



“十五五”高等院校产教融合系列教材

车辆工程专业英语

主 编 刘宏新

(修订本)

CHELIANG GONGCHENG
ZHUANYE YINGYU



南京大学出版社



“十五五”高等院校产教融合系列教材

车辆工程专业英语

主 编	刘宏新		
副 主 编	闻 铭	刘方方	解勇涛
编 委	杨亚楠	苑 磊	尚家杰
	张立伟	周 岭	辛 娜
	刘 波	王晓兵	贾 儒

南京大学出版社

内容简介

本书既是面向车辆工程专业的英文版教材,又是体例规范的专业英语读物,亦是车辆工程领域的百科全书。书中内容既对车辆工程专业的基本知识有全面的覆盖,又进行了充分的拓展和延伸,串联了汽车的全产业链。教材注重相关知识与技术的全面呈现,结构系统、严谨,又不失内容的丰富和新颖。本版继承了上一版的体系架构,设置了车辆工程基础知识、发展历程、汽车文化、汽车原理与构造、保养与维修、市场与服务等6部分,共计包含14章。本次修订除常规的更新与优化外,根据汽车工业的最新发展和未来趋势,重点强化了新能源汽车及自动驾驶等内容。为便于记忆、交流和专业文书撰写,书后配有专业词汇的缩略词表,可用于简称、全称及中文名称的对照查询。教材的编撰注重知识结构与专业素养的同步建立,兼具历史、文化、艺术等人文底蕴培养,以及保养与维修、市场和服务等售后及商业运营等相关知识传授的功能。章节设置与内容编排易于激发学生的学习热情,重点内容突出的同时又为学生提供了丰富的个性化选择。

本书可作为高等院校车辆工程相关专业的英语教材,可供汽车产业链从业人员提升业务能力、拓宽国际视野使用,具有一定英语基础的普通读者也可以把它作为了解汽车、丰富相关知识、提高英语水平的科技读物。

图书在版编目(CIP)数据

车辆工程专业英语 / 刘宏新主编. — 南京: 南京大学出版社, 2026. 8. — ISBN 978-7-305-30176-6
I. U46
中国国家版本馆 CIP 数据核字第 2026NN6886 号

出版发行 南京大学出版社

社 址 南京市汉口路 22 号 邮 编 210093

书 名 车辆工程专业英语

CHELIANG GONGCHENG ZHUANYE YINGYU

主 编 刘宏新

责任编辑 朱彦霖 编辑热线 025-83597482

照 排 南京开卷文化传媒有限公司

印 刷 南京新世纪联盟印务有限公司

开 本 787 mm×1092 mm 1/16 印张 21.75 字数 557 千

版 次 2026 年 8 月第 1 版 2026 年 8 月第 1 次印刷

ISBN 978-7-305-30176-6

定 价 58.00 元

网 址: <http://www.njupco.com>

官方微博: <http://weibo.com/njupco>

官方微信号: NJUYUNSHU

销售咨询热线: (025)83594756

* 版权所有, 侵权必究

* 凡购买南大版图书, 如有印装质量问题, 请与所购图书销售部门联系调换

前 言



汽车工业以及由汽车技术衍生的工程机械及拖拉机制造业,统属车辆工程范畴,是现代社会的支柱产业之一,承载着除其工具属性之外的历史、文化、工业美学、民族情感等诸多元素,国际化特征显著。中国汽车年产量双超 3 000 万辆,高居世界第一,新能源汽车更是引领着当前汽车产业的变革。同时,与汽车技术密切相关的工程机械行业也迅速崛起,在世界上占有举足轻重的地位。无论是从学习专业技术的角度,还是从了解汽车工业历史与文化的角度,对车辆工程及相关专业的学生而言,具备熟练的英语读写能力,尤其是系统地学习专业英语是非常重要的。同时,国家大学英语教学指导中明确规定:各高等学校应根据实际情况,按照课程要求和本校的大学英语教学目标设计各自的大学英语课程体系,将综合英语类、语言技能类、语言应用类、语言文化类和专业英语类等必修课程和选修课程有机结合,确保不同层次的学生在英语应用能力方面得到充分的训练和提高。

本教材首版(ISBN:978-7-111-48391-5)于 2015 年 3 月由机械工业出版社出版发行,历经数次重印,受到了各方使用者的肯定与好评。为适应时代发展,汲取车辆工程技术最新成就经验,紧跟相关行业发展动态,结合读者反馈意见及使用情况开展本版的修订工作,并邀请行业工程师王晓兵、贾儒、刘波加入编委会,强化产教融合,同时延续了编委由国内知名高校中既从事车辆工程相关教学、科研工作,又具有英语国家留学经历的人员,以及专业的英语教师组成的传统。专业且多元的编写团队保证了本书既是一本车辆工程专业技术的英文版教材,又是一部规范的英语语言类书籍、一部车辆工程领域的百科全书。

本书内容既全面覆盖了车辆工程专业的重要技术知识,又进行了充分的拓展和延伸,串联起了汽车的全产业链。教材注重相关知识的全面呈现,结构系统、严谨,又不失内容的丰富和新颖。教材在编写过程中遵循以下原则:一是技术知识和人文知识兼顾,对于大学阶段的学习,学生除了要具有良好的科学素养,也应具备与其相适应的历史、文化、艺术等人文底蕴;二是在内容组织上由浅入深,从汽车简介开始,依次讲述汽车的历史、文化,之后引入以汽车为主的车辆工程领域专业知识,避免单一和枯燥,激发学习热情;三是设置丰富的章节



内容,每章均提供本章中涉及的繁、难、关键词中英文对照,典型句式有专门的注释与翻译,并配有难易适中的课后练习,提供与文中内容联系紧密的阅读材料,做到重点内容突出的同时又为学生提供个性化的选择。

本书设置6大部分,共计14章,书后配有专业词汇的缩略词表,可实现简称、全称及中文名称的对照查询。第一部分车辆工程基本知识,讲述定义、用途、基本组成及分类;第二部分发展历程,讲述历史、现状及未来;第三部分汽车文化,讲述车界名人、著名车企、城市及汽车时尚;第四部分车辆原理与构造,讲述发动机与动力电源、底盘、电气及各自子系统与零部件,并重点根据汽车工业的最新发展和趋势强化了新能源汽车及自动驾驶等工程知识;第五部分汽车保养和维修,讲述汽车维护、美容保养、故障诊断与排除;第六部分市场与服务,讲述市场营销与后市场项目及服务。

编写团队虽勤勉认真,但纰漏与不当之处仍在所难免,恳请读者能够谅解并予以指正,也希望能与广大读者在车辆工程教材与课程建设方面进行广泛的交流与探讨。

读者信箱:Automobile-Tractor@hotmail.com

主编 于江苏

2026年5月1日

南京大学出版社
版权所有

目 录



Section I Motor Vehicle Basics

Chapter 1 Introduction to Motor Vehicles	3
1.1 Definition of Motor Vehicle	3
1.2 Overall Composition	3
1.3 Motor Vehicle and Society	9
Chapter 2 Classification of Motor Vehicles	21
2.1 Classification Based on Function	21
2.2 Classification Based on Energy Source	30
2.3 Classification Based on Body Type	31

Section II Motor Vehicle Development

Chapter 3 History of Motor Vehicles	39
3.1 History of Foreign Automobiles	39
3.2 History of Chinese Automobiles	44
3.3 Progress of Motor Vehicle	45
Chapter 4 Future Development and Directions of Motor Vehicles	55
4.1 Lightweight	56
4.2 Intelligence	65
4.3 Saving Energy	71
4.4 Green Vehicle	73
4.5 Aerocar	75



Section III Motor Vehicle Culture

Chapter 5 Notabilities of Motor Vehicle	83
5.1 Nikolaus August Otto	83
5.2 Karl Friedrich Benz and Gottlieb Daimler	86
5.3 Henry Ford and William Crapo Durant	91
5.4 Kiichiro Toyoda	96
Chapter 6 Well-Known Automotive Industry Organizations	101
6.1 Automotive Groups	101
6.2 Heavy Vehicle Companies	118
Chapter 7 Automotive Fashion	130
7.1 Automotive Recreation	130
7.2 Automotive Exhibition	133
7.3 Automotive Cities	137

Section IV Motor Vehicle Structure

Chapter 8 Internal Combustion Engine and Electric Power Source	151
8.1 Engine Operation	151
8.2 Engine Classifications	153
8.3 Construction of Engine	156
8.4 Subsystems of Engine	165
8.5 Electric Power Source	182
Chapter 9 Chassis	194
9.1 Mechanical Drive	194
9.2 Hybrid Drive	209
9.3 Power Battery Drive	213
9.4 Fuel Cell Drive	217
9.5 Steering System	224
9.6 Suspension System	231
9.7 Brake System	240



Chapter 10 Electrical and Electronic System	250
10.1 Charging System	250
10.2 Lighting System	252
10.3 Power Window System	257
10.4 Cruise Control System	259
10.5 Antitheft System	263
10.6 In – Car Information Entertainment System	265
10.7 Autonomous Driving Technology	270

Section V Maintenance and Repair

Chapter 11 Maintenance and Cosmetology	279
11.1 Automobile Maintenance	279
11.2 Automobile Cosmetology	283
Chapter 12 Diagnosis and Troubleshooting	289
12.1 Diagnosis System	289
12.2 Troubleshooting	294

Section VI Marketing and Service

Chapter 13 Auto Marketing	301
13.1 How to Become a Great Auto Salesman	303
13.2 Owning an Auto Dealership Franchise	307
13.3 Cross-border Business	310
Chapter 14 Aftermarket	315
14.1 Auto Accessory and Insurance	315
14.2 Auto Boutique and Modification	320
14.3 Used Car and Car Rental	322
Abbreviations	330
参考文献	340

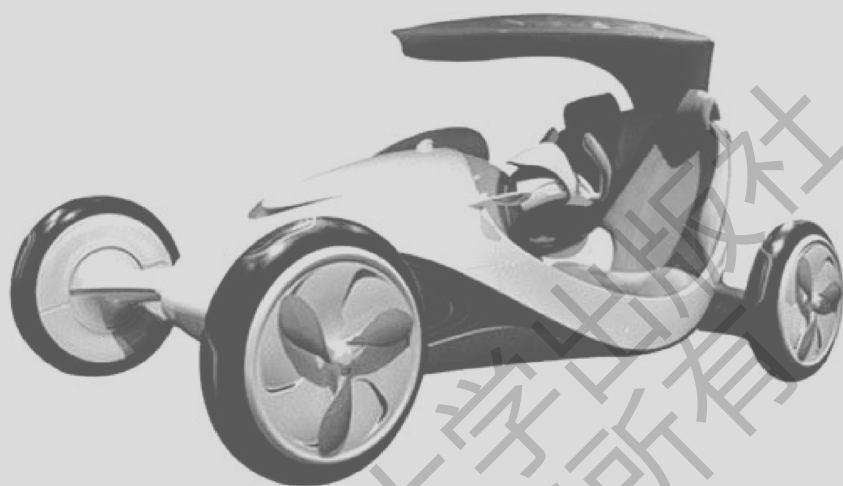
南京大学出版社
版权所有



车辆工程
★ AUTOMOBILE AND TRACTOR ★

Section I

Motor Vehicle Basics



南京理工大学
版权所有

南京大学出版社
版权所有

Chapter 1

Introduction to Motor Vehicles

Over the past century and beyond, motor vehicles have had a significant impact on human civilisation. What is the definition of a motor vehicle? What does it comprise? What is the impact of this on society? The questions posed will be addressed inside this chapter.

1.1 Definition of Motor Vehicle

A motor vehicle, often known as a road vehicle, is a wheeled vehicle that is powered by itself and is designed to operate on roadways rather than on rails like trains or trolleys. The vehicle is propelled by either an internal combustion engine, an electric motor, or a mix of both, as seen in hybrid electric vehicles and plug-in hybrids. Motor vehicles are categorised into various vehicle classes for legal purposes, which include automobiles or cars, buses, motorbikes, off-road vehicles, light trucks or light duty trucks, and trucks or lorries. The categorisations differ based on the legal statutes of each nation. ISO 3833:1977 is the established criterion for categorising, naming, and defining various categories of road vehicles. Railway devices and spacecraft have been explicitly excluded according to the definition.

Today, a vehicle is as much electronic as it is mechanical.

Malfunctioning of a computer-controlled system can have an impact on the functioning of another system that appears to be unconnected. Therefore, it is crucial to have a comprehensive understanding of the entire automotive vehicle and its key systems.

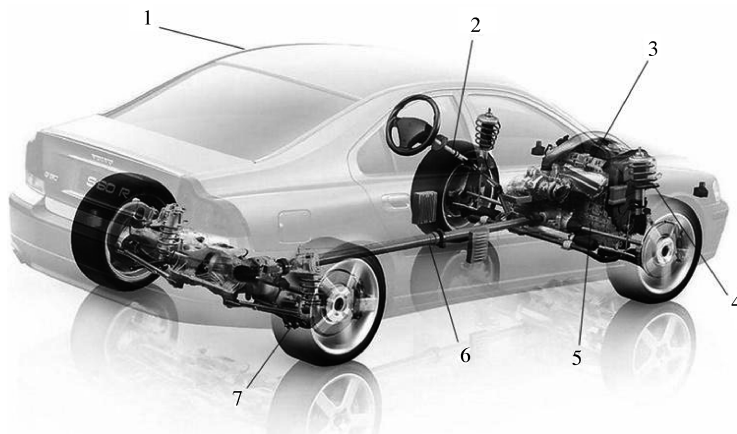
1.2 Overall Composition

1.2.1 The Basic Parts and Systems

Today's ordinary car contains more than 15 000 separate, individual parts that must work together. A part, sometimes called a component, is the smallest removable item on a car. An assembly is a set of fitted parts designed to complete a specific function. An automotive system is a group of related parts and assemblies that performs a specific job



or task. Automobile parts and systems can be organized into four major categories: engine, chassis, body and frame, electrical and electronic systems. Each category has several subsystems to which it belongs (Figure 1-1).



1-body; 2-steering; 3-engine; 4-suspension; 5-electrical equipment; 6-power train; 7-brakes

Figure 1-1 Layout of a passenger car

The engine, typically referred to as the “heart” of a vehicle, plays a part for providing power to a motor vehicle. Chapter 8 will provide an introduction to the specifics of the engine.

The term chassis is often used when referring to a vehicle’s frame and everything mounted to it except the body-tires, wheels, engine, transmission, drive axle assembly, and frame. The chassis is considered as an assembly of those systems that are the major operating parts of a vehicle. In fact, when power from the engine continues to be transmitted to the chassis, it begins with the power train, and goes on to the steering, wheel suspension, brakes and tires. These individual components interact with each other closely. The chassis includes the transmission, suspension, steering, and brake systems.

The automobile body is a shell with windows, doors, and a hood. It provides a protective covering for the engine, passengers and cargo. It can be made from steel, aluminium, fiberglass, plastic or composite. The vehicle frame is a high-strength structure used to support all other parts of the vehicle. The frame can be classified into separate frame and unitized frame (unibody) construction (Figure 1-2). Separate frame construction has a separate body structure bolted to a thick steel framework. The engine and other major assemblies forming the chassis are mounted on the frame. Unitized frame construction means that the frame and the body are welded together as one structure.

The electrical system generates and distributes the voltage and current needed to operate the vehicle’s electrical and electronic components, such as ignition, horn, lights, heater and starter. The electrical charge level is maintained by a charging circuit. This circuit consists of a battery and an alternator (or generator).

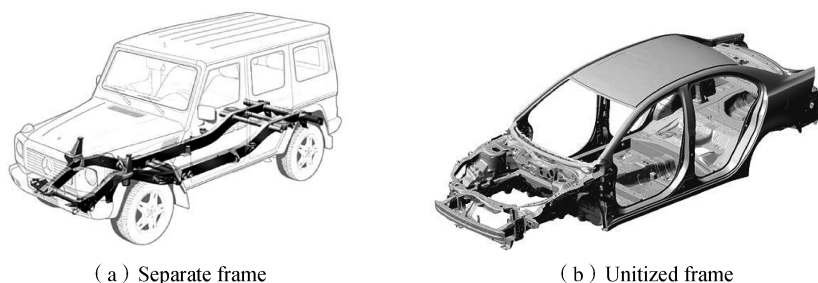


Figure 1 - 2 Frame construction

Some subsystems are briefly described below:

The computer systems monitor and control electric/electronic circuits to increase vehicle mechanical and electrical efficiency and dependability.

The fuel system provides a combustible air-fuel mixture to power the engine.

The primary function of cooling and lubrication systems is to regulate the operating temperature of the engine and minimise friction among its internal moving components, thus preventing engine damage and wear.

Exhaust and emission control systems serve to mitigate engine noise and minimise the release of harmful compounds during the processes of fuel evaporation and combustion.

Drive train systems transfer the power from the engine to the drive wheels.

The suspension, steering, and brake systems are responsible for maintaining and regulating the vehicle's movement and control. They govern the motion of the body and chassis during the vehicle's acceleration from a stationary position, maintenance of high speeds on the highway, and deceleration to a halt.

The accessory and safety systems enhance occupant comfort, safety, security, and convenience.

1.2.2 Working Equipment

The presence of working equipment that can be installed on the vehicle is crucial for effective work. Below, various types of working equipment for agricultural machinery and construction machines will be presented:

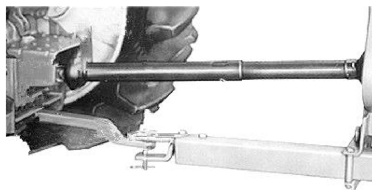
The working equipment of tractor

The tractor transmits power to the agricultural implements via the working equipment, thus constituting an operating unit. The working equipment of farm tractors usually includes the hydraulic suspension system, the drawbar system, the power take-off shaft, and the power take-off belt wheel (Figure 1 - 3), and so on.

The basic purpose of tractor hydraulic systems is to use fluid dynamics to perform work both on and off the tractor. Hydraulic implements are the typical use of hydraulics off the tractor, and selective control valves control the volume of flow. Implements use hydraulic oil to perform a variety of functions such as raising and lowering parts as well



(a) Hydraulic suspension system



(b) Drawbar and PTO shaft

Figure 1 - 3 The tractor working equipment

as providing power to motors and other devices for mechanical movement. Equipment attached to the three-point hitch can be raised or lowered hydraulically with a control lever. The equipment attached to the three-point hitch is usually completely supported by the tractor.

A drawbar is a solid coupling between a hauling vehicle and its hauled load. Agricultural implement is hauled from a tractor mounted drawbar. Specialist agricultural tools such as ploughs are attached to special drawbars which have functions in addition to transmitting tractive force.

Modern tractors use a Power Take-Off (PTO) shaft to provide rotary power to machinery that may be stationary or pulled. The PTO shaft is generally located at the rear of the tractor, and can be connected to an implement that is either towed by a drawbar or a three-point hitch.

The working equipment of excavator

The working equipment of an excavator is composed of three parts: the boom, the arm, and the bucket (Figure 1 - 4). All movements, including the boom lifting and lowering, the arm extending and retracting, and the bucket rotating are controlled by hydraulic cylinders. In order to meet the needs of various constructions, the hydraulic excavators can be equipped with a variety of working equipment, such as excavating, lifting, leveling, clamping, loading, bulldozing, impact hammer, and other operation equipment.



Figure 1 - 4 The hydraulic excavator working equipment

A hydraulic excavator uses hydraulic cylinders to extend, contract, raise, and lower its arm, as well as operate the bucket on the end of the arm. These cylinders work based on oil pressure. There is a hydraulic pump that forces oil in and out of the cylinders, causing them to extend and retract, which makes them act sort of like muscles to move the arm of the excavator.



