高等职业技术教育“十三五”规划教材——铁道机车类

# 铁道机车车辆专业英语

# ENGLISH COURSE FOR RAILWAY LOCOMOTIVE AND ROLLING STOCK

洪从鲁 员珍珍◎主编


西南交通大学出版社

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English Course for Railway Locomotive and Rolling Stock

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## 内容简介

本书比较全面地介绍了铁道机车车辆的结构组成、基本工作原理及维护方法，内容涉及电力机车、动车组、城市轨道车辆等。作为铁道车辆的重要组成部分，转向架、牵引传动等内容在相关章节作了专门介绍。本书共分六章，各章均设置词汇、注释、练习题及全章翻译。

本书可以作为高等职业院校铁道机车车辆、动车组检修技术、城市轨道车辆等专业方向的专业英语教材，也可以作为高年级学生选修课的参考书，还可作为从事与机车车辆工作相关的工程技术人员的参考书。

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# 前　言

随着中央“一带一路”战略思想的提出，我国高速、重载列车及城市轨道交通与国外的技术交流日趋频繁。对铁道机车车辆专业的学生以及从事相关专业工作的工程技术人员来说，熟练掌握专业英语对于促进国际交流与合作，了解国内外本专业的最新发展是十分必要的。由于科技英语的表达方式、词汇范畴与公共英语差异较大，所以专业英语学习也是大学高年级学生继公共英语之后的一个重要补充和提高。本书从实用角度出发，结合铁道机车车辆各专业所学内容，选取了该领域的大量的科技资料。同时本书力求做到表达规范、专业词汇丰富、内容权威、结构完整，各章均设置词汇、注释、练习题及全文翻译。全书共分为六章：

第一章，铁路简介。包括线路结构、车辆类型和铁路各子系统之间的联系。

第二章，机车。包括机车的特点、分类、基本原理和结构组成。

第三章，动车组。包括动车组运用方式、$CRH_5$ 型动车组原理、结构和牵引传动系统基本知识。

第四章，地铁。以天津地铁 1 号线为例，包括电气牵引系统，辅助电源系统和列车信息管理系统。

第五章，转向架。包括转向架基本原理、结构、分类和 $CRH_5$ 型动车组高速转向架。

第六章，车辆检修。包括车辆检修分类、检修车间和车辆段。

本教材第一、二章、第五章中的单元 1、2 由员珍珍编写并翻译，第三章和第四章由洪从鲁编写并翻译，第五章中的单元 3、第六章和附录由余建勇编写并翻译。编写工作中，参阅了兰州交通大学商跃进教授、丁旺才教授的相关资料，在此表示感谢。编者也得到了郑州铁路职业技术学院校董黎生教授及机车车辆学院有关老师的大力支持，收获了许多宝贵意见，在此表示由衷的感谢。

由于编者经验和水平有限，书中错误和不当之处在所难免，敬请读者批评指点。

编　者

2016 年 4 月

# 目 录

# Chapter 1 Introduction

Railway consists of two steel rails which are held a fixed distance apart upon a road bed. Vehicles, guided and supported by flanged steel wheels, and connected into trains, are propelled as a means of transportation.

Within this definition there are many different forms, such as driving mode, details of the track structure, train composition, traffic, etc. are all within the category of the term "railway".

The railway definition is composed of three critical factors:

(1) It reduced friction to an extent that let the heavy locomotive not only move itself across the land but have enough power left over to move a good load at an unprecedented speed.

(2) It reduced the cost of a low-friction railway, making it possible for the railway to penetrate any area of the country where raw materials were found or people lived and worked.

(3) It provided a guideway, eliminating the limitation of transporting everything in single vehicles. This distributes the cost of motive power and crew over a number of practical loads.

Railways have usually been built for economic reasons, but some railways were also constructed as part of their country's military establishment. In many countries railways were constructed to store of raw materials such as forests, coal deposits, oil fields, iron mine and copper ore.

Railways have built-in degradation, tracks, rolling stock, and motive power must be maintained and renewed.

**Power supply**

The electric locomotive is supplied externally with electric power, either through an overhead contact line or through a third-rail.

Early locomotives had a variety of forms. Generally they were designed according to the current supply mode, so locomotives with a direct current (DC) supply had DC motors while alternating current (AC) supplied locomotives operate with AC motors. AC can be either single or three phase. While the former requires two wire supply, one overhead the other being the track, three phase requires three supply wires. Three phase locomotives therefore had two lines as overhead supplies, and one as the track.

