can be broken down in four parts:

1. Motor control – IC1:A

2. Triangle wave generator – IC1:B

3. Voltage comparators – IC1:C and D

4. Motor drive – Q3-6

Note: enlarge the below diagram for any quires related to above mention points

Let us start with the motor drive section, based around MOSFETs Q3-6. Only two of these MOSFETs are on atany one time. When Q3 and Q6 are ON then current flows through the motor and it spins in one direction. When Q4 and Q5 are ON the current flow is reversed and the motor spins in the opposite direction. IC1:C and IC1:D control which MOSFETs are turned on. Op amps IC1:C and IC1:D are configured as voltage comparators. The reference voltage that each triggers at is derived from the resistor voltage divider of R6, R7 and R8.Note that the reference voltage for IC1:D is connected to the '+' input but for IC1:C it is connected to the '-' input. Therefore IC1:D is triggered by a voltage greater than its reference whereas IC1:C is triggered by a voltage less than its reference. Op amp IC1:B is set up as a triangle wave generator and provides the trigger signal for the voltage comparators. The frequency is approximately the inverse of the time constant of R5 and C1 – 270Hz for the values used. Reducing R5 or C1 will increase the frequency; increasing either will decrease the frequency. The peak-to-peak output level of the triangle wave is less than the difference between the two voltage references. Therefore it is impossible for both comparators to be triggered simultaneously. Otherwise all four MOSFETs would conduct, causing a short circuit that would destroy them.

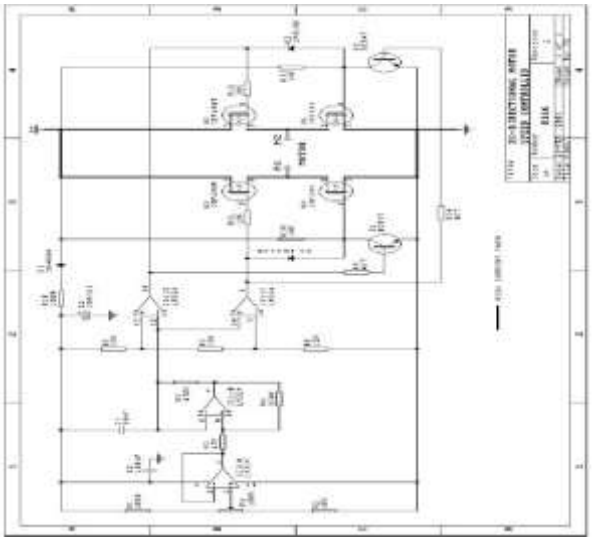

Fig: schematic of full bridge converter drive

The triangle waveform is centered around a DC offset voltage. Raising or lowering the offset voltage changes the DC position of the triangle wave accordingly.

Shifting the triangle wave up causes comparator IC1:D to trigger; lowering it causes comparator IC1:C to trigger. When the voltage level of the triangle wave is between the two voltage references then neither comparator is triggered. The DC offset voltage is controlled by the potentiometerP1 via IC1:A, which is configured as a voltage follower. This provides a low output impedance voltage source, making the DC offset voltage less susceptible to the loading effect of IC1:B. As the 'pot' is turned the DC offset voltage changes, either up or down depending on the direction the pot is turned

Diode D3 provides reverse polarity protection for the controller. Resistor R15 and capacitor C2 are a simple low pass filter. This is designed to filter out any voltage spikes caused by the MOSFETs as they switch to supply power to the motor.

Note:The motor connects to the M1 and M2 terminals. The power supply connects to the V+ and GND terminals

Troubleshooting: Most faults are due to assembly or soldering errors. Verify that you have the right components in the right place. Inspect your work carefully under a bright light. The solder joints should have a 'shiny' look about them. Check that there are no solder bridges between adjacent pads.

Check that no IC pins are bent up under the body of the IC. This can sometimes happen when inserting ICs into sockets