The working equipment of crane

The working equipment of a crane is the lifting component which includes the boom as part of the upperworks (Figure 1 - 5). The upperworks and the undercarriage are mated together through a turntable, allowing the upperworks to swing from side to side. These modern hydraulic truck cranes are usually single-engine machines, with the same engine powering the undercarriage and the upperworks. The upperworks are usually powered via hydraulics run through the turntable from the pumps mounted on the undercarriage.



Figure 1 - 5 The crane working equipment

The working equipment of forklift truck

The working equipment of a forklift truck, known as the lifting system, includes chains attached to a hydraulic cylinder (Figure 1 - 6). When the cylinder is filled with hydraulic fluid, it forces the piston to move upward. The upward movement of the piston through the chains lifts the forks to the desired height. The lifting forks on a lift truck can be moved from side to side to adjust for different types of loads. While most lift trucks require that this be done by hand, some have special controls for adjusting the forks.



Figure 1 - 6 The forklift truck working equipment

Words and Expressions

assembly [ə'sembli]

engine ['endʒɪn]

body ['bɒdi]

chassis [ˈʃæsi]

electrical [ɪˈlektɹɪk(ə)l]

shell [ʃel]

hood [hʊd]

n. 总成

n. 发动机、引擎

n. 车身

n. 底盘

adj. 电的

n. 外壳

n. (发动机)罩



cargo [ˈkɑːɡəʊ]	<i>n.</i> 货物
separate frame	(分体)非承载式车身
unitized frame	承载式(车身)
power train	传动系
steering [ˈstiəriŋ]	<i>n.</i> 转向器
suspension [səˈspenʃ(ə)n]	<i>n.</i> 悬架
brake [breɪk]	<i>n.</i> 刹车、制动器
transmission [trænzˈmɪʃ(ə)n]	<i>n.</i> 传动装置
horn [hɔːn]	<i>n.</i> 喇叭
electrical level	电平
circuit [ˈsɜːkɪt]	<i>n.</i> 电路
alternator [ˈɔːltənertə(r)]	<i>n.</i> 交流发电机
generator [ˈdʒenəretə(r)]	<i>n.</i> 发电机
control lever	操纵杆
hitch [hɪtʃ]	<i>n.</i> 钩
drawbar [ˈdrɔːbɑː]	<i>n.</i> 牵引车的挂钩
solid coupling	刚性联轴节
plough [plau]	<i>n.</i> 犁
tractive force	牵引力;驱动力
stationary [ˈsteɪʃənri]	<i>adj.</i> 固定的;静止的
mining [ˈmaɪnɪŋ]	<i>n.</i> 矿业;采矿
level off	把……弄平
bulldozing [ˈbʊldəʊzɪŋ]	<i>n.</i> 推土
impact hammer	冲击锤体
scoop [skuːp]	<i>n.</i> 勺;铲子
muscle [ˈmʌs(ə)l]	<i>n.</i> 肌肉;力量
undercarriage [ˈʌndəkæərɪdʒ]	<i>n.</i> 着陆装置;底盘

Notes



1. An automotive system is a group of related parts and assemblies that performs a specific job or task. Automobile parts and systems can be organized into four major categories: engine, chassis, body and frame, electrical and electronic systems. Each category has several subsystems to which it belongs.

汽车系统是一组执行特定工作或任务的相关部件和组件的集合体。汽车零部件和系统可以分为四大类:发动机、底盘、车身和车架、电气和电子系统,每个大类下又包含若干个子系统。

2. In fact, when power from the engine continues to be transmitted to the chassis, it begins with the power train, and goes on to the steering, wheel suspension, brakes and



tires. These individual components interact with each other closely.

事实上,当发动机的动力持续传递至底盘时,动力会先经过传动系统,再依次传递至转向系统、车轮悬挂系统、制动系统以及轮胎。这些独立的部件彼此之间联系紧密、相互配合。

3. The basic purpose of tractor hydraulic systems is to use fluid dynamics to perform work both on and off the tractor. Hydraulic implements are the typical use of hydraulics off the tractor, and selective control valves control the volume of flow. Implements use hydraulic oil to perform a variety of functions such as raising and lowering parts as well as providing power to motors and other devices for mechanical movement.

液压系统的基本功能是利用流体动力实现拖拉机内部或外部的某项工作。液压农机具典型的外部工作部件,通过选择性控制阀控制流体流量实现各种功能,如提升或降低作业部件,以及为液压马达和其他设备提供驱动。

4. In order to meet the needs of various constructions, the hydraulic excavators can be equipped with a variety of working equipment, such as excavating, lifting, leveling, clamping, loading, bulldozing, impact hammer, and other operation equipment.

为了满足各种工程施工的需求,液压挖掘机可以配备多种工作装置,例如用于挖掘、起重、平整、抓取、装载、推土的装置,以及冲击锤等其他作业设备。

1.3 Motor Vehicle and Society

Motor vehicles not only facilitate mobility but also play a significant role in promoting industrialisation and human resource development. Moreover, they have a profound influence on societies and economies worldwide. Simultaneously, it is undeniable that motorization has brought about urgent concerns such as a rise in traffic accidents and adverse effects on the environment. During this process, the general population developed a heightened level of concern for the environment and shifted their attention towards sustainable forms of transportation.

1.3.1 Promote the Development of Social Economy

The core automotive industry supports a wide range of business segments, both upstream and downstream, along with adjacent industries. This leads to a multiplier effect for growth and economic development. The automotive industry contributes to several important dimensions of nation building: generating government revenue, fostering economic development, encouraging human development and so on.

The automotive industry contributes substantial tax revenues from car sales, usage-related fees, personal income taxes, and business taxes. Furthermore, when car manufacturers capitalise on the advantages of globalisation by selling their products abroad, they also generate revenue in foreign currencies. This factor is of utmost importance in determining a country's current-account performance and trade balance with other economies.



According to the International Organisation of Motor Vehicle Manufacturers, the automotive industry plays a significant role in propelling worldwide economic expansion. Globally, the ratio of motor vehicles to individuals is 1:6. The automotive sector plays a substantial role in fostering economic growth and employment by facilitating job creation and promoting skills development. The industry's vast network of both direct and indirect employment positions it as a significant global employer, providing support to numerous associated sectors like textiles, plastics, metals, and electronics. The industry's allocation of resources into research and development is remarkable, demonstrating its dedication to fostering innovation and progress in technology. Consequently, this also reinforces the financial contributions made to different countries, highlighting the crucial importance of the automotive industry in the worldwide economy. The sector plays a pivotal role in supporting global development and prosperity by encouraging employment and advancing technology.

1.3.2 Accelerate the Road Transportation

Motor vehicles and roads have a reciprocal relationship and rely on each other. The growth of the automotive sector is heavily reliant on the establishment of road infrastructure in industrialized nations. The advent of the automobile expedited the



Figure 1 - 7 Accelerate the road transportation and the suburban society

expansion of cities and led to the rapid development of suburbs for the first time (Figure 1 - 7). Prior to the introduction of automobiles, factory workers residing in proximity to the factory or in densely populated communities further afield were linked to the factory via streetcars or railways. The automobile enabled them to reside in sparsely populated areas distant from the urban core, while yet maintaining

employment. The burgeoning suburbs generated limited employment opportunities, necessitating that the majority of inhabitants commute to work in other locations. Subsequently, shopping centres were constructed either within or in close proximity to suburban areas, so eliminating the need for inhabitants to travel to the city. The shopping centres offered a sufficient range of goods and services, hence diminishing the necessity for suburban inhabitants to travel to the city.

Ultimately, with the growing significance of the service economy, business parks emerged, providing suburban residents with the opportunity to work within their own suburban communities. Overall, motor vehicles led to the decentralization of cities and the segregation of land use.



1.3.3 Improve the Quality of Life

Motor vehicles enhance the quality of life by providing greater mobility, comfort, and safety. Globally, the motor vehicle has facilitated more convenient access to distant locations. Nevertheless, the duration of trips to frequently visited locations has increased in major urban areas. The automobile transformed regular medium-distance travel by providing a more convenient and cost-effective option, particularly in regions without developed railway infrastructure. Due to the absence of the need for rest and the increased speed compared to horse-drawn conveyances, automobiles enabled people to regularly travel longer distances than in previous eras.

The development of high-quality road infrastructure and reliable motor vehicles transformed the way people engage in leisure activities and take vacations. The songs' automotive motifs mirrored the broader cultural aspects of the automobile sector, encompassing notions of excitement, freedom from societal constraints, and expressions of male dominance. Books focused on young men who emancipated themselves from the mundane and conventional middle-class existence in order to embark on journeys and pursue thrilling experiences in unfamiliar and captivating locations. Car ownership became synonymous with autonomy, liberty, and elevated social standing.

1.3.4 Influence the Ecological Environment

The utilisation of vehicles has a significant impact on the overall quality of life in our local community (Figure 1 - 8). Traffic congestion can pose significant risks and create a sense of fear, causing social divisions and negatively impacting the quality of street life. Abandoned automobiles create a disturbance, while air pollution and traffic noise can make urban living unpleasant.

Climate change

The emissions from motor vehicles consist of a variety of greenhouse gases, most notably carbon dioxide. These gases possess the capacity to absorb and trap the infrared radiation emitted from the surface of the Earth. This solar energy gets trapped in the earth's atmosphere and causes variances in temperature. This is one of the major contributors to global warming. According to estimates, global temperatures have seen a drastic increase in the last hundred years and if we continue adding up millions of cars every year to our roads, the temperature will increase rapidly, posing a threat to the survival of the human race on this planet. Most motor vehicles are manufactured to

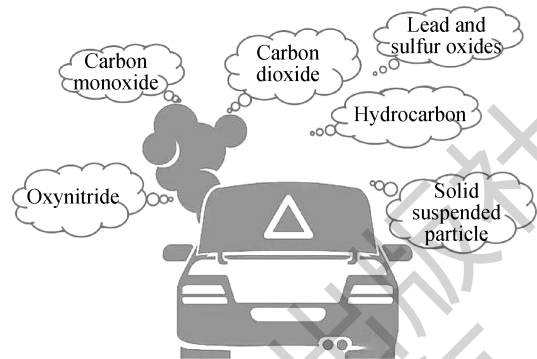


Figure 1 - 8 The ingredients of oil-fueled automobile exhaust



achieve perfect combustion of fuel but after some time as the motor vehicle undergoes wear and tear, the engine is not able to function efficiently which results in the emission of toxic substances. These pollutants are harmful to living beings and cause a host of respiratory diseases and lung cancer in humans. These noxious gases can also devastate plants, which are a vital component of the biological cycle. Car pollution poses a significant threat to the environment by depleting the ozone layer. The ozone layer acts as a barrier that blocks the damaging Ultra-Violet (UV) radiation from entering our atmosphere. UV radiation can lead to various diseases and alter the genetic composition of organisms. Nevertheless, with the projected rise in traffic volume, road transportation will remain a substantial source of greenhouse gas emissions.

Air quality

Air pollutants from transport include nitrogen oxides, particles, carbon monoxide and hydrocarbons. All have a damaging impact on the health of people, animals and vegetation locally. Vehicles are the primary source of local pollution in town centres and along major roadways. During the initial stages of a journey, vehicles have a tendency to release a greater amount of pollution when their engines are in the process of warming up. While advancements in technology and the use of cleaner fuel are reducing the amount of pollutants emitted, the positive impact is being undermined by the growing number of vehicles on the road and the distance they are being driven. Motor vehicle exhausts also contain harmful air pollutants like soot, sulfur dioxide, benzene and formaldehyde.

Car pollution aggravates lung diseases such as asthma and other pulmonary diseases. The pollutants from car exhaust can also cause burning eyes, coughing and breathing difficulties.

Lead, a pollutant produced from burning leaded fuel, interferes with normal red blood cell production by inhibiting important enzymes in the body. Lead also damages red blood cell membranes and interferes with cell metabolism, shortening the lifespan of each individual cell. All of these harmful effects can cause anemia.

Benzene is one of the pollutants released by motor vehicles. This pollutant has been linked to lowered immunity and leukemia.

Pollution from motor vehicle exhaust contributes to the formation of acid rain-acidic gases from motor vehicle exhaust dissolve in rain to form acid rain. Acid rain can acidify water bodies in turn, as well as dissolve away certain nutrients in soil and affect the growth of plants. Acid rain also increases the decay of buildings and monuments. Water species cannot survive in the water that has a higher acidity.

Noise

Motor vehicles have significantly elevated the decibel levels in the environment, hence making a substantial contribution to noise pollution. Common sources of noise pollution in urban environments include engine noise, tyre noise, car horns, car stereos, door slamming, and squeaking brakes. In urban locations, the noise generated by engines



poses a significant issue, whereas in less populated regions, the primary source of noise on busy roads is the sound produced by tyres, which intensifies as the speed increases. The presence of noise pollution has disrupted the biological cycle, leading to behavioural disturbances in numerous animal species due to elevated noise levels. In addition to its environmental impact, noise pollution can lead to several health conditions in individuals, including hypertension and psychological distress. While it is well acknowledged that a single car alone is not typically responsible for noise pollution, instances arise where individuals employ modified mufflers to manipulate the sound of their automobiles. In such cases, the noise emitted by a single vehicle can be equivalent to that generated by hundreds of vehicles. Utilizing low-noise road surfaces, implementing effective noise barriers in sensitive areas, and utilizing low noise tyres can all contribute to the reduction of noise levels. Simultaneously, promoting the practice of closing car windows when playing loud music and restricting the usage of ‘boom box’ car stereos will effectively diminish the negative effects of noise.

Land pollution

Motor cars have significantly encroached upon large areas of our cities, resulting in substantial land contamination (Figure 1-9). Extensive tracts of unproductive terrain have been transformed into parking facilities, and additional ones are being constructed to meet the increasing influx of motor vehicles on a daily basis. Moreover, the expansion of road infrastructure has detrimental impacts on wildlife habitats, mainly by causing habitat fragmentation and altering surface runoff patterns. Constructing new roads through fragile habitats can result in the depletion or degradation of ecosystems. The materials needed for roads are obtained through extensive rock quarrying and gravel extraction, which occasionally take place in ecologically vulnerable areas. Ultimately, road development modifies the water table, amplifies surface runoff, and heightens the likelihood of flooding. All of these factors pose a threat to the survival of wildlife.



Figure 1-9 The traditional automobile industry influence ecological environment

Fuel-powered cars cause major air problems in Chinese cities

With the significant growth of the Chinese middle-class in the past three decades, vehicles have emerged as the prevailing emblem of wealth and success. As the economy continues to expand, the fondness for vehicles will increase, which presents a difficulty in addressing the harmful air pollution in metropolitan China. This pollution has negative effects on health, productivity, and overall quality of life. Nevertheless, in recent years, China has experienced swift socio-economic transformations, prompting the adoption of



new rules and initiatives with the objective of mitigating automobile emissions. Moreover, the extensive implementation of new energy vehicles is actively enhancing urban air quality, providing optimism for tackling this problem.

The severe air pollution in Beijing has caused a thick haze that has obscured the skyline, making it difficult to see clearly. Slow-moving cars can be seen intermittently through the mist, creating a ghostly effect.

The inhabitants of China, who are becoming more knowledgeable and expressive, have effectively compelled the government to enhance transparency regarding the severity of air pollution in their cities. However, as their wealth increases, their aspiration for cleaner air clashes with their escalating reliance on automobiles. China, although being the largest car market globally in terms of vehicle sales, still has significant potential for expansion. This is because the country is well behind Western economies in terms of the number of cars per capita. The air pollution in large cities has been mostly attributed to motor vehicles and their emissions, with almost 30 million cars sold in China every year, which further exacerbates environmental pressure from vehicle emissions.

Vehicles were responsible for a substantial proportion of PM_{2.5} pollution in the capital city, with emissions from coal combustion and building site dust following closely behind. The emission of automobile exhaust has significantly contributed to air quality problems in urban areas of China.



Figure 1 - 10 The past haze in City

Many cities are still experiencing a persistent presence of dense haze (Figure 1 - 10), especially compared to more than ten years ago, with PM_{2.5} levels remaining continuously elevated throughout most areas of the city.

The continuous existence of dense haze can be attributed to factors such as elevated humidity levels, minimal wind, and the lack

of a cold front. These characteristics produce an environment that is favourable for the entrapment and accumulation of pollutants above the city. Despite persistent attempts to alleviate air pollution, Beijing nevertheless has difficulties, enduring sporadic occurrences of intense smog. The haze has also impacted other areas in northern and eastern China, leading to the shutdown of highways and causing delays or cancellations of flights. Simultaneously, there has been a rise in respiratory tract infections, and a surge in accidents on expressways, particularly those aggravated by decreased visibility caused by haze. These occurrences highlight the pressing necessity for comprehensive actions to tackle air quality issues and improve public health and safety.

To reduce the number of cars, the city has implemented a licence plate lottery



system and prohibited one-fifth of cars from entering the city on weekdays, with the risk of incurring fines. In order to evade surveillance cameras, car owners often resort to removing their licence plates or purchasing other vehicles. Beijing employs a four-tier alert system, utilizing the colours blue, yellow, orange, and red to signify the escalating severity of air pollution levels. State media indicated that more Chinese cities may implement restrictions on vehicle purchases as part of efforts to combat air pollution and alleviate traffic congestion. Implementing technological advancements and developing effective urban mobility strategies can effectively reduce the levels of air pollution, which have severe implications for human well-being.

1.3.5 Build Harmony between Motor Vehicle and Society

The rise of the automobile industry is akin to a double-edged sword. On one hand, it can stimulate the growth of the global economy and serve as a vehicle for individuals to pursue their aspirations. On the other hand, it can also lead to an energy crisis, environmental degradation, and transportation congestion, among other issues. Regardless of whether the motor vehicle is considered a typical mode of transportation or is elevated to a more significant status within the automotive culture, it is imperative that we contemplate how to establish a cohesive and balanced automobile civilisation.

Use Green Vehicles

A green vehicle (Figure 1 – 11), also known as an environmentally friendly vehicle, is a type of road motor vehicle that has a lesser negative impact on the environment compared to conventional internal combustion engine vehicles that run on gasoline or diesel.



Figure 1 – 11 Green vehicle

It can also refer to vehicles that utilize certain alternative fuels. Green cars encompass vehicle types that operate entirely or partially on alternative energy sources that are not derived from fossil fuels or are less carbon-intensive than gasoline or diesel. Another possibility is the utilisation of alternative fuel blends in traditional vehicles that rely on fossil fuels, enabling them to operate partially on sustainable energy sources. The transportation industry is now experiencing the most rapid increase in greenhouse gas emissions. Green vehicles play a crucial part in mitigating the greenhouse effect.

Perfect Transportation System

Urban transport systems in highly developed cities have significant obstacles as a result of the ongoing expansion of urban population, private automobile ownership, traffic congestion, and the vulnerability of public transit systems.

To address the issue of heavy traffic, urban management agencies should enhance road guidance, expand road infrastructure and upgrade management technology, improve the highway network, and prioritize the development of public transit. The



government can implement measures to restrict the access of motor cars to the city, promote suburban residency for car owners, and encourage the use of public transportation for commuting to the city.

Advocate Civilized Driving

We should promote the practice of courteous driving, foster excellent driving behaviours, and enhance drivers' understanding of civility. Governments should prioritize the implementation of effective and organised traffic management systems, as well as the fair and acceptable distribution of traffic regulations (Figure 1 - 12).



Figure 1 - 12 Civilized driving

To establish a more cohesive and efficient automotive society, it is imperative that we undertake actions that go beyond mere superficial measures. Let us strive to accurately comprehend

the concept of motor vehicles and work together to build a society that is aesthetically pleasing and in perfect harmony.