DC supplies were either overhead or by means of track level supply, commonly called

the third rail.

Now a stable electric control system means the motor does not need to match the supply. This means multi-voltage cross border locomotives are now quite common. Drive motors are generally DC, but there are more and more 3 phase drive motors.

**Railway track**

A rail is a long piece of iron. A railway track always has two rails. They always have to keep the same separation distance, otherwise the train will fall off. If a train fall off, people say that it is derailed.

Today most railways have rolling stock with hard steel flanged wheels running on two rails set at or about 1,435 mm standard gauge, supported in some way to spread loads to the ground below.

The function of the track structure is to transform the intense load of the wheel on the head of the rail to a moderate, distributed pressure under which the earth underneath can sustain under all weather conditions without settling. At present, the main elements of typical track structure include rails, crossties, fasteners, ballast, turnout, etc. The basic structure of railway components is shown in Fig.1.1.

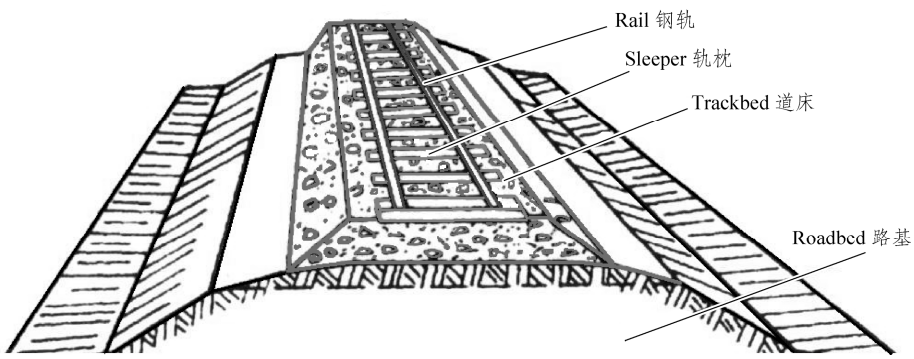


Fig.1.1 Railway structure

The term “subgrade” refers to the natural soil stratum, or embankment soil, after trimming off organic topsoil and made ground, upon which the track bed is constructed.

The “trackbed” comprises the ballast and any subballast layers to support the track, to drain water from the bottom of the sleepers and to distribute the imposed load on track to such a degree that the subgrade can resist the imposed bearing pressure adequately.

Various other civil engineering technology were also involved in the construction of railways. These included the building of bridges, tunnels and gravity wall as well as extensive earthworks and drainage.

**Train**

In order to form a train, locomotives and cars (freight cars, passenger cars or other

rolling stock) must be coupled together by couplers.

Today there is a very wide range of rolling stock used throughout the world on different railways. This range includes the following basic types:

- Locomotives.
- Freight wagons.
- Passenger coaches.
- Multiple units (with motive power in-built).
- Metro cars (usually multiple units).
- Light rail / Trams (usually articulated units).
- Railway service cars (cranes, tampers and trolleys).

Combining the vehicles into trains is important in increasing the capacity of a narrow transportation corridor, is particularly important in providing needed mobility without wasting vast areas of real estate.

**Signals and communication**

The diagram (Fig.1.2) shows the main technology interface of high-speed train, the railway is classified as a "single degree of freedom" mode of transport, that is, rail vehicles can only go back and forth along the "guideway". With only this one degree of freedom in which to maneuver, attaining high unit capacity and safety on an all-weather basis depends on a control system that keeps its vehicles in proper relation to each other. If paths cross or vehicles overtake each other from the same or opposite directions, a collision is inevitable.