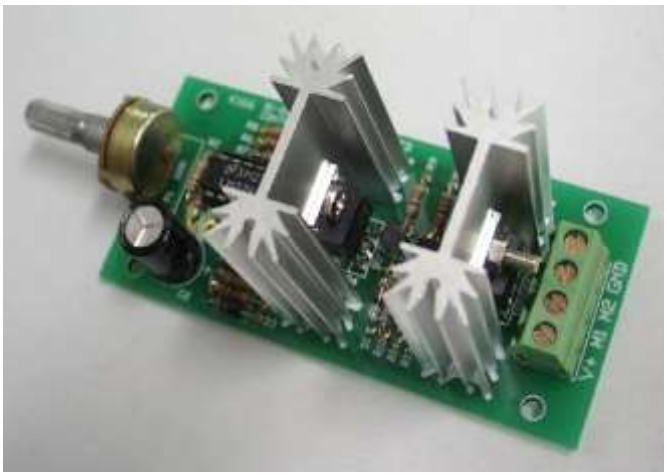

Fig: driver circuit

PERFORMANCE CHARACTERISTICS

Dc and AC series motor

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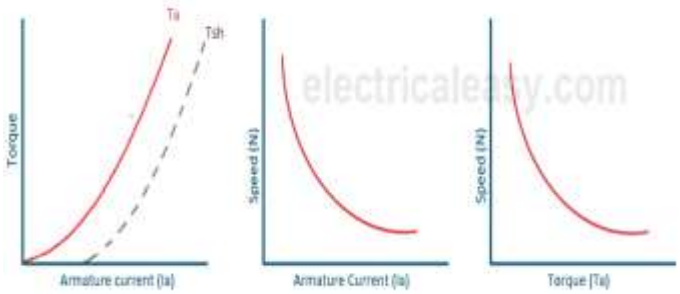
Torque Vs Armature Current:This characteristic gives us information that, how torque of machine will vary with armature current, which depends upon load on the motor.

$$\text{Torque } \alpha \text{ } \phi ia$$

$$\text{Torque } \alpha \text{ } ia^2$$

Torque VsSpeed:The below equation gives the relation between Torque and Speed. Torque is inversely proportional to the speed.

Torque=eb*ia*60/2πn



Note: ac series motor performance characteristics are slightly different from dc series motor

3-phase induction motor

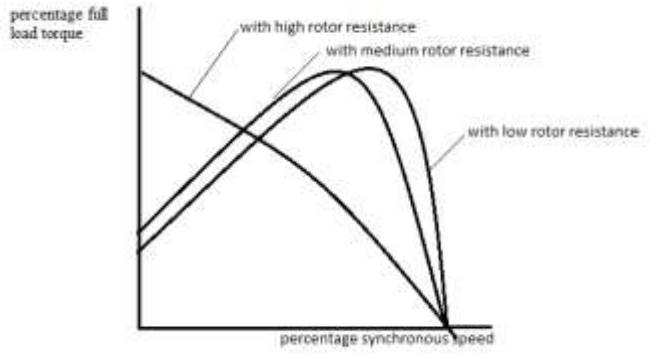


Fig:- Torque Versus Speed Characteristics

The speed of the rotating magnetic field is referred to as synchronous speed (NS). Synchronous speed is equal to 120 times the frequency (F), divided by the number of poles (P).

$$Ns = 120 F / P$$

SOFTWARE REQUIREMENT

MATLAB

MATLAB(matrix laboratory) is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming.

MATLAB is developed by MathWorks.

It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, Java, and Fortran; analyze data; develop algorithms; and create models and applications.

It has numerous built-in commands and math functions that help you in mathematical calculations, generating plots and performing numerical methods.

C LANGUAGE

The C is a general-purpose, procedural, imperative computer programming language developed in 1972 by Dennis M. Ritchie at the Bell Telephone Laboratories to develop the UNIX operating system.

The C is the most widely used computer language, it keeps fluctuating at number one scale of popularity along with Java programming language, which is also equally popular and most widely used among modern software programmers.

ANTI COLLISION SYSTEM

COLLISIONS

Collisions involve forces (there is a change in velocity). The magnitude of the velocity difference at impact is called the closing speed. All collisions conserve momentum. What distinguishes different types of collisions is whether they also conserve kinetic energy. Specifically, collisions can either be elastic, meaning they conserve both momentum and kinetic energy, or inelastic, meaning they conserve momentum but not kinetic energy. An inelastic collision is sometimes also called a plastic collision.

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A “perfectly-inelastic” collision (also called a "perfectly-plastic" collision) is a limiting case of inelastic collision in which the two bodies stick together after impact. The degree to which a collision is elastic or inelastic is quantified by the coefficient of restitution, a value that generally ranges between zero and one. A perfectly elastic collision has a coefficient of restitution of one; a perfectly-inelastic collision has a coefficient of restitution of zero.

There are tworype of collsions

- headoand rear end collision.
- head on and head on collision.

ANTI COLLISION DEVICE

ACD is ‘self-acting’ microprocessor-based data communication equipment patented by KRCL that works ‘round-the-clock’. Different variants of ACDs when installed on Locomotives (along with their Auto-Braking Units), Guard Vans/SLRs, Stations and at Level Crossings (both manned as well as un-manned), form an ‘ACD Network’.