Words and Expressions

segment ['seɡmənt]

multiplier ['mʌltɪplaɪə(r)]

decentralization [diːsentrəlaɪ'zeɪʃən]

conveyance [kən'veɪəns]

drastic ['dræstɪk]

combustion [kəm'bʌstʃən]

emission [ɪ'mɪʃ(ə)n]

toxic ['tɒksɪk]

respiratory [rə'spɪrət(ə)rɪ]

nitrogen ['naɪtrədʒən]

monoxide [mə'nɒksaɪd]

hydrocarbon [ˌhaɪdrə'kɑːbən]

sulfur ['sʌlfə(r)]

dioxide [daɪ'ɒksaɪd]

benzene ['benziːn]

formaldehyde [fɔː'mældɪhaɪd]

asthma ['æsmə]

lead [liːd]

n. 段;部分

n. 乘数

n. 分散;疏散

n. 运输;运输工具

adj. 激烈的

n. 燃烧,氧化

n. 发射,散发

adj. 有毒的;中毒的

adj. 呼吸的

n. 氮

n. 一氧化物

n. 碳氢化合物

n. 硫

n. 二氧化碳

n. 苯

n. 甲醛

n. 哮喘,气喘

n. 铅



enzyme ['enzaim]	<i>n.</i> 酶
metabolism [mə'tæbəlizəm]	<i>n.</i> 新陈代谢
leukemia [ljʊ'ki:miə]	<i>n.</i> 白血病
acidic [ə'sɪdɪk]	<i>adj.</i> 酸的, 酸性的
muffler ['mʌflə(r)]	<i>n.</i> 消声器
fragmentation [fræɡmen'teɪʃən]	<i>n.</i> 破碎; 分裂
degradation [ˌdeɡrə'deɪʃən]	<i>n.</i> 退化
ecosystem ['i:kəʊsɪstəm]	<i>n.</i> 生态系统

Notes



1. According to estimates, global temperatures have seen a drastic increase in the last hundred years and if we continue adding up millions of cars every year to our roads, the temperature will increase rapidly, posing a threat to the survival of the human race on this planet.

据估算,在过去的一百年间,全球气温急剧上升。如果我们继续每年让数以百万计的汽车驶上公路,气温将会迅速攀升,进而威胁到人类在地球上的生存。

2. Most motor vehicles are manufactured to achieve perfect combustion of fuel but after some time as the motor vehicle undergoes wear and tear, the engine is not able to function efficiently which results in the emission of toxic substances.

大多数汽车在制造时都旨在实现燃料的完全燃烧。然而,随着使用时间的推移,车辆会产生磨损与老化,导致发动机无法再高效运转,进而造成有毒物质的排放。

3. While advancements in technology and the use of cleaner fuel are reducing the amount of pollutants emitted, the positive impact is being undermined by the growing number of vehicles on the road and the distance they are being driven.

尽管技术进步与清洁能源的使用正在减少污染物排放,但道路上车辆数量的不断增加以及车辆行驶里程的拉长,正在抵消这一积极成效。

4. Lead, a pollutant produced from burning leaded fuel, interferes with normal red blood cell production by inhibiting important enzymes in the body. Lead also damages red blood cell membranes and interferes with cell metabolism, shortening the lifespan of each individual cell. All of these harmful effects can cause anemia.

铅作为一种因燃烧含铅燃料而产生的污染物,会通过抑制体内关键酶的活性来干扰正常红细胞的生成。铅还会破坏红细胞细胞膜,阻碍细胞新陈代谢,缩短单个细胞的寿命。以上这些危害都会引发贫血。

5. Extensive tracts of unproductive terrain have been transformed into parking facilities, and additional ones are being constructed to meet the increasing influx of motor vehicles on a daily basis. Moreover, the expansion of road infrastructure has detrimental impacts on wildlife habitats, mainly by causing habitat fragmentation and altering surface runoff patterns.



大片原本无法利用的荒地已改造成停车场,同时为应对每日持续增多的车流,更多停车场也正在修建当中。此外,道路基础设施的扩建会对野生动物栖息地造成不利影响,这主要表现为导致了生态栖息地的碎片化,并改变了原有的地表径流模式。

Exercises

1. True or false

- (1) By definition, motor vehicle classes include automobiles or cars, buses, motorcycles, off highway vehicles railway and so on. ()
- (2) The automotive sector contributes significant tax revenues from vehicle sales, usage-related levies, personal income taxes and business taxes. ()
- (3) Benzene is one of the pollutants released by motor vehicles. It can cause anemia. ()

2. Fill in the blanks

- (1) The working devices mainly use _____ to achieve movement and working.
- (2) In the farm tractors, _____ provide rotary power to machinery that may be stationary or pulled.
- (3) The exhaust from the motor vehicles contains various greenhouse gases such as _____ and _____.
- (4) _____ is one of the pollutants released by motor vehicles. This pollutant has been linked to lowered immunity and leukemia.
- (5) A _____ is a road motor vehicle that produces less harmful impacts to the environment than comparable conventional internal combustion engine vehicles running on gasoline or diesel, or one that uses certain alternative fuels.

3. Short answers

- (1) List the main parts of an automobile?
- (2) What are the common types of a vehicle according to body styling?
- (3) Which systems does a chassis include and what are the main functions of the chassis?
- (4) Please list several kinds of clean energy, and its application in the field of automobile.
- (5) Please list a few other relevant industries related to automotive industry.
- (6) Please list several exhaust from the motor vehicles contains various greenhouse gases.

4. Questions

- (1) The advantages and disadvantages of the formation of suburban society.
- (2) Analyse the haze problem in China, and put forward several suggestion for the sustainable development of automotive industry in the future.



(3) Summarize the positive significance to society with the development of automobile industry.

(4) Examples to illustrate, what kinds of working can the hydraulic excavators that install with various working devices achieve?

(5) Please research the types of crane and the characteristics of their working device.

5. Extra-curricular extension

What is the PM2.5? What is the relationship with automobile exhaust?

READING MATERIAL

The Development of Vehicle

A vehicle is a movable machine that conveys individuals or goods. Various types of vehicles are produced, including bicycles, automobiles, trucks, buses, motorcycles, trains, ships, boats, and aircraft. It has the ability to traverse land, water, or space. The history of vehicles is intertwined with the history of human civilisation.

Early era

Early vehicles were powered by human, animal, wind, and water energy sources. The first form of transportation used by humans is walking on foot. Boats have been utilized since ancient times. Archaeologists have discovered dugouts, which are the most ancient boats known to date, with an estimated age of approximately eight thousand years. The sailboat, often known as a sailing boat, is a type of watercraft that is powered by the use of sails.

Archaeological evidence suggests the existence of wheeled vehicles pulled by camels around 3 000 – 4 000 BCE. Ma Jun constructed a south-pointing chariot in the year 200 CE, which was equipped with an early version of a guiding system. Ivan Kulibin, in Russia during the 1780s, created a three-wheeled carriage that was powered by a human pedaling mechanism. This innovative vehicle incorporated advanced components such as flywheel, brake, gearbox, and bearings. In the year 1817, the first human methods of transportation to utilise the two-wheeler principle were push bikes, draisines, or hobby horses. The draisine, also known as the “running machine,” was designed by the German Baron Karl von Drais and is considered the precursor to the contemporary bicycle (and motorbike).

The Diolkos wagonway, which operated from circa 600 BC, was a transportation system that spanned 6 to 8.5 kilometres (4 to 5 miles) and was used to ferry boats across the Isthmus of Corinth in Greece. This wagonway is considered the earliest known evidence of its kind and is considered a forerunner to the modern railway. An ancient depiction of a railway in Europe from this era can be found in a stained-glass window



located in the Minster of Freiburg im Breisgau, which dates back to approximately 1350. Cardinal Matthäus Lang wrote a depiction of the Reisszug, a cable railway located at the Hohensalzburg Castle in Austria, around 1515. The original line utilized wooden rails and a hemp haulage rope, and was powered by manual or animal power, facilitated by a treadwheel. The Montgolfier brothers designed the inaugural balloon vehicle in 1783.

Steam era

Currently, steam is the primary source of energy. James Watt obtained a patent in 1781 for a steam engine that generated uninterrupted rotational movement. The stationary steam engine played a pivotal role in driving the Industrial Revolution. In 1769, Nicolas Joseph Cugnot, a French military engineer, built the first ever vehicle capable of movement. Richard Trevithick constructed the inaugural operational railway steam locomotive in the United Kingdom in 1804. In 1803, Robert Fulton, an American engineer, successfully sailed the first functional steamboat.

Internal combustion engine electric era

This era is also called the age of oil which is characterized by an increased use of petroleum in products and as fuel. In 1883, the German engineers made gasoline-fueled internal-combustion engine, Daimler's engine ran at up to 900 RPM. The invention of the internal combustion engine and application caused a revolution in transport. 1885 Karl Benz built (and subsequently patented) the first automobile, powered by his own four-stroke cycle gasoline engine in Mannheim, Germany. In 1903, the Wright brothers of the United States flew their "Wright Flyer" biplane in the North Carolina, conducting the world's first powered controlled flight, heralding the arrival of a new era in transportation. In 1884, the first Parsons turbo-generator was completed by the British inventor, Charles A. Parsons. Since then, turbines have become the main power plant for ships.

Automatic era

The era of automation signifies a crucial phase in the automotive sector. Due to ongoing technological breakthroughs, automobiles have progressively become more intelligent, secure, and ecologically sustainable. Autonomous driving technology, which incorporates sophisticated sensors, cameras, radar, and artificial intelligence, allows vehicles to independently detect and understand their environment, make choices, and carry out actions. As a result, it plays a vital role in future transportation systems. Intelligent vehicle systems include autonomous driving functions, vehicle-to-vehicle communication, in-vehicle entertainment and information systems, and intelligent driving assistance systems. These systems improve driving safety, comfort, and convenience by utilizing the Internet and advanced software technology. Presently, these technologies have been implemented in diverse transportation scenarios and are continuously advancing, offering individuals safer and more efficient methods of travel.

In the future, humanity will explore every corner of the Earth and outer space.

Chapter 2

Classification of Motor Vehicles

Vehicle classification can be based on many criteria such as engine type (gas or diesel), driveline type (automatic or manual transmission, front-wheel or rear-wheel drive), and other factors. Each country employs a distinct way of classification.

2.1 Classification Based on Function

The function separated the vehicles into categories such as passenger cars, buses, trucks, vehicles for special transportation, and vehicles for specific work.

2.1.1 Car

Cars are motor vehicles that carry people. The classification may differ from country to country. Even the same kind of vehicle can be named differently by region. The relevant classifications of Euro NCAP, America, Britain and China are also shown in Table 2 – 1.

Table 2 – 1 Car classifications

America	Britain	Euro NCAP	China
Microcar	Microcar or bubble car	—	Mini class car
—	City car	Supermini	
Subcompact car	Supermini		Popular class car
Compact car	Small family car	Small family car	
Mid-size car	Large family car	Large family car	Medium class car
Entry-level luxury car	Compact executive car		
Full-size car	Executive car	Executive car	Mid-high class car
Mid-size luxury car			
Full-size luxury car	Luxury car	—	High class car
Sport car	Sport car	—	Roadster



续表

America	Britain	Euro NCAP	China
Grand tourer	Grand tourer	—	
Supercar	Supercar	—	
Convertible	Convertible	—	
Roadster	Roadster	Roadster	
—	Leisure activity vehicle	Small MPV	MPV
—	Mini MPV		
Compact minivan	Compact MPV		
Minivan	Large MPV	MPV	
Mini SUV	Mini 4×4	Small off-roader	SUV
Compact SUV	Compact 4×4		
Mid-size crossover SUV	Large 4×4	Large off-roader	
Mid-size SUV	Off-roader		
Full-size SUV			

Microcar

A microcar, as shown in Figure 2-1, refers to the smallest category of automobiles, typically encompassing cars that are smaller than city cars. Subsequent iterations of these vehicles are commonly referred to as bubble cars because of their distinctive bubble-like design. Typical microcars possess the following characteristics: seating for only the driver and one passenger, a 1-cylinder engine with a capacity of 49 – 500 cm³, single-wheel drive, cable-operated brakes on either 2 or 4 wheels (no longer allowed in countries like the UK), basic springs, and road wheels measuring 6 – 8 inches in diameter.

City car

A city car (Figure 2-2), often referred to as an urban car or mini, is a compact vehicle designed especially for usage in urban areas. In contrast to microcars, a city automobile that offers higher speed and enhanced occupant protection is more suited for navigating through various traffic conditions and weather circumstances. In Japan, city cars are called “kei cars”. Kei cars have to meet strict size and engine requirements: engines have a maximum displacement of 660 cm³ and the car’s length must be under 3 400 mm.



Figure 2 - 1 Microcar



Figure 2 - 2 City car



Figure 2 - 3 Subcompact car



Figure 2 - 4 Compact car

Supermini/Subcompact car

This class is known as supermini in Europe and subcompact car in North America. Superminis (Figure 2 - 3) have three, four or five doors and are designed to seat four passengers comfortably. Current supermini hatchbacks are approximately 3 900 mm long, while saloons and estate cars are around 4 200 mm long.

Small family car/Compact car

Small family/compact cars (Figure 2 - 4) include hatchbacks, as well as the shortest saloons and estate cars that share a similar size. Hatchbacks have a length of roughly 4 250 mm, whereas saloons and estate cars have a length of around 4 500 mm. Compact automobiles typically accommodate up to five adults and are equipped with engines ranging from 1.4 to 2.2 L. However, certain models may feature engines as large as 2.5 L.

Large family car/Mid-size car

These automobiles can accommodate up to five adult passengers and possess a spacious trunk (sometimes known as a boot) (see Figure 2 - 5). Engines in larger vehicles possess greater power compared to tiny family/compact automobiles, and six-cylinder engines are more prevalent in larger vehicles than in smaller ones. Car dimensions differ across different



Figure 2 - 5 Large family car/Mid-size car

regions. In Europe, large family automobiles typically do not exceed a length of 4 700 mm, while in North America, the Middle East, and Australasia, they can often surpass 4 800 mm. The dimensions of cars in China are displayed in Table 2 - 2.



Table 2 - 2 Types of cars (China)

Type	Engine displacement (L)
Mini class car	Engine displacement ≤ 1
Popular class car	$1 < \text{Engine displacement} \leq 1.6$
Medium class car	$1.6 < \text{Engine displacement} \leq 2.5$
Mid-high class car	$2.5 < \text{Engine displacement} \leq 4$
High class car	$4 < \text{Engine displacement}$

Table 2 - 3 Types of buses

China	USA	Bus leng (m)
Urban bus, city bus	Commuter bus	Medium $7 < L \leq 10$
Motorcoach	Intercity bus	Large $10 < L \leq 12$
Double-decker bus	Double-decker bus	$10 < L \leq 12$
Articulated bus	Articulated bus	$L \leq 18$
	Microbus	$L \leq 3.5$
Minibus	Light bus	$3.5 < L \leq 7$
Midium bus	Medium bus	$7 < L \leq 10$
Trolley bus	Trolley bus	

2.1.2 Bus

Buses are large road vehicles designed to carry numerous passengers in addition to the driver and sometimes a conductor. They are important vehicles in modern society. The types of buses are shown in Table 2 - 3.



Figure 2 - 6 Commuter bus



Figure 2 - 7 Double-decker bus



Figure 2 - 8 Articulated bus



Figure 2 - 9 Motorcoach



An urban bus, also known as a city bus or commuter bus (Figure 2 – 6), typically has two axles and two doors, which provide efficient interior traffic movement. Their seats are typically fixed and spaced to allow for standing areas. Several commuter buses are equipped with a low floor design, which facilitates the process of getting on and off the bus. Double-deckers (Figure 2 – 7) and articulated buses (bendy bus) (Figure 2 – 8) are typically employed for metropolitan routes that experience high volumes of passengers. A motorcoach (Figure 2 – 9), commonly referred to as an intercity coach, is a large vehicle typically equipped with three axles, one passenger door, and no standing area. The seats are often cushioned and capable of reclining. The floor is elevated, providing ample space for sizable under-floor luggage lockers. Typically, there is a compact storage area for carry-on bags located inside the passenger cabin. In addition to their role in intercity transportation, motorcoaches are also utilized for long-distance airport shuttle services, local tours, and charters. A tour coach, particularly a cross-country touring coach, is commonly furnished with a bathroom, video system, public address system (PA system), and other amenities suitable for extended periods of comfortable travel. Short-distance tour buses are characterized by their basic features, which include a PA system and occasionally a television system. Several decommissioned double-decker buses are employed in the local tourism industry. Minibuses, depicted in Figure 2 – 10, are larger than big passenger vans and have a seating capacity of up to 25 passengers. Some vehicles may feature a small area designated for storing luggage. These vehicles are utilized for transporting passengers over short distances, conducting city tours, and providing local charter services.

2. 1. 3 Off-Road Vehicle

An off-road vehicle, as shown in Figure 2 – 11, refers to any vehicle that has the ability to travel on both paved and gravel surfaces. Typically, it is distinguished by the presence of oversized tyres with substantial treads, a flexible suspension system, or even caterpillar tracks.



Figure 2 – 10 Minibus



Figure 2 – 11 Off-road vehicle

2. 1. 4 Truck and Truck-Tractor

A truck (US, CA and AU) or lorry (UK and Ireland) (Figure 2 – 12) is a motor vehicle designed to transport cargo. Trucks exhibit significant variations in size, power,



and configuration, with the smallest ones sharing mechanical similarities with automobiles. Commercial trucks can possess significant size and strength, and can be designed to accommodate specialized equipment, such as fire trucks, concrete mixers, and suction excavators. Modern trucks predominantly utilise diesel engines, with gasoline engines being found in smaller to medium-sized trucks in the US. Within the European Union, vehicles weighing less than 3 500 kilogrammes (7 716 lb) are categorized as light commercial vehicles, whereas those beyond this weight are classified as heavy goods vehicles. The various categories of trucks are displayed in Table 2 - 4 as per the Chinese National Standard.

The truck-tractor (Figure 2 - 13) is a short truck with a driver's cab but no body, designed for hauling a trailer or semi-trailer.



Figure 2 - 12 Truck



Figure 2 - 13 Truck-tractor

Table 2 - 4 Types of truck by the Chinese National Standard

Type	Gross mass (t)
Mini truck	$M \leq 1.8$
Light truck	$1.8 < M \leq 6$
Medium truck	$6 < M \leq 14$
Heavy truck	$M > 14$

2. 1.5 Recreational Vehicle

Recreational vehicles (Figure 2 - 14) are motor vehicles specifically designed for leisure activities, such as holidays and camping. They are typically parked in designated areas such as RV parks or campgrounds. They are available for rental in the majority of prominent urban centres and popular tourist destinations. Mobile offices are sometimes utilized by business travellers and commonly support customizations such as additional desk space, an enhanced electrical system, a generator, and satellite Internet. Some recreational vehicles function as permanent mobile residences. The various types of recreational vehicles include motorhomes (class A, B, B+, and C), travel trailers, fifth wheel trailers, popup trailers, and slide-in campers.



2.1.6 Racing Car

A racing car (Figure 2 – 15) is designed specifically to meet the requirements of a given race. Given that the racing cars' components may undergo intense stress in competitions, it is imperative to employ advanced technologies to create high-performance structures. Notable motor racing events involving four-wheeled vehicles include Formula One racing, the Le Mans 24 Hours race, the World Rally Championship (WRC), the Indianapolis 500 race, GT racing, and drag racing.



Figure 2 – 14 Recreational vehicle



Figure 2 – 15 Racing car

2.1.7 Vehicle for Special Transportation

Vehicles for special transportation are used to carry special goods. Examples are: vehicles with closed bodies for easily contaminated goods, vehicles with refrigerator bodies for perishable foodstuffs (Figure 2 – 16), dump trucks (Figure 2 – 17) for sand, soil or stones, flat-bed semi-trailers for large-size cargo and tankers (Figure 2 – 18) for liquid, powder or grain.