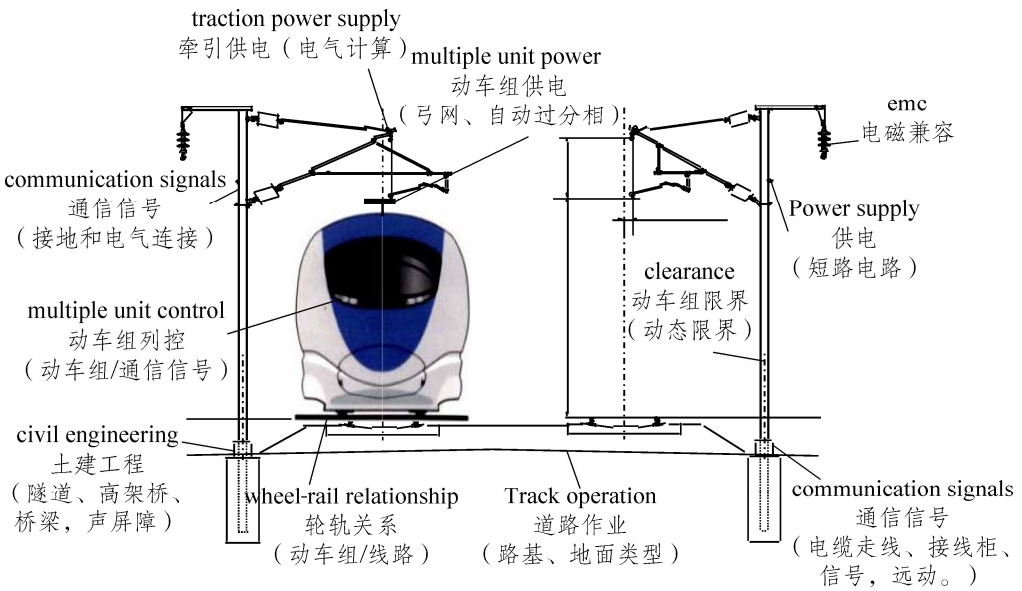


Fig.1.2 Technology interface of high-speed train

The purpose of signal systems is not so much to increase safety as it is to step up the efficiency and capacity of a line in handling traffic. Nevertheless, it is convenient to discuss

signal system principles in terms of the three types of collisions they must prevent (rear-end, side-on, and head-on).

The terms “railway” generally refers to the track and other closely associated items, i. e., signals, crossings, bridges, etc. Railway is a typical mode of land transport, which can only sell service. The traffic department is the department of operation & management and marketing of railroad, and its job is to sell transportation. It obtains profits from administering traffic.

## Words and Expressions

roadbed ['rəʊdbed] *n*. 路基
turnout ['tɜːnaʊt] *n*. 道岔
crosstie ['krɔːs,taɪ] *n*. 枕木
subgrade ['sʌbgreɪd] *n*. 地基，路基
crossing ['krɒsɪŋ] *n*. 平交道口
embankment [ɪm'bæŋkm(ə)nt; em-] *n*. 堤坝
trackbed ['træk'bed] *n*. 道床
ballast ['bæləst] *n*. 道砟
subballast [sʌb'bæləst] *n*. 底层道砟
sleeper ['sliːpə] *n*. 轨枕
earthworks ['ɜːθwɜːks] *n*. 土方工程
drainage ['dreɪnɪdʒ] *n*. 排水

## Notes

1. Vehicles, guided and supported by flanged steel wheels, and connected into trains, are propelled as a means of transportation.

车辆作为一种交通工具，由带钢缘的钢轮支撑和导向，编组运行。

2. It provided a guideway, eliminating the limitation of transporting everything in single vehicles.

铁路提供了一条克服单个车辆运输局限的途径。

3. Railways have built-in degradation, tracks, rolling stock, and motive power must be maintained and renewed.

铁路存在固有的老化现象，轨道、机车车辆和牵引动力必须进行维护与更新。

4. The “trackbed” comprises the ballast and any subballast layers to support the track, to drain water from the bottom of the sleepers and to distribute the imposed load on track to such a degree that the subgrade can resist the imposed bearing pressure adequately.

道床由道砟和所有底层道砟组成，用于支撑轨道，使水从轨枕底部排出，并且分散

施加在轨道上的载荷，以至路基足以承受的压力。

## Exercises

1. Translate the following phrases into Chinese.

locomotive freight wagon passenger coach multiple units metro car light rail railway service cars

2. Translate the following sentences into Chinese.

(1) At present, the main elements of typical track structure include rails, crossties, fasteners, ballast, turnout, etc.

(2) The purpose of signal systems is not so much to increase safety as it is to step up the efficiency and capacity of a line in handling traffic.

3. Translate the following paragraphs into Chinese.

The terms “railway” generally refers to the track and other closely associated items, i. e., signals, crossings, bridges, etc. Railway is a typical mode of land transport, which can only sell service. The traffic department is the department of operation & management and marketing of railroad, and its job is to sell transportation. It obtains profits from administering traffic.

