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# Recent Advancement of Electrical Vehicle Battery Charger

**Parul M Vachhani[1], Shukla Darshan H[2], Raval Grishma J[3]**

Lecturer, Electrical, C U Shah Polytechnic, Surendranagar, India[1]

Lecturer, Electrical, C U Shah Polytechnic, Surendranagar, India[2]

Lecturer, Electrical, C U Shah Polytechnic, Surendranagar, India[3]

**Abstract:** Energy Saving and Energy Conservation concept is propagated everywhere. Also, different government forms are actively taking part to get fulfil result by organising different activities and Awareness programme. In this case automobile industries manufacturing Electrical vehicle like Two and Four, also awareness about Electrical Vehicle is going more and more. Government forms making scheme about purchase an electrical vehicle, but every technology has own limitation, like EV has more charging time and day by day life of battery reduces. If we not taken care then in charging time and continuously charge then life span of battery reduces, sometime damages cases increase, Consequence Customer of Electrical vehicles become unsatisfied also another customer denied for purchasing. Now days research are going to solve this major problems and doing research on decrease a charging time with effective cooling system to reduce a damage battery case. In this paper we discuss about technologies are innovate by different forms for electrical vehicle charging system.

**Keywords**: Introduction, Research in battery charger, Recent advancement in battery charger

## I. INTRODUCTION

At past time battery charging circuit is nothing but a simple rectifier circuit with filter and voltage regulator circuit,

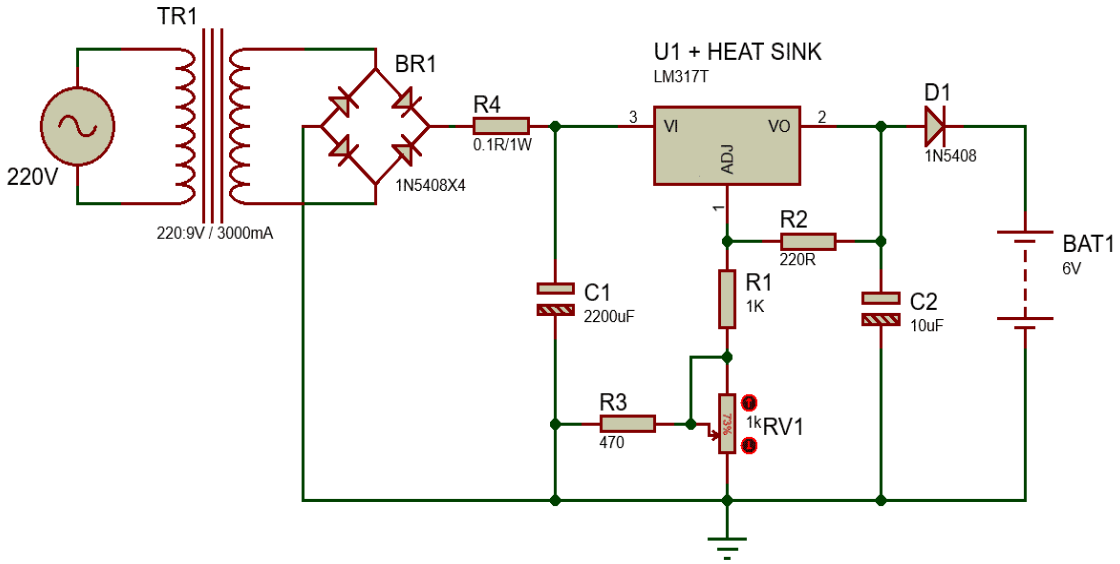


Fig 1. Simple battery charger circuit

A circuit is simple but many of disadvantages like

1. It used not for higher power battery because it become bulky
2. Become very costly for higher power battery
3. Use only for specific battery like Lead acid, Nickle cadmium etc.
4. Not suitable for Li-Ion type battery
5. It has not any types of protection against overcharging.
6. If any components are damages or overheated then operation of charging become change.