2.1.8 Vehicle for Special Work

Vehicles for special work have special equipment to meet the requirements of special tasks. Examples include: mobile-shops, ambulances, fire engines and vehicles for urban sanitation and road cleaning, garbage disposal trucks, hydraulic excavators, bulk material loaders (Figure 2 – 19), etc.



Figure 2 – 16 Refrigerated truck



Figure 2 – 17 Dump truck



Figure 2 - 18 Tanker



Figure 2 - 19 Bulk material loader

2.1.9 Agricultural Vehicle

Agricultural vehicles or farm transporters are types of machinery used on farms to help with farming. A good example of this kind is the tractor (Figure 2 - 20).



Figure 2 - 20 Tractor

Words and Expressions

European New Car Assessment Program (Euro NCAP)

Kei car

displacement [dɪs'pleɪsmənt]

subcompact ['sʌbkəm'pækt]

hatchback ['hætʃ'bæk]

saloon [sə'luːn]

estate car

conductor [kən'dʌktə(r)]

commuter bus

double-decker

articulated bus

欧洲新车评估体系

轻四轮车

n. 取代, 排量

n. 微型汽车

n. 掀背式轿车

n. 轿车, 酒吧

客货两用车

n. 乘务员, 导体

城市客车

双层客车

铰接式客车



motorcoach ['məʊtəkəʊtʃ]	<i>n.</i> 长途客车
charter ['tʃɑ:tə(r)]	<i>n.</i> 包车, 特许
tour coach	旅游客车
public address system	公共广播系统
amenity [ə'mɪnɪti]	<i>n.</i> 舒适, 便利设施
minibus ['mɪnɪbʌs]	<i>n.</i> 轻型客车(中巴)
off-road ['ɒf rəʊd]	<i>adj.</i> 越野的
tread [tred]	<i>n.</i> 胎面, <i>vt.</i> 踩, 踏
caterpillar ['kætəpɪlə]	<i>adj.</i> 有履带装置的
excavator ['ekskeɪvətə(r)]	<i>n.</i> 挖掘机
trailer ['treɪlə(r)]	<i>n.</i> 挂车
recreational vehicle	休闲车, 房车, 旅居车
motorhome ['məʊtəhəʊm]	<i>n.</i> 自行式房车
travel trailer	拖挂房车
Formula one racing	一级方程式汽车竞赛
vehicle for special transportation	运输型专用汽车
dump truck	自卸车
vehicle for special work	作业型专用汽车
mobile-shop	售货车
fire engine	消防车
sanitation [sænɪ'teɪʃ(ə)n]	<i>n.</i> 卫生设备
garbage disposal truck	垃圾处理车
farm transporter	农用车
tractor ['træktə(r)]	<i>n.</i> 拖拉机

Notes



1. The various types of recreational vehicles include motorhomes (class A, B, B+, and C), travel trailers, fifth wheel trailers, popup trailers, and slide-in campers.

各类休闲旅居车辆包含自行式房车(A型、B型、B+型以及C型)、旅行拖挂房车、第五轮拖挂房车、折叠式拖挂房车以及车载露营舱。

2. Notable motor racing events involving four-wheeled vehicles include Formula One racing, the Le Mans 24 Hours race, the World Rally Championship (WRC), the Indianapolis 500 race, GT racing, and drag racing.

四轮车辆知名赛车赛事包括一级方程式赛车、勒芒24小时耐力赛、世界汽车拉力锦标赛(WRC)、印第安纳波利斯500英里大赛、GT跑车赛以及直线加速赛。

3. Vehicles for special transportation are used to carry special goods. Examples are: vehicles with closed bodies for easily contaminated goods, vehicles with refrigerator



bodies for perishable foodstuffs, dump trucks for sand, soil or stones, flat-bed semi-trailers for large-size cargo and tankers for liquid, powder or grain.

运输型专用汽车是运输特殊货物的车辆,如装运易污货物的闭式车身的汽车、装运易腐食品的冷藏车身的汽车,运输沙子、泥土或是石头的自卸汽车、运输大型货物的平板半挂车以及运液体、粉状、粒状货物的罐车。

2.2 Classification Based on Energy Source

2.2.1 Conventional Vehicle

The conventional vehicle is propelled by an internal combustion engine, which utilizes gasoline or diesel as fuel. The majority of cars now in use are conventional vehicles.

2.2.2 Battery Electric Vehicle

Battery Electric Vehicles (BEVs) exclusively operate using electricity. Their propulsion is achieved through the utilisation of an electric motor (or motors) that are energized by rechargeable battery packs. Battery electric vehicles provide numerous advantages compared to vehicles equipped with internal combustion engines. These include high energy efficiency, environmental friendliness, improved performance, and less reliance on traditional energy sources.

However, battery electric vehicles encounter notable obstacles connected to their batteries, such as limited driving range, lengthy recharge time, high battery cost, and the large size and weight of the batteries. Scientists are now developing enhanced battery technologies to augment the distance electric vehicles can travel and reduce the time and expense of recharging, as well as the weight of batteries. These factors will eventually dictate the future of BEVs.

2.2.3 Hybrid Electric Vehicle

A Hybrid Electric Vehicle (HEV) is a vehicle that combines a traditional Internal Combustion Engine (ICE) propulsion system with an electric propulsion system, working together in harmony. There are various types of HEVs, and their degree of operation as EVs varies. The predominant type of HEV is the hybrid electric automobile, although hybrid electric trucks (pickups and tractors) and buses also exist.

2.2.4 Fuel Cell Vehicle

A Fuel Cell Vehicle (FCV) or Fuel Cell Electric Vehicle (FCEV) is a vehicle that utilizes a fuel cell to generate electricity for an electric motor. Vehicle fuel cells generate electricity to operate an electric motor by utilizing hydrogen stored on board and oxygen



from the atmosphere. Fuel cell vehicles possess the capacity to substantially diminish our reliance on imported petroleum and decrease the release of detrimental emissions that contribute to climate change.

2.3 Classification Based on Body Type

Currently, there are multiple fundamental body shapes or roof designs being utilized.

2.3.1 Sedan

A sedan, as depicted in Figure 2 – 21, is an automobile equipped with both front and rear seating areas, capable of accommodating either four or six individuals. Both two-door and four-door sedans are offered. The vehicle features centre body pillars, sometimes known as “B” pillars, positioned between the front door and rear quarter panel.

2.3.2 Hardtop

A hardtop (Figure 2 – 22) does not have a center pillar to support the roof, so the roof must be reinforced to provide enough strength. A hardtop is also available in both two- and four-door versions.



Figure 2 – 21 Sedan(four doors)



Figure 2 – 22 Hardtop

2.3.3 Hatchback

A hatchback (Figure 2 – 23), often known as a liftback, is equipped with a spacious rear door that facilitates convenient loading and unloading of cargo. This particular car type is offered in both three-door and five-door variants.

2.3.4 Convertible

A convertible vehicle, as shown in Figure 2 – 24, is equipped with a roof panel that may be elevated or lowered into a designated compartment situated behind the rear seat. The convertible roof might be constructed from metal, a composite material, or a synthetic fabric. The metal roof may be folded and stored in the trunk space. A convertible lacks center pillars, and its structural integrity depends mainly on the frame



and floorpan. The majority of convertibles are two-door versions.



Figure 2 - 23 Hatchback



Figure 2 - 24 Convertible

2.3.5 Van

A van (Figure 2 - 25) has a large, box-shaped body to increase interior volume or space. A full-size van normally is front-engine, rear-wheel drive with a full perimeter frame. A minivan is midsize and similar to the station wagon, but it has a higher roofline for more headroom and cargo space. Minivan often uses front-engine, front-wheel drive with unibody construction.

2.3.6 Station Wagon

The station wagon (Figure 2 - 26) features an elongated, unbroken roof that stretches to the back of the vehicle. Station wagons feature spacious rear cabin compartments and are available in both two-door and four-door variants.



Figure 2 - 25 Van



Figure 2 - 26 Station wagon

2.3.7 Sport Utility Vehicle

An SUV (Figure 2 - 27), often known as a sport utility vehicle, is designed with four-wheel drive systems and features a tall roofline and floorpan. SUVs possess increased ground clearance for off-road driving due to their elevated floorpan. These vehicles offer the comfort often seen in passenger cars, the spaciousness of station wagons, and the ruggedness of trucks. Due to its substantial weight and intricate heavy-duty four-wheel drive system, an SUV is less fuel-efficient compared to other vehicle types.



2.3.8 Pickup Truck

A pickup truck typically consists of a distinct cab and bed, as seen in Figure 2-28. The cab, bed, fenders, and other body panels are securely fastened to the frame using bolts. Rubber bushings are installed between the body panels and the frame in order to effectively mitigate the transmission of noise and vibration into the passenger compartment. The majority of pickup trucks employ a configuration in which the engine is located in the front and the power is sent to the rear wheels. Some vehicles are equipped with four-wheel drive.



Figure 2-27 SUV



Figure 2-28 Pickup

Words and Expressions

conventional vehicle

battery ['bætri]

hybrid electric vehicle

fuel cell vehicle

sedan [si'dæn]

pillar ['pilə(r)]

hardtop ['hɑ:dtɒp]

convertible [kən'vɜ:təbl]

roof [ru:f]

van [væn]

full perimeter frame

unibody ['ju:nibɒdi]

station wagon

pickup truck

cab [kæb]

传统汽车

n. 电池

混合动力汽车

燃料电池汽车

n. 轿车

n. 柱子, 柱形物

n. 硬顶车

n. 敞篷汽车

n. 车顶

n. 厢式货车

边梁式车架

n. 承载式车身

旅行车

敞篷载货卡车

n. 驾驶室



Notes



1. However, battery electric vehicles encounter notable obstacles connected to their batteries, such as limited driving range, lengthy recharge time, high battery cost, and the large size and weight of the batteries.

然而,纯电动汽车在电池方面面临着诸多显著难题,包括续航里程有限、充电耗时久、电池造价高昂,以及电池体积大、重量大等问题。

2. A Hybrid Electric Vehicle (HEV) is a vehicle that combines a traditional Internal Combustion Engine (ICE) propulsion system with an electric propulsion system, working together in harmony. There are various types of HEVs, and their degree of operation as EVs varies.

混合动力汽车(HEV)是一种将传统内燃机(ICE)动力系统与电驱动系统相结合,并使两者完美协同工作的车辆。混合动力汽车拥有多种技术构型,不同构型车的纯电行驶能力与电气化程度各不相同。

Exercises



1. The vehicle is classified into _____, _____, _____, _____, _____, _____, according to the function.

2. Hybrid electric vehicle combines a conventional _____ (ICE) propulsion system with an _____ propulsion system.

3. Choose these words and fill in the blanks

Sedan; station wagon; SUV; pickup truck; van; hatchback; hardtop; convertible















READING MATERIAL

Excavator

Excavators are a type of construction machinery that consists of several essential parts, such as the cab, engine, hydraulic cylinder, boom, bucket, counterweight, and track frame (Figure 2 – R – 1).

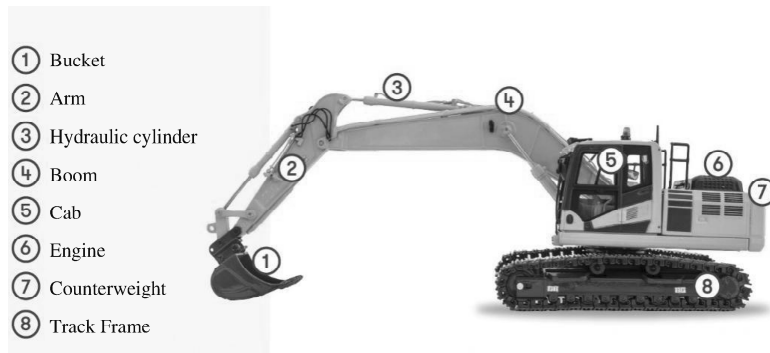


Figure 2 – R – 1 Excavator composition

The cab functions as the central command centre for operating the excavator, where the operator manages and oversees its operations. The engine functions as the primary power provider, propelling the functioning of the hydraulic system and other mechanical elements. The hydraulic cylinder is an essential element that is activated by the hydraulic system to facilitate the movement of various components, such as the bucket and boom. The boom offers structural reinforcement for the bucket and hydraulic cylinder, guaranteeing stability and support. The bucket serves as the operative tool employed for the purposes of excavation, loading, and transportation of materials. The counterweight is used to stabilise and ensure the safety of the excavator by balancing its centre of gravity during operation. The track frame provides structural support and facilitates the transmission of the excavator's weight, allowing it to manoeuvre and function effectively across diverse terrain conditions. Collectively, these fundamental elements constitute the overarching framework of the excavator, allowing it to fulfil a pivotal function in the construction sector.

Hydraulic System

The hydraulic system is the primary element of the excavator, employing hydraulic oil to transfer power and execute diverse mechanical operations. The primary elements comprise the hydraulic pump, solenoid directional valve, flow control valve, and hydraulic cylinder (Figure 2 – R – 2).

The hydraulic pump draws hydraulic oil from the reservoir and transmits it with force to the hydraulic cylinder. The hydraulic oil pressure propels the piston within the

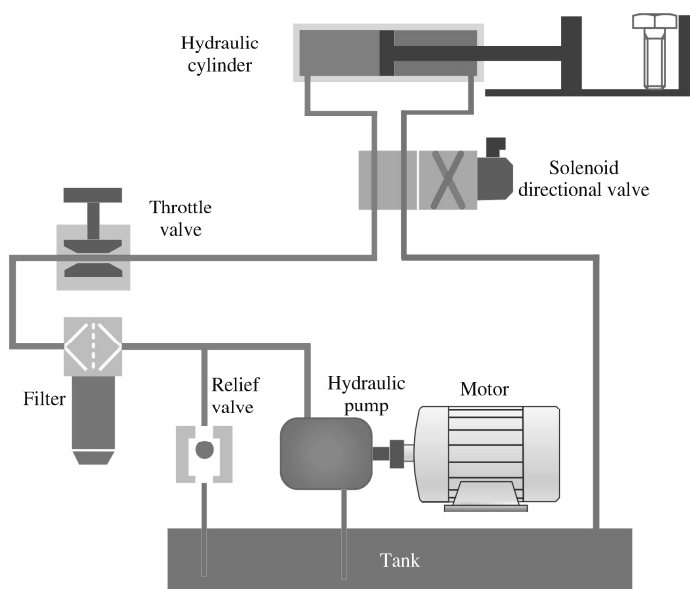


Figure 2 - R - 2 Hydraulic system schematic diagram

hydraulic cylinder, facilitating the motion of excavator parts such as the bucket and boom. The hydraulic cylinder consists of two sides: the rod side and the blind side. When hydraulic oil flows into the side of the hydraulic cylinder that is not visible, the piston rod moves outward; on the other hand, when hydraulic oil flows into the side of the hydraulic cylinder that contains the rod, the piston rod moves inward. The solenoid directional valve governs the orientation of hydraulic oil movement, while the flow control valve manages fluid flow by modifying the flow area or length, guaranteeing accurate management of the hydraulic system. Hydraulic oil offers exceptional lubricating and sealing characteristics, capable of enduring elevated pressure and temperature, thus guaranteeing the smooth functioning of the hydraulic system. This technology employs hydraulic fluid to transfer energy, facilitating accurate manipulation and productive performance of the excavator.

Power System

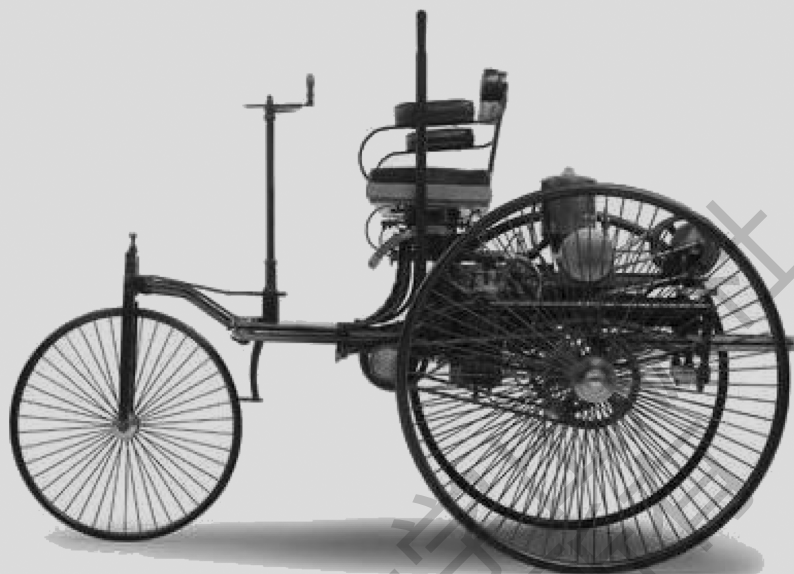
The excavator's power system primarily comprises the engine and power transmission device. The engine supplies the requisite power for the excavator, commonly employing diesel engines, but certain models may utilise hydraulic motors or electric motors. The engine transfers power to the hydraulic system and drive devices via the power transmission device, enabling the hydraulic pump, hydraulic cylinder, and hydraulic motor to execute different functions of the excavator, such as raising and lowering the bucket, rotating the boom, and moving. The power transmission device commonly comprises a gearbox, drive shaft, and drive chain. It facilitates the transfer of the engine's power output to different components, thereby enabling the movement and functioning of the excavator.



车辆工程
★ AUTOMOBILE AND TRACTOR ★

Section II

Motor Vehicle Development



南京大學
版權所有

南京大学出版社
版权所有

Chapter 3

History of Motor Vehicles

The structure of a motor vehicle is a complex mechanism with several moving parts that may not have been created by one or two people. The gradual advancement brought about by the innovative thoughts of thousands of people has taken a considerable amount of time. The invention and growth of the vehicle were intimately associated with scientific and technological advancements as well as the industrial revolution.

3.1 History of Foreign Automobiles

3.1.1 Steam-Powered Vehicle

The British were the early designers of the steam engine, which was the basis of the invention of the steam-powered vehicle around 1672. Ferdinand Verbiest, a member of a Jesuit mission in China, built the first steam-powered vehicle as a toy for the Chinese emperor. It was possibly the first operational steam-powered vehicle, despite being too small to accommodate a driver. Thomas Newcomen constructed his first steam engine in 1712, which was utilized to extract water from the pit. It was massive and perfectly motionless. James Watt created the first pressurized steam engine in 1765, and it turned out to be significantly more compact and efficient than the Newcomen's engine. Watt's engine was considered a pivotal moment in the industrial revolution. Nicolas Joseph Cugnot, a French artillery engineer, created the first moving vehicle in 1769. It was a tricycle and had a steam boiler with a diameter of 1.3 m at the front. The vehicle was 7.3 m long, the same size as a modern medium truck. It was rather clumsy and difficult to steer due to the heavy load on the front wheel (Figure 3-1).