**【英译中】**

# 第一章 铁路概述

轨道由铺设在路基上有固定间距的两条钢轨组成。车辆作为一种交通工具，由带轮缘的钢轮支撑和导向，编组运行。

该定义包含许多不同的形式，如驱动方式、轨道结构、列车组成、交通管辖等，都在铁路这个术语的范畴内。

铁路包含三个关键要素：

（1）可以使摩擦力降低到允许重型机车以空前的速度运输大宗货物的程度。

（2）可以降低成本，从而使其在全国原料基地和人们工作生活的区域内穿行成为可能。

（3）把运行动力和人员的成本作为一定数量的实际载荷分散开来，提供了一个克服单个车辆运输的局限方式。

建设铁路通常是因为经济原因，也有一些铁路建设是作为国家军事设施的一部分。许多国家建设铁路是为了获取诸如森林、煤矿、油田、铁矿和铜矿等原材料储备。

铁路存在固有的老化现象，轨道、机车车辆和牵引动力必须进行维护与更新。

**供电**

电力机车由接触网或者第三轨外部供电。

早期的机车有许多的类型，一般是按照供电电流来设计运行方式。因此，以直流电为电源的机车设置有直流电机，以交流电为电源的机车设置有交流电机。交流电可以是单相的或者三相的，单相的需要两根线，一条在空中，一条是钢轨；三相的需要三根线，两条线在空中，轨道作为第三条线。

直流供电要么是一条空中线路，要么是一条与轨道水平的第三轨。

现在状态稳定的电气控制系统意味着电动机不需要相匹配的电源供电。多电压机车如今已相当普遍，驱动电动机通常是直流的，但三相交流驱动电动机也越来越多。

**钢轨**

钢轨本质是一条很长的铁条。每股轨道总是有两条钢轨，两者之间必须保持同样的距离，否则，列车就要掉道，如果列车发生了掉道，人们称为列车脱轨。

目前，大多数铁路使带有硬钢轮缘车轮的机车车辆运行在两条大约 1 434 mm 标准轨距的钢轨上，以某种方式支持分散载荷到地下。

轨道结构的功能是将作用在钢轨顶部的车轮集中载荷，转换为适当的分布压力，使路基在任何天气条件下均不塌陷。如图 1.1 所示，目前，典型的轨道结构的主要元件包括钢轨、轨枕、连接件、道床和道岔等。

“路基”一词指的是去掉上部有机层并且被整平的自然土壤或者堤坝土壤，轨道就铺设在上面。

“道床”由道砟和一些底层道砟组成，以支持轨道，使水从轨枕下排出，并且分散施加在轨道上的载荷，以至路基足以承受的压力。

其他的一些土木工程技术也被用在了铁路建造中，包括桥隧工程、重力墙和给排水技术。

**列车**

要组成一列列车，机车和车辆必须用车钩连在一起。

如今，运行在遍及世界的不同铁路上的机车车辆有了一个更广泛的种类范围：机车、货车、旅客列车、动车组、地下铁路（大众捷运系统）、轻轨铁路、铁路用工务车辆。

将车辆连接组成列车，对增加这种狭长通道的交通方式的运输能力至关重要，特别重要的是提供了必要的灵活性，以免造成大量实际资产的浪费。

**信号**

图 1.2 表示的是高速铁路主要的技术接口，由于轨道车辆只能沿着导轨前进和后退，因此，铁路属于单自由度交通模式。在这种单自由度运输模式下，要获得较高的通过能力和安全性，就要依靠能确保车辆相互关系的控制系统。如果线路交叉、列车同向或者反向相遇，碰撞就会在所难免。

虽然信号系统对提高安全性的效果不如对提高线路的效率和能力的效果大，但是，按照它必须防止的三种碰撞（追尾、侧碰和正碰）来讨论信号系统的原理更方便。

铁路这个词通常指的是轨道和其他与之相联系的信号、道岔、桥梁等。铁路是一个典型的陆地运输模式，铁路只能出售运输服务。交通部是铁路的运营和管理部门，其工作是出售运输，它管理交通并因此而获利。

# Chapter 2 Locomotive

## Unit 1 Introduction of Locomotive

A locomotive is a railway vehicle that provides the motive power for a train, and has no payload capacity of its own, its sole purpose is to move the train along the tracks. Many trains feature self-propelled payload-carrying vehicles, these are not normally considered locomotives, and may be referred to as multiple units or railcars (railcar here refers to non-passenger railway vehicles with power to transport personnel and material), the use of these self-propelled vehicles is increasingly common for passenger trains, but very rare for freight. Vehicles, which provide the motive power to haul an unpowered train, are not generally considered locomotives but known as power cars because they have payload space or are rarely detached from their trains.