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Also, there are many reasons to not suitable for these kinds of charger used for higher rating battery, also every vehicle mostly Li-Ion Battery is applied for its good output capability, good loading capacity, less charging time and more discharging time etc. So here some techniques are applied to improve a battery charger device. The techniques are as follow [1]

1. Conventional battery charger techniques
2. Pulse charging techniques
3. State of the art charging techniques

❖ Conventional battery charger techniques:

In this type of techniques there are three types are included

1. Constant current charging
2. Fast constant current charging
3. Constant voltage and constant current charging

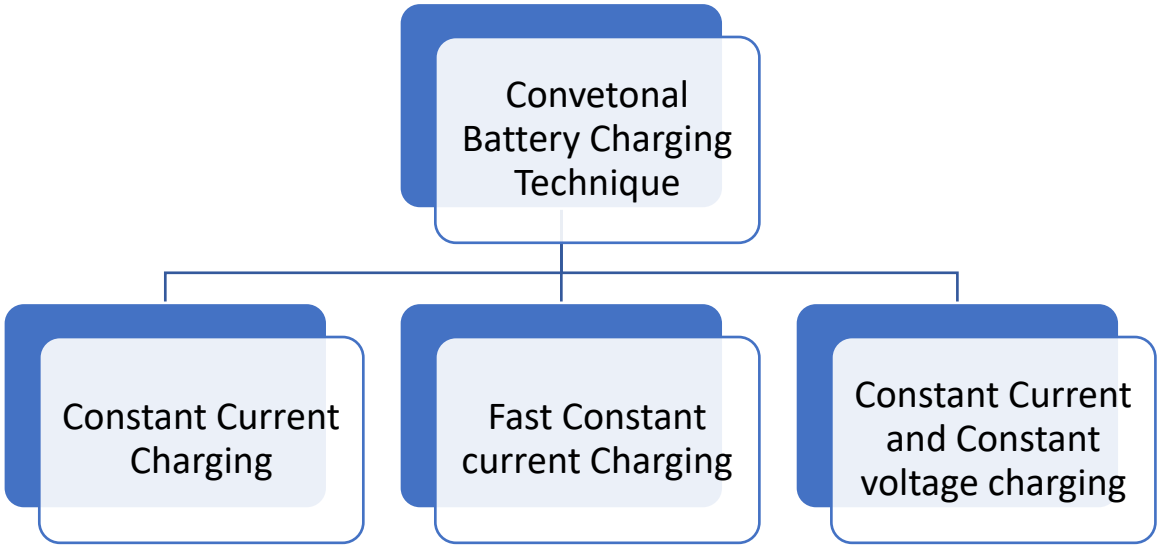


Fig 2. Types of conventional current charging techniques

1. A constant current charger supplies a very low current so charging time is high, It is a simple design and low cost . Also, it is called “Trickle Charger”, It not used for all battery. It hasn’t any protective circuit which can avoid a battery against Overcharging.
2. Fast charging concept is to reduce a charging time of a battery with supplies a large current to battery. It consists with a circuit which disconnect a battery to supply after fully charge, also monitor a temperature at time of charging. But these kinds of charger have a limitation that if we use continuously, it will reduce a battery life, increase an internal resistance by formation of metallic crystal and charging by large current.
3. Constant current Constant voltage charger techniques battery receives a constant current until voltage reaches it predefine value. At this point charging voltage held constant until the charging current become zero. It has a same negative effect like fast charging techniques

❖ Pulse charging techniques:

To minimize an above limitation pulse charge techniques overcome this limitation. In this techniques Charge/Rest period is carried out, A techniques which supplies a charging pulse current followed by resetting period in order to millisecond. A pulse charge has charge/rest/discharge/rest period, A discharging pulse have short duration and having two and a half times the magnitude of the charging pulse. This technique improves overall efficiency of battery performance.

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❖ State of the Art Technique

In these techniques use an algorithm for better charging and more efficiency, so that battery life span increases.

## II. RESEARCH IN BATTERY CHARGER TECHNIQUES [1]

1. In 1971 Indar K Sethi patented a battery charger so can charge any type of secondary battery. This charger is on pulse charging technique which consists control charging current followed by discharging pulse that occurs in function of battery's terminal voltages.
2. In 1979, Per-Edward samsioe, clams that battery should be charged at 80% of its capacity by constant current less then 1 hours, also except constant current charging all charging methods are not safe for battery parameters and not safe.
3. In 1999 In 1999, inventors Pittman et al. patented a charging method and apparatus designed to quickly and efficiently charge secondary batteries while simultaneously reconditioning them. Pittman et al. built a quick and efficient charger based on the pulse charging technique.
4. In 2000 inventor James Chin-Ming Chen patented a low-cost battery charger. A simple pulse charging techniques used for fast charging while avoid an overheating and over charge.
5. In 2002 Vladimir Petrovic, fuelled by the belief that there is a specific need for rapid battery chargers that can quickly recharge lead-acid batteries without reducing their service life patented an invention capable of recharging lead-acid batteries in under two hours