Cugnot's vehicle was widely acknowledged as the world's first self-propelled road vehicle and the world's first self-propelled transportation tool, notwithstanding its impracticality. Following Cugnot, a number of other innovators created steam-powered automobiles. Oliver Evans received the first U. S. patent for a steam-powered land vehicle in 1789. Richard Trevithick constructed the first steam-powered road vehicle in Britain in 1801. In Britain, from 1820 to 1840, steam-powered stagecoaches were in regular service. These were later banned from public roads, and Britain's railroad system

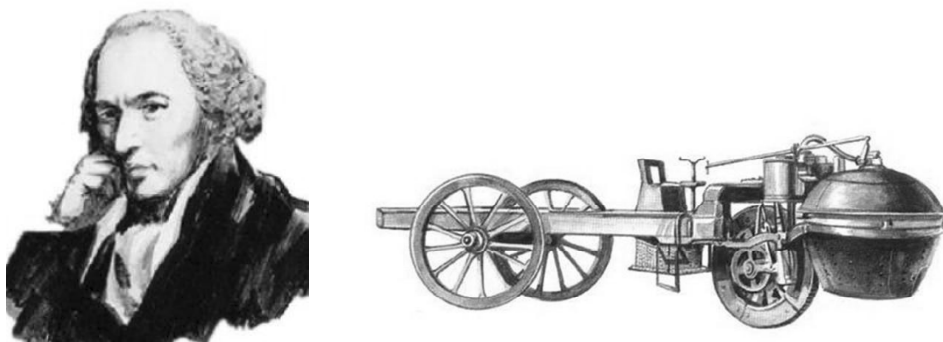


Figure 3 - 1 Nicolas Joseph Cugnot and his tricycle

developed as a result. Steam-driven road tractors (built by Charles Deitz) pulled passenger carriages around Paris and Bordeaux up to 1850. In the United States, numerous steam coaches were built from 1860 to 1880. Inventors included: Harrison Dyer, Joseph Dixon, Rufus Porter, and William T. James. Amedee Bollee Sr. built advanced steam cars from 1873 to 1883. The “La Mancelle” built in 1878, had a front-mounted engine, shaft drive to the differential, chain drive to the rear wheels, steering wheel on a vertical shaft and driver’s seat behind the engine. The boiler was carried behind the passenger compartment. In 1871, Dr. J. W. Carhart, professor of physics at Wisconsin State University, and the J. I. Case Company built a working steam car that won a 200-mile race. The steam-powered vehicles have some disadvantages, such as being big, heavy and low thermal efficiency. So they would be an alternative to internal combustion engine vehicles.

3. 1. 2 Internal Combustion Engine Vehicle

The late nineteenth-century structural revolution of motor vehicles was greatly influenced by the internal combustion engine, a type of lightweight power source. Unlike the steam engine, which is an external combustion engine, the internal combustion engine achieves far higher efficiency by burning fuel directly inside the cylinder. The first usable gas engine was patented in Paris in 1860 by a Frenchman by the name of Etienne Lenoir (Figure 3 - 2). The first gas engine was a 610mm stroke engine with a 127 mm bore that ran on coal gas. It was big and heavy, turned 100 rpm, and consumed 2 800 liters of gas per horsepower (3 800 L/kW). In 1861, a French engineer, Alphonse Eugène Beau de Rochas, published the principle of the four-stroke internal-combustion engine and emphasized the previously unappreciated importance of compressing the fuel-air mixture before ignition.

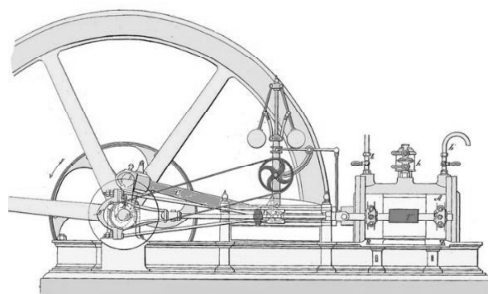


Figure 3 - 2 Etienne Lenoir and his gas engine

An engine with nearly the exact same operating mechanism as that discovered by Rochas was patented in 1876 by Nikolaus August Otto, an engineer for a German company that produced gas engines in Cologne. The Otto cycle, also called the four-stroke cycle, is the sequence of events that involves introducing gas into the cylinder, compressing it, combusting the compressed mixture, and finally exhausting it (Figure 3 - 3). Rochas had already found the functioning process, but he had not described it in sufficient detail.

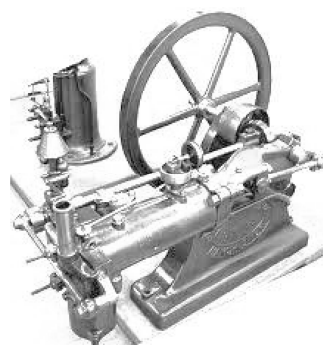


Figure 3 - 3 Nikolaus August Otto and Otto Engine

In 1885, at Mannheim in Germany, an engineer, Karl Friedrich Benz, made a single-cylinder, water-cooled, 0.55 kW (3/4 hp) engine and installed it beneath the seat of a tricycle. At the rear of his car, a horizontal flywheel was used to start the engine (Figure 3 - 4). The car was patented as a complete unit in 1886.

In the same year, Gottlieb Wilhelm Daimler, a German engineer, and his friend Wilhelm Maybach made their first motor vehicle, which had a single cylinder, air-cooled engine of 0.462 L, 0.81 kW(1.1 hp), and was successfully installed onto a second-hand horse carriage (Figure 3 - 5). Karl Benz, Gottlieb Daimler, and Wilhelm Maybach were called “the father of the automobile,” among them Karl Benz is remembered by most ordinary people.

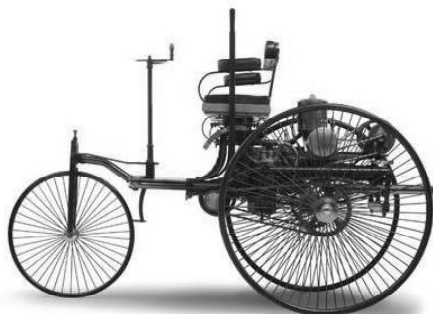


Figure 3 - 4 Karl Friedrich Benz and his first tricycle

In America, Henry Ford is recognized as the founder of the Ford Motor Company and is often referred to as the Father of the American automobile. Although he did not develop the car, he constructed his initial gasoline-powered vehicle in 1896 and commenced manufacturing his Model T (Figure 3 - 6) in 1908.

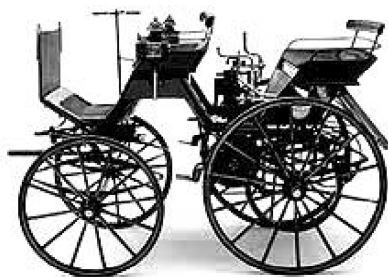


Figure 3 - 5 Gottlieb Wilhelm Daimler, Wilhelm Maybach and their first carriage

The production of Model Ts at Highland Park in Detroit commenced in 1913 with the implementation of a moving assembly line. The novel methodology employed was the flow process, yielding substantial productivity gains and cost reductions. The advent of Ford's mass production revolutionized the world and marked the dawn of a new epoch in industrial history.



Figure 3 - 6 Henry Ford's model T

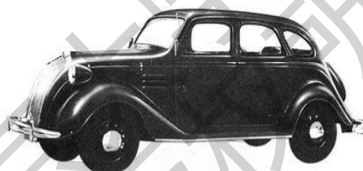


Figure 3 - 7 Toyota model A - 1



In Japan, the Toyota Motor Company produced its earliest car, the Model A - 1 (Figure 3 - 7). In 1937, Kiichiro Toyota became the president and was the man leading the company to great achievements. The success of Toyota Motor Company was based on effective production management, the so-called “Toyota Production System” which was highly evaluated as a good example of lean production. Two main supports of this system are “just in time (JIT)” and “automation.”

Words and Expressions



steam engine	蒸汽机
boiler ['bɔɪlə(r)]	<i>n.</i> 锅炉, 热水器
clumsy ['klʌmzi]	<i>adj.</i> 笨拙的, 不得当的
stagecoach ['steɪdʒkəʊtʃ]	<i>n.</i> 公共马车
ban [bæn]	<i>vt.</i> 禁止, 取缔; <i>n.</i> 禁令
differential [ˌdɪfə'renʃ(ə)l]	<i>n.</i> 差速器, 差别
thermal ['θɜ:m(ə)l]	<i>adj.</i> 热的, 热量的
internal combustion engine	内燃机
cylinder ['sɪlɪndə(r)]	<i>n.</i> 圆柱体, 气缸
horsepower ['hɔ:spauə(r)]	<i>n.</i> 马力
compressing [kəm'presɪŋ]	<i>n.</i> 压缩; <i>v.</i> 压缩
ignition [ɪg'nɪʃ(ə)n]	<i>n.</i> 点火装置, 燃烧
flywheel ['flaɪwi:l]	<i>n.</i> 飞轮
carriage ['kærɪdʒ]	<i>n.</i> 运输, 四轮马车
flow process	流水作业
lean production	精益生产
just in time	准时制
automation [ˌɔ:tə'meɪʃ(ə)n]	<i>n.</i> 自动化

Notes



1. Cugnot's vehicle was widely acknowledged as the world's first self-propelled road vehicle and the world's first self-propelled transportation tool, notwithstanding its impracticality.

尽管屈尼奥设计的汽车并不实用,但是人们普遍认为它是世界上第一辆自走式机动车,同时也是世界上第一个自走式运输工具。

2. The Otto cycle, also called the four-stroke cycle, is the sequence of events that involves introducing gas into the cylinder, compressing it, combusting the compressed



mixture, and finally exhausting it.

奥托循环,也被称作四冲程循环,其工作过程具体包括向气缸内吸入气体、压缩气体、点燃压缩后的混合气体做功,最后排出废气。

3.2 History of Chinese Automobiles

In 1953, First Automobile Works (FAW) was founded in Changchun, Jilin Province, with the Soviet Union's help. Its first product, the 4-ton Jiefang CA-10 truck (based on the Russian ZIS-150) (Figure 3-8), began production in 1956. FAW initially made only commercial trucks but started producing passenger cars in 1958. The Hongqi CA72 luxury sedan (Figure 3-9), was one of the first domestically produced Chinese automobiles and was used to celebrate the 10th anniversary of the founding of the People's Republic of China.



Figure 3-8 Jiefang truck



Figure 3-9 Hongqi CA72

From the late 1950s to the 1960s, several automobile factories were set up in Nanjing (today is Nanjing Automobile (Group) Corporation), Shanghai (today is Shanghai Automotive Industry Corporation), Jinan (evolving into China National Heavy Duty Truck Group), and Beijing (today is Beijing Automotive Industry Holding Corporation). In 1968, the Second Automobile Works (later Dongfeng Motor Corporation) was created.

In the 1980s, China implemented import restrictions and simultaneously sought to enhance domestic production by expanding existing joint-venture agreements for passenger car manufacturing and establishing new ones. In 1983, American Motors Corporation (AMC), which was later acquired by Chrysler Corporation, entered into a 20-year agreement to manufacture its Jeep-model automobiles in Beijing. In the same year, Volkswagen, a German automobile company, entered into a 25-year agreement to manufacture passenger cars in Shanghai. Additionally, Peugeot, a French car manufacturer, decided to undertake a separate project in Guangzhou, a thriving city in southern China, to produce vehicles. These initial collaborative projects restricted Chinese partners' access to core foreign technology. Instead, the majority of manufacturing activity focused on assembling knock-down kits. There are three major joint-ventures involved in the production of these automobile models. The Shanghai



Automotive Industry Corporation produces the Volkswagen Santana compact car (Figure 3 – 10), FAW produces the Volkswagen Jetta compact car, and Dongfeng Motor Corporation produces the Citroën Fukang compact car (Figure 3 – 11).



Figure 3 – 10 Volkswagen Santana



Figure 3 – 11 Citroën Fukang

From 1990 to the present, several enterprises have entered the automobile industry. Some of them originate from the defense industry, such as Chang'an Motors, Changhe, and Hafei Motor; some were developed from old state-owned companies, such as BYD Auto, Brilliance China Auto, Chery Automobile, and Changfeng Automobile. Others are privately-owned companies, such as Geely Automobile and Great Wall Motors. In recent years, new automobile manufacturers focusing on electric vehicles have also emerged and gained significant market share.

China surpassed the United States to become the world's largest automobile market in 2009. Since then, China has maintained its position as the world's leading country in both vehicle production and sales. In 2023, China's annual automobile production reached 27.01 million units and sales reached 26.98 million units, with new energy vehicles accounting for a significant portion of the market.

3.3 Progress of Motor Vehicle

In the early days, motor cars were far from perfect. At that time, to drive a car was not a matter of happiness and comfort, but a kind of physical labor. To start the car, the driver had to crank the engine. Owing to a lot of mechanical troubles, the car might break down midway and had to be cranked again and again, which required effort and thus kept women from driving. The poor steering system led to directional deviation and even dangerous situations. The brake system was not good, and only two rear wheels were equipped with brakes. Poor adhesion of tires made the matter even worse, as it was difficult to stop the car immediately in an emergency.

There have been many innovations to make the car mature. The six-cylinder engine had largely replaced the four by 1916. Ford's famous V-8 was remarkable for single casting and excellent performance. High-quality gasoline of high anti-knock property resulted in a high compression ratio to increase engine efficiency. Battery ignition system not only improved the engine performance, but also made the use of electric equipment



such as headlamps, indicators, horn and gauges possible, especially the use of the self-starter. Transmissions with synchronized gears, final drive with hypoid gears in 1928 and four-wheel brakes, almost exclusively hydraulic by 1936, independent suspensions and automatic transmission in 1938 made driving and riding more comfortable. All steel body supported by new technologies of stamping and welding replaced the heavy wooden structure. Laminated safety glasses, windshield wipers, rear-view mirrors, heaters and radios became popular accessories.

The motor car was no longer a troublesome machine or a clumsy carriage. It became the symbol of wealth and status. It was fast, convenient, safe and comfortable. It was designed to catch everyone's eye with elegant streamlined style, colorful paintwork and glittering decorations.

From the 1950s to the 1990s, automobiles experienced significant technological advancements. Electronic fuel injection systems gradually replaced carburetors, providing more precise fuel control and better engine performance. Safety features such as Anti-Lock Brake Systems (ABS), airbags, and three-point seat belts became standard equipment. The introduction of catalytic converters and emission control systems marked the industry's first major step toward environmental protection. The application of Electronic Control Units (ECUs) brought vehicles into the electronic era, enabling more sophisticated control of the engine, transmission, and other vehicle systems.

The early 21st century witnessed a revolutionary transformation in automobile technology. Hybrid vehicles, combining traditional internal combustion engines with electric motors, achieved remarkable fuel efficiency. Tesla's successful launch of pure electric vehicles in 2008 marked the beginning of a new era. Traditional automakers also started their transition toward electrification. Meanwhile, Advanced Driver Assistance Systems (ADAS) were introduced, including Adaptive Cruise Control (ACC), lane departure warning, and automatic emergency braking, making vehicles safer and more intelligent.

Since 2015, the automotive industry has entered an era of unprecedented innovation. New energy vehicles, particularly battery electric vehicles, have gained significant market share. The concept of "software-defined vehicles" has emerged, with cars becoming increasingly connected and intelligent. Advanced autonomous driving technologies are being developed and tested, while Vehicle-to-Everything (V2X) communication systems are enhancing road safety and traffic efficiency. These developments suggest that future automobiles will be not just transportation tools, but mobile smart spaces integrating cutting-edge technologies in electronics, information, and artificial intelligence.



Words and Expressions

First Automobile Works

truck [trʌk]

sedan [si'dæən]

anniversary [ˌæni'vɜ:səri]

joint-venture

assembly [ə'sembli]

tooling ['tu:liŋ]

defense industry

crank [kræŋk]

steering system

deviation [ˌdi:vi'eɪʃn]

brake system

casting ['kɑ:stiŋ]

anti-knock property

battery ignition system

headlamp

indicator

self-starter

final drive with hypoid gear

automatic transmission

laminated safety glass

windshield wiper

rear-view mirror

elegant streamlined style

electronic fuel injection

Anti-Lock Brake System (ABS)

Electronic Control Unit (ECU)

Vehicle-to-Everything (V2X)

Adaptive Cruise Control (ACC)

中国第一汽车集团公司

n. 卡车, 载重汽车

n. 轿车

n. 周年纪念日

合资企业

n. 装配, 集合

n. 工具作业, 机床安装

国防工业

n. 曲柄; *vt.* 装曲柄

转向系统

n. 偏差, 误差, 偏离

制动系统

n. 铸件

抗爆性能

电池点火系统

前照灯

转向指示灯

电启动装置

准双曲面齿轮的减速器

自动变速器

夹层安全玻璃

风窗刮雨器

后视镜

优雅的流线型风格

电子燃油喷射系统

防抱死制动系统

电子控制单元

车联网通信

自适应巡航控制

Notes

1. In 1983, American Motors Corporation (AMC), which was later acquired by Chrysler Corporation, entered into a 20-year agreement to manufacture its Jeep-model



automobiles in Beijing. In the same year, Volkswagen, a German automobile company, entered into a 25-year agreement to manufacture passenger cars in Shanghai. Additionally, Peugeot, a French car manufacturer, decided to undertake a separate project in Guangzhou, a thriving city in southern China, to produce vehicles.

1983年,后来被克莱斯勒公司收购的美国汽车公司与中方签订了一份为期20年的协议,在北京生产旗下吉普系列汽车。同年,德国汽车企业大众公司签署了一份为期25年的协议,在上海生产乘用车。此外,法国汽车制造商标致集团也选定在中国南方的繁华城市广州单独建厂,开展整车生产项目。

2. Some of them originate from the defense industry, such as Chang'an Motors, Changhe, and Hafei Motor; some were developed from old state-owned companies, such as BYD Auto, Brilliance China Auto, Chery Automobile, and Changfeng Automobile.

它们中有些脱胎于军工企业,如长安汽车、昌河汽车、哈飞汽车;有些是由老牌国有企业发展而来,如比亚迪汽车、华晨中国汽车、奇瑞汽车、长丰汽车。

3. Transmissions with synchronized gears, final drive with hypoid gears in 1928 and four-wheel brakes, almost exclusively hydraulic by 1936, independent suspensions and automatic transmission in 1938 made driving and riding more comfortable.

自1928年开始,引入了同步齿轮变速器和准双曲面齿轮主减速器;到1936年,四轮液压制动系统得到普及;1938年,独立悬架和自动变速器问世。这些技术的应用提升了驾驶与乘坐的舒适性。



Exercises



1. Who are the father of the world's automobile?

- | | |
|---------------|--------------------------|
| A. Karl Benz | B. Gottlieb Daimler |
| C. Henry Ford | D. Nicolas Joseph Cugnot |

2. What is the earliest ancestor of the modern automobile probably?

- | | |
|---------------|--------------------------|
| A. Karl Benz | B. Nicolas Joseph Cugnot |
| C. Henry Ford | D. Eiji Toyota |

3. Who built the first gasoline-powered car in the USA?

- | | |
|--------------------------|--------------------|
| A. Nicolas Joseph Cugnot | B. Wilhelm Maybach |
| C. Henry Ford | D. Eiji Toyota |

4. Which is China's first automobile manufacturer?

- | | |
|--------|-------------|
| A. FAW | B. Geely |
| C. BYD | D. Dongfeng |

5. Where is the headquarters of FAW?

- | | |
|--------------|--------------|
| A. Beijing | B. Shanghai |
| C. Guangzhou | D. Changchun |



6. What is the earliest automobile made in China?

- A. Jiefang CA - 10 B. Hongqi CA72
C. Santana D. Jetta

7. Which country was the largest auto maker in 2012?

- A. China B. Japan C. USA D. Germany

READING MATERIAL

The Development of Automobile Models

1908 - 1927 Ford Model T—the most widely produced and available car of the era. It used an improved transmission, and had a pedal-based control system.

1922 - 1939 Austin 7—the Austin Seven was one of the most widely copied vehicle designs ever, serving as a template for cars around the world, from BMW to Nissan.

1924 - 1929 Bugatti Type 35—the Type 35 was one of the most successful racing cars of all time, with over 1 000 victories in five years.

1922 - 1931 Lancia Lambda—very advanced car for the time, the first car to feature an independent suspension in front.

1932 - 1948 Ford V - 8—the introduction of the powerful Flathead V8 in mainstream vehicles, setting new performance and efficiency standards.

1934 - 1956 Citroën Traction Avant—the first mass-produced front-wheel drive car.