Traditionally, locomotives haul their trains. Increasingly common these days in passenger service is push-pull operation, where the locomotives push the trains in one direction, and are controlled from a control cab at the opposite end of the train. The locomotives are often subdivided into three main categories according to their usage in rail transport operations. They are passenger locomotives, freight locomotives and switcher (or shunter) locomotives. These categories mainly depend on manoeuvrability, traction power and speed. Some locomotives are designed to work in mountain railways.

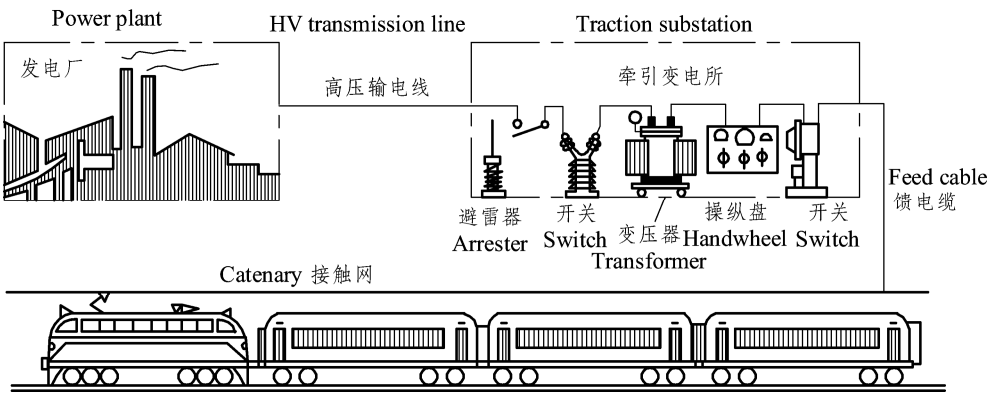


Fig.2.1 Schematic diagram of power supply system for electric locomotive

Locomotives may generate mechanical work from fuel, or they may get power from an

outside source. It is common to classify locomotives by the means of providing motive work — one common classification is: steam locomotives, diesel-mechanical locomotives, diesel-electric locomotives, diesel-hydraulic locomotives, gas turbine locomotives, electric locomotives, electro-diesel locomotives, magnetic levitation locomotives. This diagram (Fig.2.1) shows a simplified schematic for electric locomotive power supply system.

The traditional train comprises a collection of coaches (or freight wagons) with suitable motive power attached in the form of a locomotive. The train is made up of sufficient vehicles to carry the traffic offering and is provided with enough power for the job. For passenger operations, one locomotive is usually sufficient. For heavy freight operations, this number might go up to four locomotives on the front and at some other places along the train.

A good deal of flexibility is possible with locomotive haulage. As long as the train weight remains within the capacity of the locomotive(s), any number of vehicles can be attached, although limitations will be imposed by platform or siding lengths. Locomotives themselves can also be flexible, many of them are designed to cover a range of duties.

The advantages of locomotive hauled trains show they are the best option for many railway operators around the world, particularly freight but, where traffic is dense, i. e., where a large number of trains are required, a more rational approach is necessary, particularly at terminals. In addition, in very predictable operations like commuter services or metro lines, fixed formation trains will be the most efficient.

## Unit 2 Parts of Electric Locomotive

The diagram (Fig.2.2) shows an AC electric locomotive, i. e., a locomotive collecting AC power from overhead line. The current passes directly from the pantograph (or shoe) to the main and auxiliary inverters.