## III. RECENT ADVANCEMENT IN EV BATTERY CHARGER

1. High-Power on-Board Charger (OBC): [2]

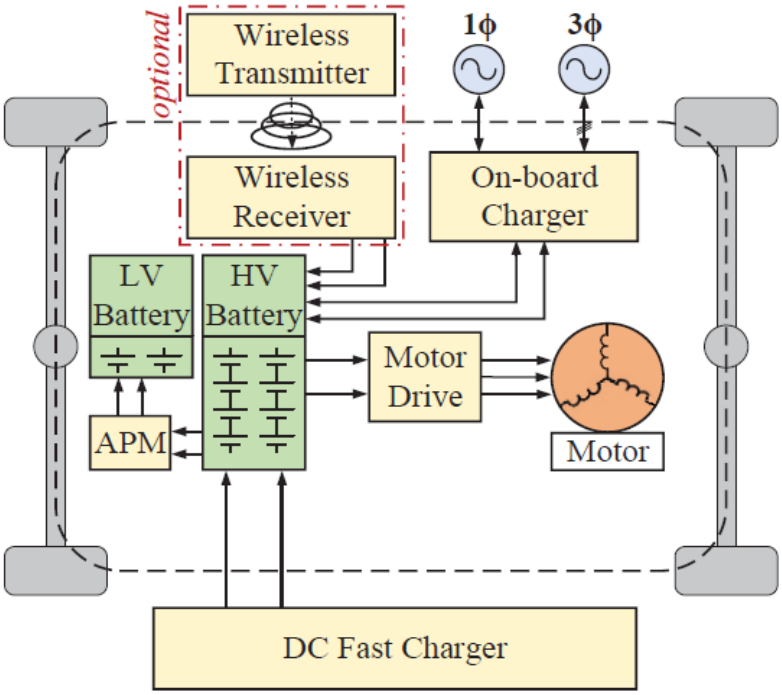


Fig 3. Direction of power flow of OBC

This is a state of the art and future trends for electric vehicle. This type of charger either "Uni-direction" or "Bi-direction", and also integrated or non-integrated system. A Non-integrated is a recent advancement of electric vehicle charger whereas integrated includes auxiliary power module and wireless charging system.

On Board Charger supports Uni-Direction or Bi-direction power flow which indicates by arrow in fig 1. But a Bi-direction charger is costly.

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- A Bi-Directional charger capable to flow power from grid to vehicle, also capable for external load and back vehicle. In bi-directional On-Board ChargerPFC (Power Factor Correction) stage at front end and DC -DC converter secondary side are necessary. An advantages of Bi-Directional techniques more safe and beneficial functionalities, but as we discuss above cost is more because more components require so increases a cost of circuit and size of circuit and weight.

- Uni-Directional charger reduce a complexity of structure, A front end and DC-DC secondary side after isolation are realize by diode bridge, also a PFC stage at front end because reduction in total PFC components in conduction path which helps to improve efficiency. Although this charger requires less components so reduce a cost and size. But it is not able to facilities for smart grid.