1938 - 2003 Volkswagen Beetle—a design for efficiency and low price, which was developed over 60 years with minimal basic changes.

1936 - 1939 Rolls-Royce Phantom III—V12 engined pinnacle of prewar engineering, with technological advances not seen in most other manufacturers until the 1960s.

1959 - 2000 Mini—this quintessential small car lasted for four decades, and is one of the most famous cars of all time.

1966 - present Toyota Corolla—a simple small Japanese sedan that has come to be the best-selling car of all time.

1970 - present Range Rover—the first vehicle to combine luxury and four-wheel drive utility, the original “SUV.”

1973 - present Mercedes-Benz S-Class—electronic Anti-lock Brake System, supplemental restraint airbags, seat belt pretensioners, and electronic traction control system all made their debut on the S-Class. These features would later become standard throughout the car industry.

1975 - present BMW 3 Series—the 3 Series has been on *Car and Driver* magazine's annual Ten Best list 17 times, making it the longest-running entry in the list.

1977 - present Honda Accord Sedan—this Japanese sedan became the most popular car in the United States in the 1990s, pushing the Ford Taurus aside, and setting the stage



for today's upscale Asian sedans.

1994 – present Audi A8—a four-door four/five-seat large luxury car built by the German automaker Audi, designed to replace the Audi V8 as its flagship model.

In 1885, Karl Benz manufactured the first Benz Patent-Motorwagen, which is considered the pioneer of modern automobiles and laid the foundation for automotive design. Benz applied for a patent for an automobile invention to the German Patent Office on January 29, 1886, and the patent office officially approved its publication on November 2 of the same year. Therefore, January 29, 1886, is recognized as the birthday of the world automobile, and Benz's patent certificate also became the world's first automobile patent certificate.

In 1891, Daimler introduced a float carburetor, improved the fuel supply system, and increased engine efficiency.

In 1899, Rolls-Royce introduced the six-cylinder engine, which had a profound impact on later automotive engines.

In 1908, the Ford Model T was introduced, and its assembly line production method significantly reduced the cost of automobiles, making them more popular.

In the 1920s, four-wheel braking systems became popular, improving the safety of automobiles.

In the 1930s, hydraulic power steering systems began to be applied to automobiles, improving driving comfort.

In 1949, Chrysler introduced automatic transmissions to make driving easier.

In the 1950s, fuel injection technology began to be applied in automobiles, improving the efficiency and performance of engines.

In the 1960s, disc brakes gradually replaced drum brakes, providing better braking performance.

In the 1970s, electronic ignition systems became popular, improving the reliability and efficiency of engines.

In the 1980s, ABS began to be applied in automobiles, further improving their safety.

In the 1990s, advanced electronic assistance systems such as traction control and electronic stability control began to become popular.

In the 2000s, direct injection engine technology began to be widely applied, improving fuel efficiency and power output.

In the 2010s, turbocharging technology was widely used in small displacement engines to improve power while reducing emissions.

In the early 2000s, hybrid technology began to be commercialized, such as the launch of the Toyota Prius, which combined an internal combustion engine and an electric motor to improve fuel efficiency.

In 2004, BMW introduced an active steering system for the first time in its 7 Series



models, which can adjust the steering ratio according to the vehicle speed, improving the vehicle's handling and stability.

In 2007, Tesla launched the Roadster, an electric vehicle that marked a revival of electric vehicle technology and drew traditional car manufacturers' attention to new energy technologies.

In the 2010s, start-stop technology became popular, which automatically shuts down and starts the engine when the vehicle comes to a stop to reduce fuel consumption and emissions.

In 2012, Ford introduced EcoBoost technology, a small displacement turbocharged direct injection engine designed to provide higher power and torque while reducing fuel consumption.

In 2013, Mercedes-Benz launched intelligent driving assistance systems, including adaptive cruise control, lane-keeping assistance, and automatic emergency braking.

In 2014, Audi introduced matrix LED headlight technology, providing more precise and wider lighting range, while automatically adjusting the beam to avoid glare for other drivers.

In 2015, BMW introduced wireless charging technology, allowing specific models to transfer energy through wireless charging pads.

In 2016, autonomous driving technology began testing in some high-end car models, including adaptive cruise control, lane centering assist, and automatic lane change functions.

In 2017, Volvo launched Pilot Assist, a semi-autonomous drive system, which can realize automatic driving on highways, including acceleration, braking and steering.

In 2018, Nissan launched the Variable Compression Ratio (VC-Turbo) engine, which can automatically adjust the compression ratio based on driving conditions to optimize performance and efficiency.

In 2019, some car manufacturers began introducing 48-volt mild hybrid electric vehicles (MHEVs), which can provide auxiliary power during vehicle acceleration and recover energy during deceleration.

In the 2020s, with the global focus on reducing carbon emissions, many car manufacturers began to gradually phase out pure fuel vehicles and instead develop more hybrid and plug-in hybrid models.

In 2020, with global attention on reducing greenhouse gas emissions, some car manufacturers began developing more efficient internal combustion engine technologies, such as using more advanced thermal management systems and lower friction materials.

In 2021, automakers were increasingly adopting digital twin technology to simulate the performance of cars in virtual environments, in order to optimize design and improve research and development efficiency.

In 2022, some high-end car models began to introduce more advanced aerodynamic



designs, such as active grille and variable geometry body components, to reduce wind resistance and improve fuel efficiency.

In 2023, with the development of connected car technology, some cars began to offer richer remote-control functions, such as remotely starting the engine, preheating or precooling the interior space through smartphone applications.

In 2024, it is expected that more cars will adopt biometric technologies such as fingerprint recognition, facial recognition, or iris scanning to improve vehicle safety and personalized experiences.

By 2025, it is expected that car manufacturers will increasingly adopt sustainable materials such as recycled plastics, natural fiber composites, etc. to reduce the environmental impact of the car manufacturing process.

By 2026, with the development of artificial intelligence technology, it is expected that more cars will be equipped with intelligent driving assistance systems that can learn driver behavior and provide personalized driving assistance.

By 2027, it is expected that automobile manufacturers will increasingly adopt modular platforms to improve production efficiency and reduce costs, while allowing for greater flexibility in adapting to the needs of different vehicle models.

By 2028, with the advancement of battery technology, it is expected that more cars will adopt 48-volt electrical systems, which will further improve the fuel efficiency and performance of vehicles.

By 2029, it is expected that more cars will adopt advanced sensor fusion technology, combining radar, LiDAR, camera and ultrasonic sensors to improve the accuracy and reliability of the autonomous driving system.

By 2030 and beyond, with sustained global efforts to reduce oil dependence and carbon emissions, it is expected that traditional fuel vehicles will gradually be replaced by electric vehicles, plug-in hybrid vehicles, and other new energy vehicle models.

The History of Electric Vehicles

The evolution of electric vehicles has experienced an initial surge, subsequent downturn, and contemporary resurgence. During the late 19th and early 20th centuries, electric vehicles gained popularity for short-distance urban transport because of the advancements in lead-acid batteries and electric motor technology. These vehicles were popular because they offered advantages such as low cost, simple operation, and little noise or pollution. Nevertheless, due to the emergence of internal combustion engine vehicle technology and the subsequent reduction in production costs, particularly with the implementation of assembly line production for the Ford Model T, electric vehicles progressively relinquished their competitive edge in the market. During the mid-20th century, the discovery of oil resources and the subsequent drop in fuel prices led to a further decline in the importance and relevance of electric cars. During the 1970s, concerns about the oil crisis and environmental pollution led to a reassessment of electric



vehicles. The introduction of hybrid vehicles set the stage for the resurgence of electric vehicles. In the early 21st century, the advancement of battery technologies, particularly lithium batteries, has greatly enhanced the range and performance of electric cars. Electric vehicles are currently gaining significant market attention and experiencing rapid global development due to a combination of government policy support, growing consumer environmental awareness, and the integration of intelligent technology. Technological advancements, market demand, legislative direction, environmental concerns, and energy security have collectively propelled the evolution of electric vehicles from their initial prosperous era to their current resurgence.

The development history of electric vehicles can be traced back to the 19th century, and it has gone through several important stages:

1. Early development (late 19th century to early 20th century):

American inventor Thomas Davenport manufactured the first electric vehicle driven by a direct current motor in 1834.

Gustave Trouvé, a Frenchman, constructed the world's first acknowledged electric vehicle in 1881 by utilizing improved lead-acid batteries and Siemens motors.

During the late 19th century and early 20th century, electric vehicles gained significant popularity in Europe and America, particularly in the US where they became the preferred option for private transportation due to their ease of use.

2. The golden age (early 20th century):

In the early 1900s, electric vehicles had a significant portion of the European and American markets, particularly in the United States. In fact, electric vehicles had a higher market share than gasoline vehicles.

By 1912, the United States had a total of 33 842 electric vehicles. This number increased to 50 000 by 1915, with electric vehicles holding a market share that was 16% higher than that of gasoline vehicles.

3. Decline and forgetfulness (mid-20th century):

Due to the significant decrease in the cost of gasoline vehicles and the expansion of the highway network, the market share of electric vehicles started to decrease.

In the 1930s, the market for electric vehicles declined as a result of the discovery of vast oil reserves and advancements in fuel vehicle technology.

4. Re-focus (1970s):

Electric vehicles garnered fresh attention due to the impact of the oil crisis and environmental pollution issues.

Countries started developing hybrid vehicles as a solution to address issues related to battery life and driving range. Among them, the Toyota Prius emerged as the global leader in sales in 1997 and became the iconic hybrid vehicle.

5. Modern Renaissance (since the beginning of the 21st century):

The advancement of battery technology, particularly the utilization of lithium



batteries, has enhanced the range limitation of electric vehicles, hence fostering the progress of electric vehicle development.

In 2009, China initiated the “Ten Cities and Thousand Vehicles” project, signifying the commencement of the industrialization of new energy vehicles in the country.

The comprehensive development of the new energy automotive sector in China commenced in 2013, facilitated by the implementation of a financial subsidy strategy that greatly accelerated market expansion.

In 2015, the domestic wholesale sales of new energy passenger cars surpassed 100 000 for the first time, establishing China as the leading global market for new energy vehicles.

In 2018, the sales volume surpassed 1 million units, specifically achieving 1.02 million units.

Significant growth was achieved in the manufacture and sales of new energy vehicles in China in 2023. Based on the figures published by the China Automobile Industry Association, the yearly production and sales of new energy cars reached 9.587 million and 9.495 million respectively, representing an increase of 35.8% and 37.9% respectively. Additionally, the market share of these vehicles reached 31.6%. The growth pattern mentioned indicates the robust progress of China’s new energy automotive industry, which has consistently held the top position globally for nine consecutive years.

Recently, due to advancements in technology and government assistance, the new energy automotive industry in China has experienced rapid growth. The new energy automobile industry is rapidly incorporating technologies from the energy, transportation, information, and communication sectors. This integration is driving the transformation of automobiles from basic transportation vehicles to advanced mobile intelligent devices. It is also facilitating the development and improvement of the associated infrastructure. China has achieved significant advancements in the development of charging infrastructure for new energy vehicles. The number of both public and private charging stations has substantially grown, thereby offering substantial support for the widespread adoption of new energy vehicles. The new energy automotive sector in China has demonstrated significant competitiveness at an international level. China’s consistent technological innovation and industrial upgrading have positioned it as a significant global player in the advancement of new energy vehicles.

Chapter 4



Future Development and Directions of Motor Vehicles

The automobile is such a wonderful product that it becomes the preferred means of transportation for almost everyone. This is true for trips from a few hundred meters to several hundred kilometers whether you are alone, with one other person, or with the entire family, with or without all sorts of cargo. It is not only a means of transportation but also an extension of your home where you can feel and behave as you wish, whether you are driving or not. Some economists predict that the number of vehicles on the road will maintain growth momentum (mostly due to the newly developing countries), while the miles travelled by each car are also on the increase because of new infrastructures and better use of these infrastructures. There are some concerns for consumers, governments and manufacturers. The first one is safety. It is well known that almost all accidents are due to human errors, mostly due to reaction time being too long and inability to control the vehicle in emergency situations. The second concern in the list of governments (who issue the rules) and manufacturers (who must comply with them) is the energy consumption, and more precisely the burning of fossil fuels. The solutions are in two directions: drive less (move less or use other transportation modes which do not burn fossil fuels), or develop another type of power source for the car. The third concern is with local pollutants, in particular in cities. The next concern is all the nuisances the automobile has brought to cities. There is just not enough space for all the cars that would want to go there, not enough freeways, not enough parking. The recent improvements to the car in order to alleviate many of the problems mentioned above are, for the most part, derived from computer and new material technology, control technologies and new energy technology inside it. In the future, the development of vehicles will be lightweight, intelligent, energy-saving and environmentally friendly.

The automotive industry is increasingly shifting towards electrification, intelligence, connectedness, and sharing as its future trajectory. Advancements in battery technology have significantly improved electrification by enabling longer driving ranges and faster charging rates. Simultaneously, the worldwide focus on decreasing carbon emissions has led governments and manufacturers to advocate for electric vehicles. The advancement of intelligent and autonomous driving technology will revolutionize our driving experience, enhancing safety and efficiency. Additionally, vehicle networking



technology will facilitate communication between automobiles and infrastructure, leading to more intelligent traffic management. The emergence of the sharing economy could potentially diminish the prevalence of personal car ownership, as individuals are increasingly willing to utilize cars as needed, due to the convenience and cost-effectiveness of shared car services. The factors contributing to these trends encompass technological advancements, economic influences, societal needs, environmental regulations, globalization, consumer choices, government policies and incentives, urban planning and infrastructure development, energy availability and price fluctuations, as well as technological innovation and investment in research and development. These elements synergistically propel the automotive industry into a trajectory that is characterized by enhanced efficiency, environmental sustainability, safety, and personalization.

4.1 Lightweight

The primary efficiency indicators of the automotive sector are weight reduction, fuel conservation, and environmental sustainability. The global automotive industry is currently grappling with significant resource and environmental concerns. As a result, there is a growing emphasis on reducing the weight of automobiles as a key trend in the industry's development. Automobile weight reduction refers to the reduction of the overall weight of the automobile on the premise of guaranteeing the strength and safety performance of the automobile, so as to improve the power performance of the automobile, reduce fuel consumption, and cut down emission pollution. Studies indicate that decreasing a car's weight by 10 percent can lead to a fuel efficiency improvement of 6 to 8 percent. Similarly, reducing the overall weight of a car by 100 kg can result in a decrease in fuel consumption per 100 km of 0.3 to 0.6 liters. Furthermore, a 1 percent reduction in a car's weight can lead to a 0.7 percent reduction in fuel consumption. In addition, a decrease of 100 kg in the weight of an automobile can result in a reduction of around 5 g of carbon dioxide emissions per kilometer.

Methods for reducing vehicle weight include optimizing the design of mainstream automobiles, utilizing lightweight materials, employing computer-based structural design, and implementing unibody construction. The primary approach involves the utilization of lightweight materials to decrease the overall weight of the vehicle. Due to their low energy consumption during manufacturing, lightweight nature, high strength, excellent formability, resistance to erosion, and attractive molding effect, certain lightweight materials are a good choice for reducing the weight of automobiles.

4.1.1 Alloy

Aluminum and its alloys have a major advantage over steel and copper alloys. Their



much lower densities lead to lower weight components and consequent fuel energy savings. Pure aluminum is more expensive than iron and copper and has lower inherent strength and stiffness. However, it does have corrosion resistance as well as good thermal and electrical conductivity. Duralumin, also known as duraluminum, is one of the alloys. This material is aluminum alloyed with copper, manganese and magnesium. It is much lighter than steel but has greater strength than pure aluminum. But duralumin components usually need a thin aluminum outer coating to help prevent corrosion. A wide range of alloys is now available with various heat treatment and manufacturing options. These materials have now replaced steel and copper alloys in many vehicle component applications.

Titanium alloy is a novel material with a unique combination of structural and functional properties. It exhibits exceptional overall performance, characterized by its low density, high strength, great corrosion resistance, and favorable elasticity even at extremely low temperatures (-253°C). Additionally, it demonstrates remarkable heat resistance up to 550°C , as well as good workability and welding capabilities. The density of titanium alloy is around 60% of that of steel, but its elastic modulus is roughly half that of steel. Replacing steel parts with titanium is not often the optimal approach, but in reality, it should result in an instant weight reduction of at least 40%. The low modulus of titanium is advantageous for springs; however, it may require component redesign in applications where stiffness is critical. Titanium exhibits superior specific strength, as well as specific toughness and fatigue resistance, in comparison to both steel and aluminum alloys. The properties of several materials are compared in Table 4 – 1.

Titanium is used in cars for two main purposes. The first purpose is to reduce the weight of reciprocating components in internal combustion engines (which are parts that move back and forth). Even a small reduction in weight is significant for these engine parts. The second purpose is to reduce the overall weight of the car. Titanium is used in engine components and chassis sections of the new generation of mainstream vehicles, based on its design and material qualities. Titanium is used in the engine system to manufacture valves, valve springs, valve spring retainers, and components such as bearings. In the chassis parts, titanium is mostly used for springs, exhaust systems, half shafts, and fasteners.

Table 4 – 1 Characteristic comparison of materials

Material	Density(kg/L)	Young's Modulus (GPa)	Yield Strength(MPa)	Specific Strength
CP Titanium	4.51	105	250 – 450	50 – 100
Ti-6Al-4V	4.43	112	900 – 1 100	200 – 250
Ti-LCB	4.79	110	950 – 1 400	200 – 290
Carbon Steel	7.8	200	350 – 450	45 – 60
Aluminium Alloy	2.8	70	100 – 350	35 – 125



In addition, magnesium is the lightest of all metals in practical use. This material has useful properties such as shielding against electromagnetic waves, vibration damping, dent resistance, machinability, and low toxicity in humans. On the other hand, magnesium has shortcomings such as insufficient strength, ductility and heat resistance, as well as being prone to corrosion. Alloying magnesium improves its strength, heat resistance and creep resistance (creep is defined as deformation at a high temperature and under load).

4.1.2 Plastic and Polymers

Polymeric materials are made up of very long chain molecules with a backbone of principally carbon atoms, which are held together by primary forces or bonds, comparable in strength to those in metals. Most polymers are now made from oil and natural gas and form the basis of several major industries, namely plastics, rubbers, fibers, coatings and adhesives, all of which supply the motor vehicle industry with a range of products. The plastics group is commonly divided into thermoplastics, which soften on heating and harden again on cooling, and thermosetting polymers or resins, which do not soften on re-heating after the original forming process. Polyethylene (PE), polystyrene, polyacetal, and polycarbonate belong to thermoplastics. Common thermosets are phenolics (Bakelite), epoxy resins (Araldite) and unsaturated polyesters used in glass reinforced plastic composites. These materials also find use in coatings and adhesives. Thermosets are normally made by mixing two components, a resin and a hardener, which react and harden at room temperature or on heating.

Polycarbonates (PC) are a specific category of thermoplastic polymers, commonly referred to by trademarked names such as Lexan, Makrolon, Makroclear, and others. They can be readily machined, shaped, and subjected to thermoforming processes. Due to these characteristics, polycarbonates are utilized in several applications.

In the automotive industry, injection-molded polycarbonate can produce very smooth surfaces that make it well-suited for sputter deposition or evaporation deposition of aluminum without the need for a base coat. Due to its low weight and high impact resistance, polycarbonate is the dominant material for making automotive headlamp lenses. However, due to its low scratch resistance and susceptibility to ultraviolet degradation (yellowing), automotive headlamps require outer surface coatings. The use of polycarbonate in automotive applications is limited to low-stress applications. Stress from fasteners, plastic welding and molding renders polycarbonate susceptible to stress corrosion cracking when it comes in contact with certain accelerants such as salt water and plastisol. It can be laminated to make bullet-proof "glass," although "bullet-resistant" is more accurate for the thinner windows, such as those used in bullet-resistant windows in automobiles. The thicker barriers of transparent plastic used in teller windows and barriers in banks are also polycarbonate.