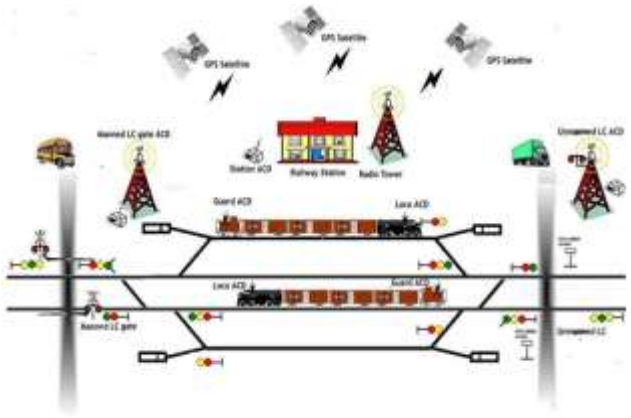


Fig.5.3:-Anti-collision device network

ACD units (train bound as well as those fixed on ground) that are within a radial range of 3000 metres, communicate with each other, and based on train working rules programmed in them, take decisions automatically, without any input from their users, triggering automatic brake applications (through Loco ACDs) if two units are deemed to be at ‘risk of collision’, thereby preventing ‘dangerous’ collisions or minimizing the extent of damages that may be caused by collisions in mid-sections and station areas resulting in saving the lives of human beings. Further, added responsibilities have also been assigned to ACD Network in the form of ‘administrative’ requirements namely, Loco ACD to ‘alert’ Driver on ‘Station Approach’ and also to trigger ‘Train Approach’ warning at Level crossings for the road users.

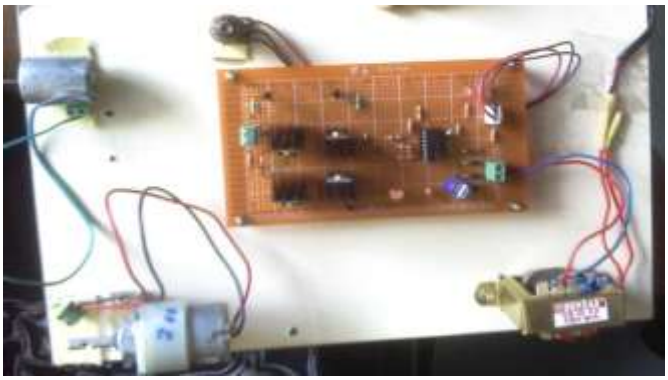
For their operations, various ACDs derive inputs from locomotives, self-propelled vehicles, existing signalling systems, speedometers, devices that provide ‘open’/‘closed’ status of Level Crossing Gates etc.

Users of ACDs, namely Drivers, Guards, Station Masters and Gatemen neither depend on it while performing their normal duties related to ‘Train operations’ and ‘Train passing’ nor give any ‘Manual inputs’ to ACDs for their ‘operations’. ACDs however empower Drivers, Guards and Station Masters to ‘stop’ trains by pressing of ‘Twin SOS’ buttons provided on their respective consoles, in case they perceive ANY type of danger in train operations.

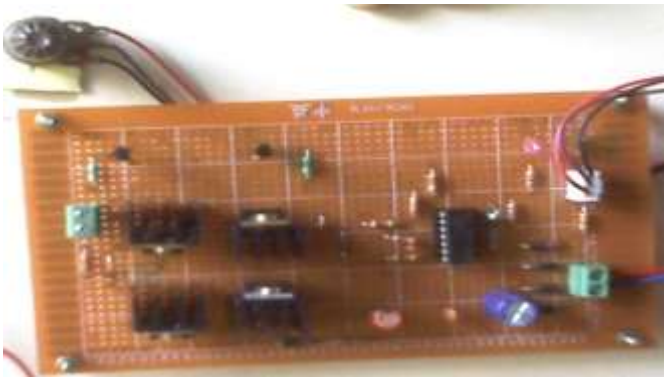
This ‘Train Collision Prevention System’ (TCPS) thus ‘enhances safety’ in train operations by providing a ‘NON-SIGNAL’ additional ‘safety overlay’ over the existing signalling system, without replacing any of them and nowhere affects the vital functioning of the present safety systems deployed for train operations**.**