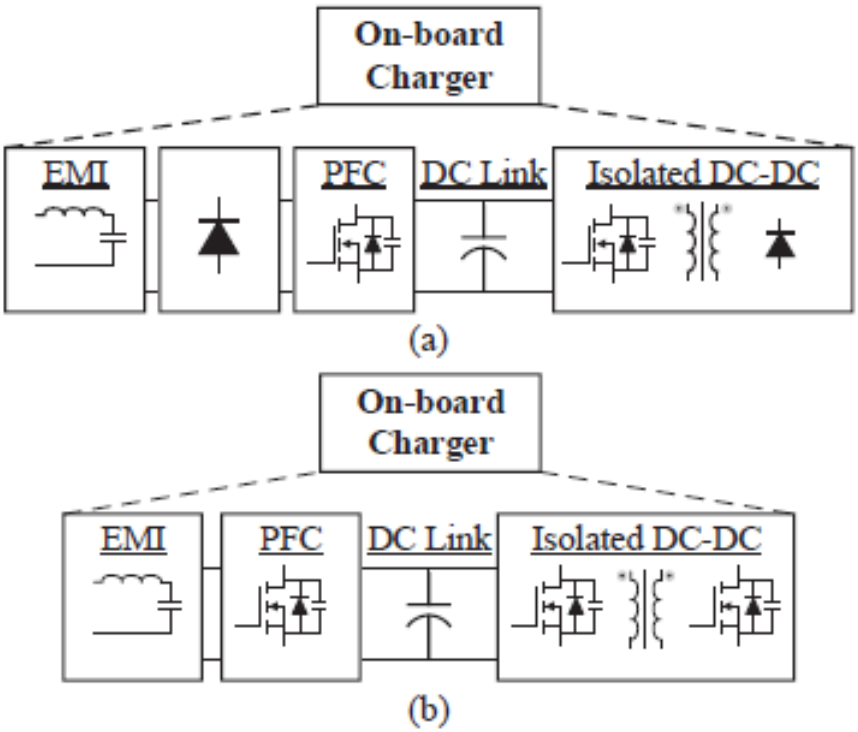


Fig 4. (a) Uni directional OBC (b) Bi-directional OBC

Using this type of battery charger

1. It increases battery capacity and higher battery voltage will be present in future charger.
2. Increases charging power level and it will fulfil a requirement of EV, to maintain and improve overnight charging times for higher capacity EVs.
3. Its facilities higher power density and higher efficiency.

2. Ultra Capacitor Charger: [5]

The structure is a simple. A capacitor voltage varies from full to zero voltage when stored energy varies from full to zero. A volage varies only 25% so it is different from battery. Capacitor connected to internal point. Although isolation transformer converter no needed that's why tapped converter should be used for higher efficiency.

3. Negative Pulse charging:[6]

At past this charging method used form lead acid battery but now it is extended for Li-Ion batteries. This method imposes small discharge current to battery at a time of rest period, consequence decrease a stress in cell and reduce a temperature rise of battery cell. Also, it can pump into battery, which enabling higher charge rate. This method helps the chemical reaction of battery which improve the life of battery.

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4. Inductive charging [6]:

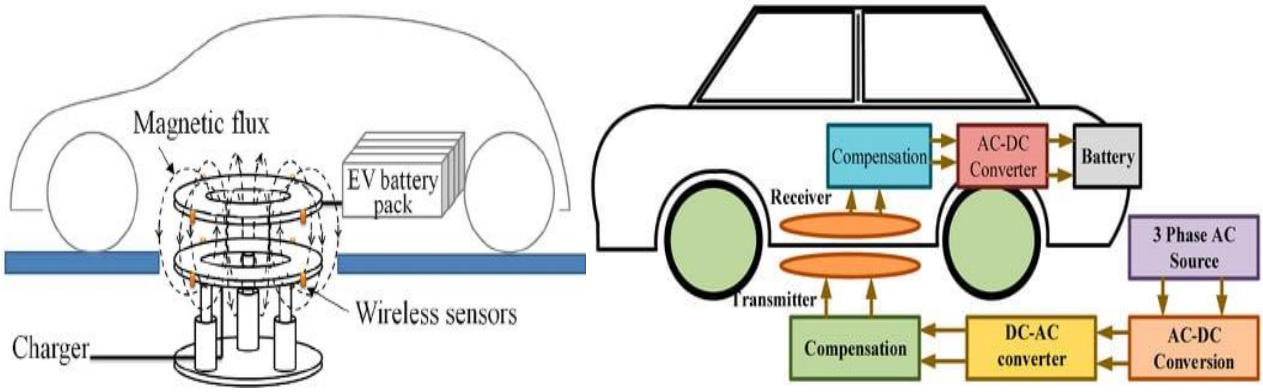


Fig 5. Arrangement of Inductive wireless charging

This charging is used for when vehicle steady or in running mode, although it is a solution of wireless EV charging. It works same as power transfer from one point to another point by mutual induce EMF.A one large coil in EV and it coupled to another charging coil which allowing power to transfer through the magnetic couple method. This method has advantage like

- Simple and convenient
- Safer method
- Eliminates charging plug

A Capacity of charger in 50kW fast charging which develop at 25kHz frequency and for 100kW wireless operates 22kHz. But it has some limitation

- Interference Risk because of resonance
- Geometrical dimension problem
- Need thermal management which increase a cost of system.

5. Dynamic Conductive charging:

This charging also known as Electric Road System (ESR). A charging of electric vehicle through conductor while it moving. This system reduces a need for batteries. Also, it reduces a total cost of electrification of road transport.