Glass-fiber-reinforced polymers have demonstrated their capacity to fulfill the structural and durability requirements of automotive interior and exterior components. The automotive sector has successfully incorporated glass-fiber-reinforced plastics due to their favorable mechanical properties and the presence of a well-established manufacturing infrastructure. Nevertheless, glass-reinforced plastics have many drawbacks, including their comparatively higher fiber density (about 40% greater than natural fibers), challenges in machining, and limited recycling capability. Additionally, there are potential health risks associated with glass-fiber particles. Table 4 – 2 presents a comparison between unsaturated polyester composites reinforced with glass fiber and those reinforced with natural fibers (flax), which were made via compression molding. This suggests that the attributes are comparable to properties that have similar amounts of fiber. Automobile parts are reinforced using natural fibers such as kenaf, hemp, flax, jute, and sisal. This is done to reduce weight, cost, and CO₂ emissions, as well as to decrease dependence on imported energy supplies. Additionally, these fiber sources are recyclable and environmentally friendly. An ecological assessment, or eco-balance, comparing natural-fiber mat with glass-fiber mat provides an alternative viewpoint.

**Table 4 – 2 Glass-fiber-reinforced unsaturated polyester
and natural-fiber-reinforced unsaturated polyester composites**

Property	Glass Fiber (30 wt. %)	Natural Fiber (35 wt. %)
Flex Strength (MPa)	80	70
Flex Modulus (GPa)	6.0	6.0
Elongation at Break (%)	2.2	1.9
Impact Strength (kJ/m ²)	38	20
Density (g/cm ³)	1.54	1.42

The manufacture of natural-fiber composites includes the use of either a thermoset or thermoplastic polymer binder system combined with the natural fiber preform or mat. Several synthetic thermoplastics are utilized including polyethylene, polystyrene, and polyamides (nylon 6). Common thermoplastic properties are listed in Table 4 – 3. Polypropylene is favored due to its low density, excellent processability, mechanical properties, excellent electrical properties, and good dimensional stability and impact strength. Thus, in automotive applications, the most common system used today is polypropylene thermoplastic composite, particularly for nonstructural components.



Table 4-3 Properties of typical thermoplastic polymers used in natural fiber composite fabrication

Property	PP	LDPE	HDPE	PS	Nylon 6
Density (g/cm^3)	0.899 - 0.920	0.910 - 0.925	0.94 - 0.96	1.04 - 1.06	1.12 - 1.14
Water Absorption-24 hours (%)	0.01 - 0.02	<0.015	0.01 - 0.2	0.03 - 0.10	1.3 - 1.8
Softening Point T_g ($^{\circ}\text{C}$)	-10 to -23	-125	-133 to -100	—	48
Melting Point T_m ($^{\circ}\text{C}$)	160 - 176	105 - 116	120 - 140	110 - 135	215
Heat Deflection Temp ($^{\circ}\text{C}$)	50 - 63	32 - 50	43 - 60	Max. 220	56 - 80
Coefficient of Thermal Expansion($1\text{E-}6/^{\circ}\text{C}$)	6.8 - 13.5	10	12 - 13	6 - 8	8 - 8.6
Tensile Strength (MPa)	26 - 41.4	40 - 78	14.5 - 38	25 - 69	43 - 79
Elastic Modulus (GPa)	0.95 - 1.77	0.055 - 0.38	0.4 - 1.5	4 - 5	2.9
Elongation (%)	15 - 700	90 - 800	2.0 - 130	1 - 2.5	20 - 150
Izod Impact Strength (J/m)	21.4 - 267	>854	26.7 - 1 068	1.1	42.7 - 160

LDPE = low-density polyethylene; HDPE = high-density polyethylene; PP = polypropylene; PS = polystyrene.

The primary thermoset resins used today in natural-fiber composites for automotive applications are polyester, vinyl ester, and epoxy resins. A comparison of typical thermoset properties is provided in Table 4-4.

Natural-fiber composites with thermoplastic and thermoset matrices have been adopted by European car manufacturers and suppliers for door panels, seat backs, headliners, package trays, dashboards, and interior parts. Uses of natural-fiber reinforcement have proven viable in a number of automotive parts. Flax, sisal, and hemp are processed into door cladding, seatback linings, and floor panels. Coconut fiber is used to make seat bottoms, back cushions, and head restraints, while cotton is used to provide soundproofing, and wood fiber is used in seatback cushions (Table 4-5).

Table 4-4 Properties of typical thermoset polymers for natural fiber composites

Property	Polyester Resin	Vinyl ester Resin	Epoxy
Density (g/cm^3)	1.2 - 1.5	1.2 - 1.4	1.1 - 1.4
Elastic Modulus (GPa)	2 - 4.5	3.1 - 3.8	3 - 6
Tensile Strength (MPa)	40 - 90	69 - 83	35 - 100
Compressive Strength (MPa)	90 - 250	100	100 - 200
Elongation (%)	2	4 - 7	1 - 6
Cure Shrinkage (%)	4 - 8	—	1 - 2
Water Absorption (24 h , 20°C)	0.1 - 0.3	0.1	0.1 - 0.4
Izod Impact, Notched (J/m)	15 - 320	250	30



Presently, extensive worldwide research is being conducted on the integration of natural-fiber composites, and automobile manufacturers are creating prototypes that offer a glimpse into future production.

Table 4 – 5 Examples of interior and exterior automotive parts produced from natural materials

Vehicle Part	Material Used
Glove Box	Wood/cotton fibers molded, flax/sisal
Door Panels	Flax/sisal with thermoset resin
Seat Coverings	Leather/wool backing
Seat Surface/Backrest	Coconut fiber/natural rubber
Trunk Panel	Cotton fiber
Trunk Floor	Cotton with PP/PET fibers
Insulation	Cotton fiber
Floor Panels	Flax mat with polypropylene

4.1.3 Composite Materials

A composite material is formed by combining two separate materials, resulting in a substance that possesses unique properties. The strength or other desired property of the combination is superior or significantly distinct from that of either individual component on its own. Composite materials are very desirable due to their superior characteristics of being lightweight, rigid, and possessing higher strength compared to other structural materials. Originally designed to fulfill the rigorous requirements of supersonic flight, space exploration, and deep sea operations, these technologies are now commonly employed in several engineering fields, including automotive applications. Artificial composites achieve comparable outcomes by blending robust fibers like carbon or glass with a more pliable matrix such as epoxy or polyester resin. Composite materials are utilized in the construction of high-performance race cars and aircraft components due to their requirement for lightweight yet durable materials capable of withstanding extreme conditions, such as high temperatures and significant stress and strain. Carbon composites are the predominant material employed in the aerospace sector for launch vehicles, spacecraft, and inter-stage structural components. The potential of new composite materials for use in automotive engineering is being recognized, following their initial development in the aerospace industry.

Carbon Fiber Reinforced Polymer

Carbon Fiber Reinforced Polymer (CFRP) (Figure 4 – 1) is a composite material. In this case the composite consists of two parts: a matrix and a reinforcement. In CFRP the reinforcement is carbon fiber, which provides the strength. The matrix is usually a polymer resin, such as epoxy, which binds the reinforcements together. CFRP possesses

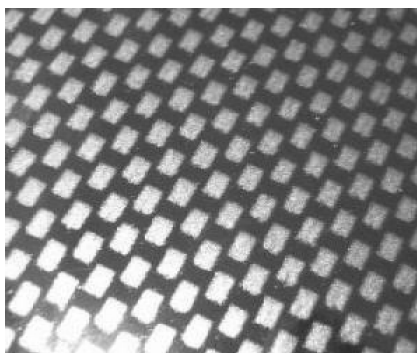


Figure 4 - 1 The surface of CFRP

CFRP in a vehicle can significantly decrease the weight. This would additionally enhance the inventiveness of designers and engineers, while also providing passengers with greater space within the cabin. The new BMW i3 uses a CFRP passenger cell, which serves the dual purpose of reducing the car's weight and minimizing the consumption of water and energy during the manufacturing process. CFRP, although costly, has gained popularity among automotive engineers in the 21st century due to its high strength, durability, and lightweight properties, making it a preferred material for auto bodies.

Carbon Nanotubes

Carbon Nanotubes (CNTs) (Figure 4 - 2) are unique tubular structures of nanometer diameter and large length/diameter ratio. The nanotubes may consist of one to tens or hundreds of concentric shells of carbon with adjacent shells separated by 0.34 nm.

The carbon network of the shells is intricately linked to the hexagonal arrangement of carbon atoms in the graphite sheets. CNTs exhibit exceptional strength, with a tensile strength that is

100 times greater than that of steel. Additionally, they have a remarkably low weight and density. Carbon nanotubes have both metallic and semiconductor properties, surpassing copper in electrical conductivity and diamond in thermal conductivity. Additionally, they are among the most resilient materials discovered to date. Nanotubes have the potential to serve as a lighter and more high-performing alternative to carbon fiber. Fiat, the renowned Italian automotive company, has obtained a patent for utilizing carbon nanotubes in the manufacturing of motor vehicle components. This innovation allows for the creation of parts that possess integrated sensing capabilities. The patent specifies fuel tanks, pipelines, seats, and bumpers as potential applications. Carbon nanotubes have the potential to both provide energy for future vehicles and serve

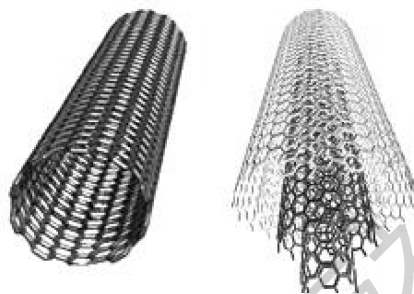


Figure 4 - 2 The structure of carbon nanotubes



as their structural elements. One demonstration has proven the feasibility of creating nanotube capacitors that can store a comparable amount of electrical power as a battery. These capacitors offer benefits such as faster discharge and recharge times. In previous experiments, hydrogen, a potential future fuel, has been successfully stored using these methods, demonstrating excellent efficiency.

Words and Expressions

infrastructure [ˈɪnfəstrʌktʃə(r)]	<i>n.</i> 基础设施
pollutant [pəˈlu:tənt]	<i>n.</i> 污染物
nuisance [ˈnju:sn̩s]	<i>n.</i> 讨厌的人、事
lightweight [ˈlaɪtweɪt]	<i>n.</i> 轻量; <i>adj.</i> 重量轻的
precondition [ˌpri:kənˈdɪʃn]	<i>n.</i> 先决条件
alloy [ˈæləɪ]	<i>n.</i> 合金; <i>v.</i> 使成合金
duralumin [dʒuəˈræljʊmɪn]	<i>n.</i> 硬铝合金
duraluminum	<i>n.</i> 杜拉铝
elastic modulus	弹性系数
Young's modulus	杨氏模量
yield strength	屈服强度
specific strength	比强度
machinability [məˌʃɪ:nəˈbɪlətɪ]	<i>n.</i> 机械加工性
creep resistance	抗蠕变性
polymeric material	聚合材料
thermoplastic [ˌθɜ:məʊˈplæstɪk]	<i>n.</i> 热塑性塑料
polyethylene [ˌpɒliˈeθəli:n]	<i>n.</i> 聚乙烯
polystyrene [ˌpɒliˈstairi:n]	<i>n.</i> 聚苯乙烯
polycarbonate [ˌpɒliˈkɑ:bənət]	<i>n.</i> 聚碳酸酯
thermoset [ˈθɜ:məʊset]	<i>n.</i> 热固性
epoxy resins	环氧树脂
glass reinforced plastic	玻璃增强塑料
coating [ˈkəʊtɪŋ]	<i>n.</i> 涂层, 镀膜加工
adhesive [ədˈhi:sɪv]	<i>n.</i> 粘合剂
susceptibility [səˌseptɪˈbɪlətɪ]	<i>n.</i> 敏感性, 易感性
accelerant [əkˈselərənt]	<i>n.</i> 促进剂
plastisol [ˈplæstɪsəl]	<i>n.</i> 塑料溶胶
bullet-resistant	防弹的
unsaturated polyester composite	不饱和聚酯复合材料
flax [flæks]	<i>n.</i> 亚麻



flex strength	挠曲强度
flex modulus	挠曲模量
elongation at break	断裂延伸
impact strength	冲击强度
polyamide [ˌpɒlɪˈæmaɪd]	<i>n.</i> 聚酰胺
processability [ˌprəʊsesəˈbɪlɪti]	<i>n.</i> 加工性能
polypropylene [ˌpɒlɪˈprɒpɪliːn]	<i>n.</i> 聚丙烯
water absorption	吸水性
softening point	软化点
melting point	熔点
heat deflection	热变形温度
coefficient of thermal expansion	热膨胀系数
tensile Strength	拉伸强度
Izod impact strength	艾佐德冲击强度
polyester [ˌpɒlɪˈestə(r)]	<i>n.</i> 聚酯
vinyl ester	乙烯基酯
cure shrinkage	固化收缩率
door panel	车门内饰板
headliner [ˈhedlaɪnə(r)]	<i>n.</i> 车顶内衬
package tray	后窗台板
dashboard [ˈdæʃbɔːd]	<i>n.</i> 仪表盘
door cladding	门包层
head restraints	头枕
supersonic flight	超音速飞机
matrix [ˈmetrɪks]	<i>n.</i> 基体, 矩阵
launch vehicle	运载火箭
carbon fiber reinforced polymer	碳纤维增强聚合物
monocoque chassis	单体壳底盘
carbon nanotube	碳纳米管
tubular [ˈtjuːbjələ(r)]	<i>adj.</i> 管状的
concentric [kənˈsentrɪk]	<i>adj.</i> 同心的; 同轴的
capacitor [kəˈpæsɪtə(r)]	<i>n.</i> 电容, 电容器
electrical power	电功率

Notes



1. The plastics group is commonly divided into thermoplastics, which soften on heating and harden again on cooling, and thermosetting polymers or resins, which do not



soften on re-heating after the original forming process. Polyethylene (PE), polystyrene, polyacetal, and polycarbonate belong to thermoplastics. Common thermosets are phenolics (Bakelite), epoxy resins (Araldite) and unsaturated polyesters used in glass reinforced plastic composites.

塑料通常分为热塑性塑料和热固性塑料(树脂)。热塑性塑料在加热时软化,冷却后重新硬化,而热固性塑料成型后再加热则不再软化。聚乙烯、聚苯乙烯、聚缩醛树脂和聚碳酸酯属于热塑性塑料。常见的热固性塑料有酚醛塑料(Bakelite)、环氧树脂(Araldite)和用在玻璃增强复合材料中的不饱和聚酯。

2. Automobile parts are reinforced using natural fibers such as kenaf, hemp, flax, jute, and sisal. This is done to reduce weight, cost, and CO₂ emissions, as well as to decrease dependence on imported energy supplies. Additionally, these fiber sources are recyclable and environmentally friendly.

汽车零部件会采用洋麻、大麻、亚麻、黄麻和剑麻等天然纤维进行加固。此举旨在减轻车身重量、降低生产成本、减少二氧化碳排放,同时降低对境外能源供应的依赖。此外,这类纤维原料可回收利用,兼具环保优势。

3. Natural-fiber composites with thermoplastic and thermoset matrices have been adopted by European car manufacturers and suppliers for door panels, seat backs, headliners, package trays, dashboards, and interior parts.

欧洲汽车制造商和供应商已广泛采用含有热塑性和热固性塑料基体的天然纤维复合材料制作车门内饰板、座椅靠背、车顶内衬、后窗台板、仪表盘和内部零件。

4. Carbon fiber reinforced polymer (CFRP) is a composite material. In this case the composite consists of two parts: a matrix and a reinforcement. In CFRP the reinforcement is carbon fiber, which provides the strength. The matrix is usually a polymer resin, such as epoxy, which binds the reinforcements together.

碳纤维增强塑料属于复合材料,这类复合材料由基体和增强体两部分构成。在碳纤维增强复合材料中,增强相为碳纤维,负责提供材料强度;基体一般选用环氧树脂等聚合物树脂,作用是将增强纤维粘固化为整体。

5. The nanotubes may consist of one to tens or hundreds of concentric shells of carbon with adjacent shells separated by 0.34 nm. The carbon network of the shells is intricately linked to the hexagonal arrangement of carbon atoms in the graphite sheets.

碳纳米管可由单层到数十乃至数百层的同心碳壳层组成,相邻壳层之间的间距为0.34 nm。壳层的碳网络与石墨片层中碳原子的六边形排列结构紧密相连。

4.2 Intelligence

Driving cars on a daily basis is both tedious and perilous. During our time spent traveling on the roads, we constantly face the risks associated with inadequate road conditions. Additionally, encountering drivers with insufficient competence or discretion can lead to exhaustion or a loss of focus. In the future, it may become increasingly



difficult to perform such maneuvers, and driving may be increasingly dominated by automatic control. The Intelligent Vehicle (IV) would offer improved safety, increased efficiency, and less driver stress. IV systems are considered to be an advancement beyond existing active safety systems, as they not only offer basic control assistance but also have the ability to perceive the surroundings and evaluate potential risks.

4.2.1 Safety Technology

A vehicle is safe to drive when the brakes are properly controlled. First, several generations of Anti-Lock Brake System (ABS) take over some control from the driver in order to limit slippage of wheels during braking. This is followed by Electronic Stability Program (ESP), which can prevent a car from spinning in a turn. Torque control is also used to prevent the car from flipping backwards. It can ensure stable steering of the car at high speed without any dangerous deviation. Now, with ACC which can regulate the speed of the vehicle depending on the relative distance and speed of the vehicle ahead. The normal end of this trend is the full automation of the driving, not just for comfort but for safety and for better management of the infrastructure.

The next wave of active safety includes lane departure warning system, lane detection system, and lane-keeping assistance, and so on.

Lane Departure Warning System

Lane Departure Warning System (LDWS) is a mechanism designed to warn a driver when the vehicle begins to move out of its lane (unless a turn signal is on in that direction) on freeways and arterial roads. These systems are designed to minimize accidents by addressing the main causes of collisions: driver error, distractions and drowsiness.

Previous iterations of lane departure warning systems utilized a single video camera to monitor lane markers. However, contemporary systems that rely on visual data commonly employ multiple video cameras. Alternative contemporary systems utilize laser or radar sensors in lieu of other methods. The approaches employed by these systems to deliver corrective measures vary depending on the specific circumstances. Early lane-keeping systems utilized electronic stability control devices to ensure that a vehicle stays within its designated lane. This was achieved by exerting a small amount of braking force on the relevant wheels. Contemporary systems include the capability to access power steering controls in order to deliver a subtle steering adjustment.

Lane detection technology

To avoid run-off-road and sideswipe crashes and to support the driver in lane-keeping, IV systems must extract information about the lane/road boundaries ahead of the vehicle and the vehicle's position within the lane. Several techniques have been investigated for lane detection and tracking: (1) Embedded magnetic markers in the roadway; (2) Highly accurate Global Positioning System (GPS) and digital maps; (3) Image processing. Another approach is to combine highly accurate digital mapping



of the roadway lanes with satellite positioning accuracy on the order of 0.5 m or better.