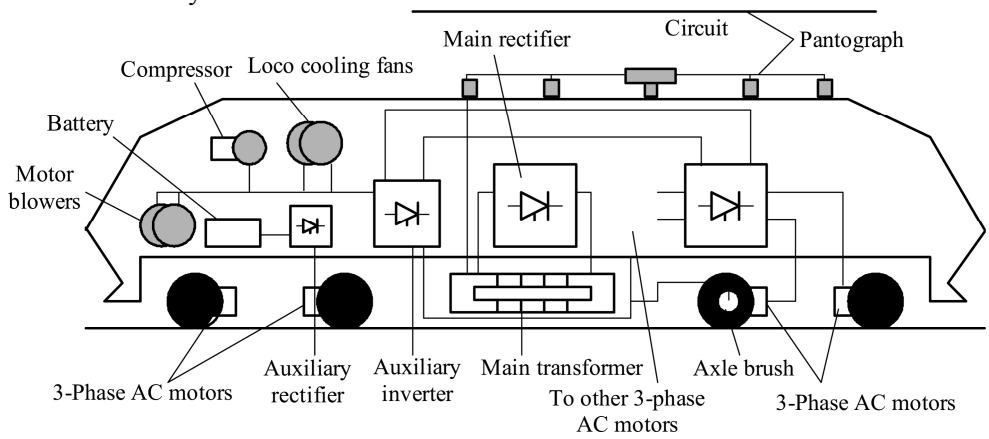


Fig. 2.2 Parts of an AC electric locomotive

**Electronic Controls**

Almost every part of the modern locomotive equipment uses electronic control. They are usually collected in a control cubicle near the cab for easy access. The controls usually include a maintenance management system which can be used to download data to a portable or hand-held computer.

**Pinion/Gear**

The traction motor drives the axle through a reduction gear of a range between 3 to 1 (freight) and 4 to 1 (passenger).

**Asynchronous Motor**

Modern traction motors use three phase AC electrical supply and this favoured design can be used on DC and AC electrified railways and electric locomotives, which are equipped with suitable control electronics.

**Axle Brush**

The means by which the power supply circuit is completed with the substation once power has been drawn on the locomotive. Current collected from the overhead line or third rail is returned via the axle brush and one of the running rails.

**Battery**

All trains are provided with a battery for start-up current and for supplying essential circuits, such as emergency lighting in the case of the line supply fails. The battery is usually connected across the DC control supply circuit.

**Circuit Breaker**

An electric train is almost always provided with some sort of circuit breaker to isolate the power supply when there is a fault, or for maintenance. On AC systems they are usually on the roof near the pantograph. There are two types—the air blast circuit breaker and the vacuum circuit breaker (VCB). The air or vacuum part is used to extinguish the arc when two tips of the circuit breaker open.

**Converter**

Converter is a generic term for any solid state electronic system for converting alternating current to direct current or vice versa. Where an AC supply has to be converted to DC it is called a rectifier and where DC is converted to AC it is called an inverter. The word originated in the US but is now common elsewhere.

**Cooling Fans**

To keep the thyristors and other electronic power systems cool, the interior of a modern locomotive is equipped with an air management system, electronically controlled to keep all systems operating at the correct temperature. The fans are powered by an auxiliary inverter producing 3-phase AC at about 400 V.

**DC Link**

DC link is used on modem electronic power systems between the single phase rectifier and the 3-phase inverter. It is easy to convert the single phase AC from the overhead line to the 3-phase required for the motors by rectifying it to DC and then inverting the DC to 3-phase AC.

**Inverter**

Inverter is a type of electronic power device mounted on trains to provide alternating current from direct current. It is popular nowadays for DC railways to allow three phase drive or for auxiliary supplies which need an AC supply.

**Line Breaker**

Line breaker is a type of electro-mechanical switch in a traction motor power circuit used to activate or disable the circuit. It is normally closed to start the train and remains closed all the time while power is required. It is opened by a command from the driving controller, no-volts detected, overload detected and wheel spin or slide detected. It is linked to the overload and no-volt control circuits so that it actually functions as a protective circuit breaker.

**Master Controller**

Master controller is driver's power control device located in the cab. The driver moves the handle of master controller to apply or reduce power of the locomotive or train.

**Motor Blowers**

Traction motors on electric locomotives get very hot and, to keep their temperature at a reasonable level for long periods of hard work, they are usually fitted with electric fans called motor blowers. On a modern locomotive, they are powered by an auxiliary 3-phase AC supply of around 400 V supplied by an auxiliary inverter.

**Rectifier**

Rectifier is a type of converter consisting of thyristors and diodes is used to convert AC to DC. A modern locomotive will usually have at least two rectifiers, one for the power circuits and one or more for the auxiliary circuits.

**Air Compressor**

The air compressor is required to provide a constant supply of compressed air for the locomotive and train brakes. The compressor is usually electrically driven and can therefore can be mounted anywhere.

**Sand Box**

Locomotives always carry sand to assist adhesion in bad rail conditions, sand is often provided on multiple unit train too.