This system implemented by siemens in Sweden and Scania for conductive supply from side. A rating design is 180kW at 156km/h and in future extended to 450kW at 200km/h. Italian company Ansaldo also developed ERS from Tram wave. But main limitation of infrastructure of Road.

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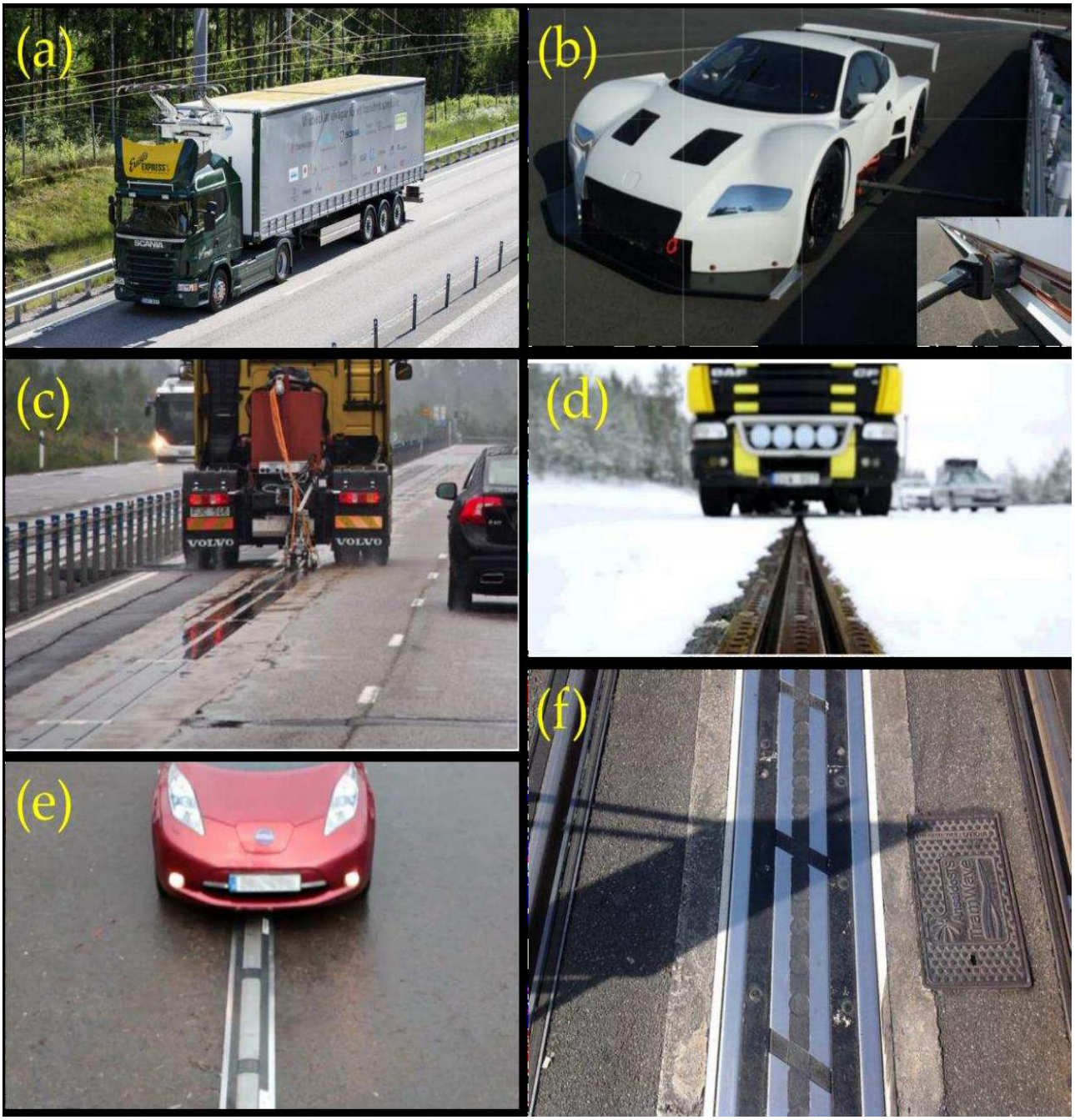


Fig 6. Image of ESR

## IV. CONCLUSION

A new version of battery charger technology is depending upon a new version of EV and its technology. If a charger operation is safe for battery with fast charger, then it will affect a seal of EV in commercial market. Also, new techniques in future can replace a battery and methods of EV charging. By overcome a limitation of new techniques we can make an affordable prize for EV and become a part of green energy.

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