RESULT

Assembled Circuit Board



Assembled PCB



Dc Series Motor Output Charecteristics

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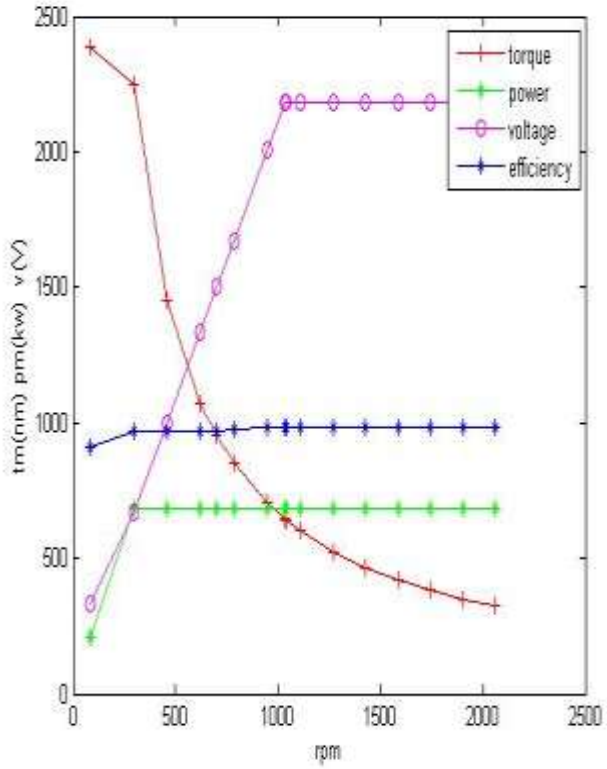
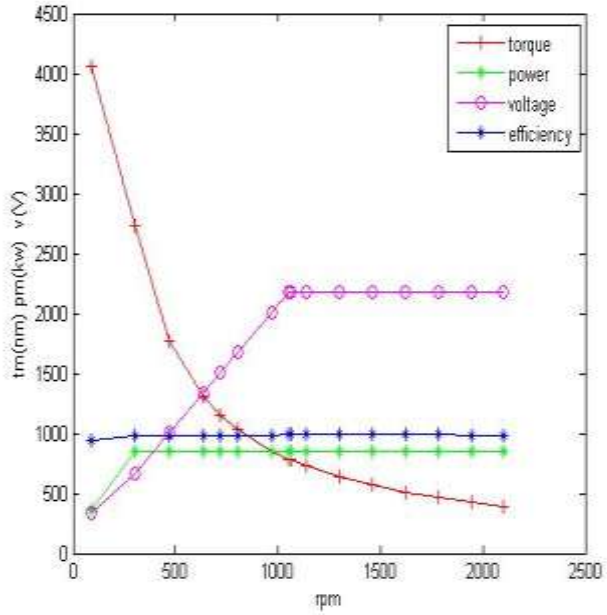
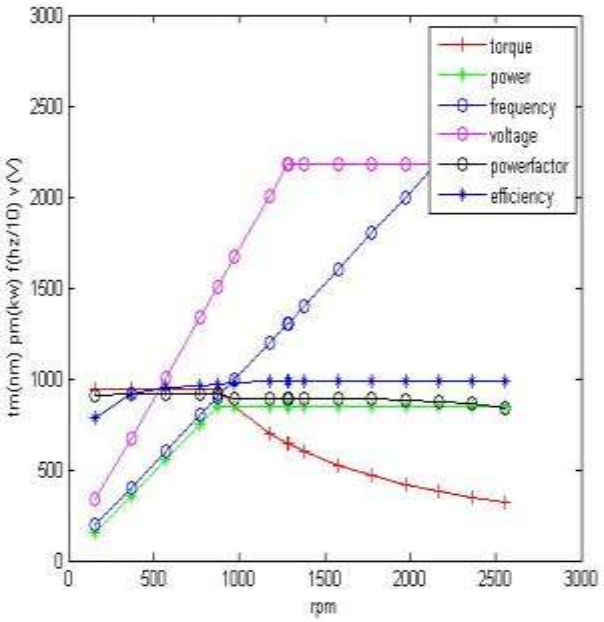


Ac Series Motor Output Charecteristics



3-Phase Induction Motor Output Characteristics



CONCLUSION

Traction as earlier mentioned is a tangential force which results in forward or backward motion of a vehicle or locomotive.in electric traction depending up on the proximity the motors employed are categorized as urban, sub urban and main line services. for urban lines due to high frequency of halts and pickups it require more torque during starting and hence dc series motor are employed here.in main line services the distance between two stops is long so the service does not require so high acceleration n and retardation and hence induction motor are employed here. all these motors are simple in construction ,robust and require less maintenance and are designed with good voltages and current ratings.

MoreOver, speed control can be achieved easily by modern methods using drives. electric traction is pollution free. Railways are the world's second-largest railway. Safe transportation of passengers is the key business objective of any transportation system. Railways are recognized as the safest mode of mass transportation and Safety has been recognized as the key issue for the railways and one of its special attributes. ACD is 'self-acting' microprocessor-based data communication equipment patented by KRCL that works 'round-the-clock'. Different variants of ACDs when installed on Locomotives (along with their Auto-Braking Units), Guard Vans/SLRs, Stations and at Level Crossings (both manned as well as un-manned), form an 'ACD Network'.

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