Lane detection technology is a fundamental element of the autonomous driving system. It aids the car in self-guided navigation and obstacle detection by recognizing the boundaries of the route. Lane detection technology encompasses conventional image processing techniques such as edge detection combined with Hough Transform and color thresholding, as well as a range of deep learning algorithms including semantic segmentation, detection, parametric curve, and keypoint-based methods. Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) including Long Short-Term Memory (LSTM) are deep learning algorithms that automatically extract visual information. These methods enhance the accuracy and robustness of detection. Despite facing problems related to dataset needs, model interpretability, and scene generalization, lane detection technology is progressing towards improved efficiency and intelligence through ongoing technological innovation and algorithm optimization. Furthermore, the integration of multiple sensors, such as LiDAR and millimeter-wave radar, enhances the dependability of detection. This sensor fusion method offers robust assistance for ensuring the safe operation of autonomous vehicles in dynamic road conditions and intricate traffic scenarios.

Lane-Keeping Assistance

Lane-Keeping Assistance (LKA) is a sophisticated driver assistance system that utilizes cameras and sensors installed in the vehicle to continuously track the car's location in relation to the lane. Its purpose is to aid the driver in maintaining the vehicle's position within the lane. Upon detecting potential lane deviation, the system promptly notifies the driver and autonomously adjusts the steering wheel using the sophisticated corrective system. Once a specific speed threshold is surpassed, the driver gains the ability to take control of the steering wheel and override the autonomous control. Despite encountering technical difficulties in various settings and intricate road conditions, lane-keeping capabilities are being enhanced by utilizing deep learning and artificial intelligence algorithms. The ultimate goal is to seamlessly integrate these capabilities with autonomous driving technology, thereby offering more comprehensive and intelligent driving assistance.

4.2.2 Automatic Technology

The new automatic systems used in IV include the automatic navigation system, automated driving, and so on.

Automatic navigation

Navigation is the science of directing a craft by determining its position, course, and distance traveled. Navigation was first used in military field. The automotive navigation system was already established in the 1980s. At present, automotive navigation system includes GPS satellite signal technology, dead reckoning or deduced reckoning, map



matching, Vehicle Information and Communication System (VICS) or Traffic Message Channel (TMC), and so on. The basic functions of car navigation consist of three major parts, which are: matching car location on a map, route planning for destinations, and route guidance. In-car navigation system is an integrated system that mainly consists of navigation function, audio and video function, and communication function. It will enhance the functions of navigation, entertainment, and information, and will be a must-have feature in vehicles to come in the future.

An automatic navigation system is an essential component of autonomous driving technology. It enables vehicles to drive independently, without human involvement, by integrating a range of advanced technologies. The core of the system consists of its exceptionally responsive sensing components, which encompass high-definition cameras, multi-band radar, LiDAR, and ultrasonic sensors. These components collaborate to promptly capture and interpret real-time information regarding the vehicle's surroundings, encompassing road signs, traffic signals, pedestrians, bicycles, and other vehicles. Based on this data, the system can precisely detect lane lines, analyze traffic patterns, and identify potential obstructions.

The system's integrated positioning system and inertial measurement unit offer accurate vehicle location and speed data. Advanced data processing algorithms utilize this information along with high-precision map data to dynamically determine the most efficient driving route in real-time. The automatic navigation system possesses robust decision-making abilities that replicate the driving behavior of human drivers and autonomously execute tasks such as lane keeping, adaptive cruise control, automatic lane changes, obstacle avoidance, and emergency braking.

Moreover, the system is engineered with numerous layers of safety redundancy, guaranteeing that the vehicle can continue to function securely in the event of a failure in any one component. The human-machine interface facilitates user-friendly operation and provides real-time feedback, allowing the driver to stay informed about the vehicle's current status and forthcoming actions. The system possesses the capacity to acquire knowledge and modify itself, consistently enhancing its efficiency through machine learning to accommodate new traffic patterns and environmental fluctuations.

The automated guidance system's design considers various traffic settings, such as urban streets, highways, diverse weather conditions, and intricate traffic patterns. It enhances both driving safety and comfort, while also boosting road efficiency by minimizing human error. As technology advances, automatic navigation systems are becoming more automated and intelligent. This is leading to the commercialization and widespread use of fully autonomous vehicles, which represents the future vision of intelligent transportation systems.

Automatic navigation has the potential to reduce operator fatigue and improve the positioning accuracy of the vehicle. A number of agricultural navigation techniques have



been developed or demonstrated in recent years, such as machine vision, GPS, inertial positioning system, radar, ultrasonic, etc.

Recently, there has been a growing demand for audio and video devices to support a wide range of audio and video formats from external storage devices. Additionally, there is a great requirement for these devices to be able to display digital TV broadcasts. Figure 4-3 depicts the system architecture, which consists of distinct components for navigation and audio/video, in order to fulfill the aforementioned objectives. This architecture type would be implemented in an in-car navigation system that demands high performance. However, a cost-constrained in-car navigation system would consist of only a navigation platform, resulting in the availability of audio functionality but the absence of video functionality.

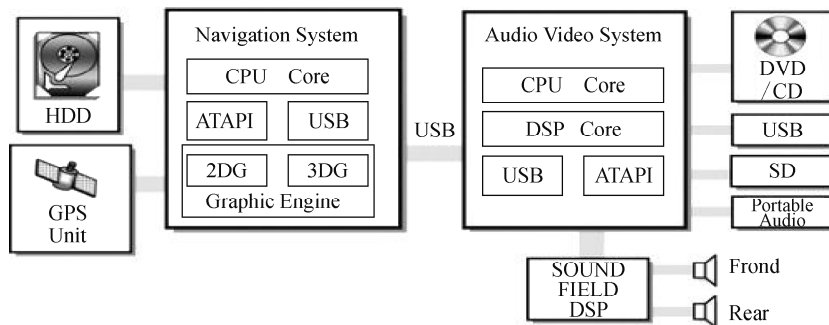


Figure 4-3 System structure of separated audio and video in-car navigation system

Automatic driving technology

Automatic driving technology, commonly referred to as driverless or autonomous car technology, is an advanced technology that integrates machine learning, computer vision, sensor fusion, control systems, and artificial intelligence. It allows vehicles to independently perform tasks such as initiating, increasing speed, changing direction, and stopping, while also facilitating intricate route mapping and decision-making.

The essence of this technology resides in its exceptionally automated control system, capable of analyzing real-time data obtained from diverse sensors, encompassing, but not restricted to, visual cameras for capturing images, radar for detecting distance and speed, LiDAR for providing precise 3D maps, and GPS for offering accurate location information. Using this data, autonomous vehicles can construct a comprehensive representation of the surrounding environment and subsequently make driving judgments based on it.

Furthermore, autonomous vehicles have the capacity to continually enhance their driving methods by utilizing machine learning algorithms. This enables them to adapt to various driving scenarios and traffic patterns. This cognitive capacity allows autonomous vehicles to more accurately anticipate the actions of other drivers, hence ensuring safety in intricate traffic conditions.



The advancement of autonomous driving technology includes the utilization of V2X technology. This technology facilitates communication between cars, vehicles and infrastructure, and even vehicles and pedestrians. It enables the exchange of crucial information such as position, speed, and driving intentions. The capacity to communicate considerably boosts the autonomous vehicle's understanding of the environment, and enhances the efficiency and safety of the transportation system.

The progress of technology is anticipated to revolutionize transportation in the future through the implementation of autonomous driving technology. This innovation is expected to diminish traffic accidents caused by human error, enhance road efficiency, minimize energy consumption, reduce environmental pollution, and contribute to the realization of an intelligent, eco-friendly, and sustainable transportation system.

Words and Expressions

intelligent vehicle	智能汽车
Electronic Stability Program(ESP)	电子稳定系统
Lane Departure Warning System(LDWS)	车道偏离警示系统
lane detection technology	车道线检测技术
Lane-Keeping Assistance(LKA)	车道维持辅助
collision [kə'liʒ(ə)n]	<i>n.</i> 碰撞; 冲突
camera ['kæm(ə)rə]	<i>n.</i> 照相机
automatic navigation system	自动导航系统
deduced reckoning	航位推算
map matching	地图匹配
Vehicle Information and Communication System(VICS)	道路交通信息通信系统
fatigue [fə'ti:g]	<i>n.</i> 疲劳; <i>vt.</i> 使疲劳

Notes

1. Previous iterations of lane departure warning systems utilized a single video camera to monitor lane markers. However, contemporary systems that rely on visual data commonly employ multiple video cameras. Alternative contemporary systems utilize laser or radar sensors in lieu of other methods.

早期版本的车道偏离预警系统(LDW)利用单目摄像头来监测车道线。然而,如今依赖视觉数据的现代系统已普遍采用多摄像头方案。除此之外,另一些现代系统则采用激光或雷达传感器作为其他感知方法的替代方案。



2. Several techniques have been investigated for lane detection and tracking: (1) Embedded magnetic markers in the roadway; (2) Highly accurate Global Positioning System (GPS) and digital maps; (3) Image processing. Another approach is to combine highly accurate digital mapping of the roadway lanes with satellite positioning accuracy on the order of 0.5 m or better.

车道检测和跟踪已研究了多种技术:(1) 道路上嵌入磁性标记;(2) 高精度 GPS 和数字地图;(3) 图像处理。另一种方案是将高精度车道数字地图与定位精度达到 0.5 米及以上的卫星定位系统相结合。

4.3 Saving Energy

4.3.1 Design of Structure

Based on emission reduction, many new structures can be used to improve the fuel economy, such as increasing engine efficiency, improving combustion, selecting a higher air-fuel ratio and using electronic fuel injection. Besides these, the tubeless radial tires are used for reducing tire rolling resistance. A radial tire delivers fuel economy of a 7% reduction compared with the conventional bias-ply tire. To reduce air resistance, the styling of motor vehicles becomes smooth and round (Figure 4-4), because when the drag coefficient of a car is reduced from 0.5 to 0.3, about 0.02 L/km of fuel can be saved. The truck equipped with fairings (Figure 4-5) can save 3% to 4% of fuel. And increasing the number of gears in transmission is a good way to improve traction performance and to save fuel.



Figure 4-4 Elegant styling of a car



Figure 4-5 The truck equipped with fairings

4.3.2 Diversity for Fuel

Gasoline and diesel, derived from petroleum, are the primary fuel sources for motor vehicles in modern times. Nevertheless, their reserves are diminishing. There is a global recognition of the imperative to produce alternative fuels. Several alternative fuels have been utilized in motor vehicles.



Compressed Natural Gas (CNG)

Gas is compressed in order to reduce its volume. Like any kind of gas, natural gas can be pressurized using a compressor. Its volume thereby becomes significantly smaller. Natural gas is traditionally compressed to a pressure from 200 to 250 bars, which gives a 200 – 250-fold volume contraction. The main component of CNG is methane. Its advantages are high octane number, low harmful emissions, low price, rich resources and easy retrofitting of gasoline engine. So CNG as a fuel is much more eco-friendly than oil. And it is supposed to gradually replace oil. The disadvantages are difficulty for the high pressure cylinders to refill and the requirement for construction of a lot of refilling stations throughout the country.

Ethanol and methanol

The characteristics of ethanol and methanol closely resemble those of gasoline. Blending gasoline with 20% ethanol or methanol can be done effortlessly without requiring any modifications to the engine. Methanol has been regarded as a fuel, primarily when used in conjunction with gasoline. Methanol has garnered less attention compared to ethanol due to its significant toxicity. Ethanol is being utilized more and more as an oxygenate ingredient in regular gasoline, replacing Methyl Tert-Butyl Ether (MTBE). MTBE has caused significant contamination of groundwater and soil. Ethanol is a viable fuel source for fuel cells. Bio-ethanol, which is obtained from crops, has the potential to be a sustainable energy source that could provide environmental and long-term economic benefits compared to fossil fuels.

Dimethyl Ether

Dimethyl Ether (DME) is a gaseous substance that shares similar characteristics to propane when exposed to normal environmental conditions. Nevertheless, due to its ability to be stored in liquid form at moderate pressure, it eliminates the necessity for high-pressure containers often employed for Compressed Natural Gas (CNG) or the cryogenic storage of Liquefied Natural Gas (LNG). The fuel's high cetane number and quiet burning, along with its cost-effective propane-like fueling mechanism, make it a highly suitable and affordable alternative to diesel that can meet stringent emissions regulations. Domestic production of this substance can be achieved using several feedstocks, such as biogas and natural gas. DME is a sustainable and renewable fuel that is both environmentally friendly and highly clean. It serves as an alternative to traditional fuels for vehicles and has a promising future for development. DME has been utilized as a primary energy resource in China, Japan, Korea, Egypt, and Brazil.

Hydrogen

Hydrogen gas (H_2) is now being investigated as a potential fuel source for passenger automobiles. Domestic production of hydrogen can be derived from several sources such as fossil fuels, biomass, and other renewable energy technologies. This helps to decrease reliance on imported petroleum. As the combustion process occurs in the presence of



oxygen, water molecules are produced without emitting any air pollutants or greenhouse gases into the environment. Hydrogen is classified as an energy carrier rather than an energy source due to the substantial amount of energy required for its extraction from water. It serves as a convenient and efficient energy carrier in fuel cells and batteries. One drawback of hydrogen is the challenge of preparing, transporting, and storing it. The research on hydrogen engines is now in the experimental phase and has not yet reached the level of large-scale production. In the future, hydrogen has the potential to serve as a crucial energy carrier, facilitating the transportation and delivery of energy in a usable form to consumers through fuel cell technology.

4.4 Green Vehicle

A green vehicle, also known as an environmentally friendly car, is a type of motor vehicle that has a lower negative impact on the environment compared to traditional internal combustion engine vehicles that run on gasoline or diesel. It can also refer to vehicles that use specific alternative fuels. Green vehicles encompass a wide range of transportation options that utilize alternative fuels and advanced vehicle technologies. These include hybrid electric vehicles, plug-in hybrid electric vehicles, battery electric vehicles, compressed-air vehicles, hydrogen and fuel-cell vehicles, solar vehicles, neat ethanol vehicles, flexible-fuel vehicles, natural gas vehicles, clean diesel vehicles, and vehicles that use blends of biodiesel and ethanol fuel or gasohol.

4.4.1 Alternative Fuel Vehicle

An alternative fuel vehicle is a type of vehicle that operates using a fuel other than conventional petroleum fuels such as petrol or diesel. It can also refer to any technology that powers an engine without relying solely on petroleum, such as ethanol, methanol, DME, or hydrogen. Due to a confluence of circumstances, including environmental considerations, elevated oil prices, and the possibility of reaching peak oil, the advancement of cleaner alternative fuels and improved power systems for automobiles has emerged as a top priority for numerous governments and vehicle manufacturers worldwide. The concept of alternative fuel was introduced in Section 4.3.2.

4.4.2 Electric Vehicle

An Electric vehicle (EV) is a category of road vehicle driven by an electric motor and equipped with its own power source, that is, not including those vehicles operating along rails or supplied by overhead cable such as trams, trolleybuses or locomotives. EVs have several advantages over vehicles with internal combustion engines (ICEs):

1. High energy efficiency. Electric vehicles have an energy conversion efficiency of approximately 59 – 62%, meaning they can convert that percentage of electrical energy



from the grid into power at the wheels. In contrast, conventional gasoline vehicles have an energy conversion efficiency of only about 17 – 21%, meaning they can convert that percentage of the energy stored in gasoline into power at the wheels.

2. Ecologically sustainable. EVs do not release any pollutants from their tailpipes, although the power plant generating the electricity used to charge them may emit such pollutants. Electricity generated by nuclear, hydro, solar, or wind power plants is free from any air pollution.

3. Advantages in terms of performance. Electric motors provide quiet, smooth operation and stronger acceleration and require less maintenance than ICEs.

4. Decrease reliance on fossil fuels. Electricity is a form of energy that is used in homes.

EVs can be classified into three main kinds, i. e. Zero Emission Vehicle (ZEV), Hybrid Electric Vehicle (HEV) and Fuel Cell Electric Vehicle (FCEV) (Figure 4 – 6). The development direction of the automotive future would be hydrogen fuel cell vehicles.

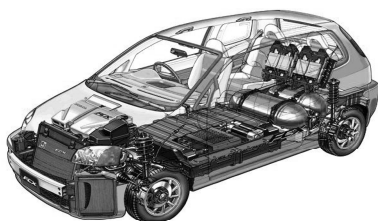


Figure 4 – 6 Fuel cell electric vehicle



Figure 4 – 7 Solar vehicle

4.4.3 Solar Vehicle

A solar vehicle (Figure 4 – 7) is an electric vehicle powered completely or significantly by direct solar energy. Usually, Photovoltaic (PV) cells contained in solar panels convert the sun's energy directly into electric energy. The term "solar vehicle" typically refers to a vehicle that utilizes solar energy to provide power for its propulsion system, either fully or partially. Solar power can also be utilized to supply energy for communication, control, and other supplementary operations. Solar vehicles are largely utilized as showcase vehicles and technical endeavors, frequently supported by government entities. Furthermore, there is a wide prevalence of indirectly solar-charged automobiles and commercially available solar boats. Currently, solar vehicles are not commercially available as efficient and viable means of transportation for everyday usage. This is due to the limitations associated with using photovoltaic (PV) cells in vehicles, which are as follows:

Power density. The power generated by a solar array is constrained by the dimensions of the vehicle and the surface area available for sunlight exposure. Although



batteries can store energy to reduce the peak level of demand on the solar power system and enable operation in the absence of sunlight, they also increase the weight and expense of the vehicle. The power constraint can be alleviated by employing traditional electric vehicles powered by solar or alternative energy sources, which can be recharged from the electric grid.

Cost. While sunlight is free, the production of PV cells to capture that sunlight is expensive. Costs for solar panels are steadily declining (22% cost reduction per doubling of production volume).

Design considerations. Even though sunlight has no lifespan, PV cells do. The lifetime of a solar module is approximately 30 years. Standard photovoltaics often come with a warranty of 90% (from nominal power) after 10 years and 80% after 25 years. Mobile applications are unlikely to require lifetimes as long as building-integrated PV and solar parks. Current PV panels are mostly designed for stationary installations. However, to be successful in mobile applications, PV panels need to be designed to withstand vibrations. Also, solar panels, especially those incorporating glass have significant weight. To be useful, the energy harvested by a panel must exceed the added fuel consumption caused by the added weight.

4.5 Aerocar

An aerocar, commonly referred to as a flying car, is a hybrid vehicle that integrates both terrestrial driving and aerial flight capabilities. The proposal of three-dimensional urban transportation has emerged as a response to the increasing strain on ground transportation caused by population growth and rapid urbanization in recent decades. The aerocar can efficiently utilize the underutilized space near the ground, alleviating the burden on ground transportation and enabling three-dimensional urban transit. The aerocar offers greater route flexibility compared to both terrestrial and underground transit. When compared to high-altitude transportation, aerocars require fewer areas for takeoff and landing, which makes them more ideal for urban transit.

The concept of an aerocar is not entirely original. With advancements in autonomous control technology, new materials, and battery technology, the aerocar has transitioned from the laboratory to the market in recent years. The aerocar is primarily available in three configurations: fixed-wing, rotor-wing, and ducted fan.

4.5.1 Fixed-Wing Aerocar

Fixed-wing refers to an aircraft that has wings that are rigid and do not move (Figure 4-8). The aerocar is propelled by a power unit and generates lift through the use of wings. Early flying automobiles frequently adopted this form. The inaugural flight of the first flying car with a monoplane configuration took place in 1906, demonstrating

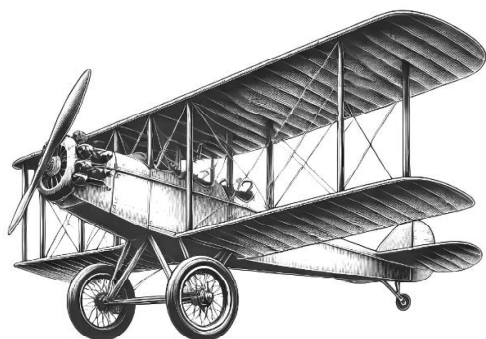


Figure 4 - 8 Fixed-wing aircraft

its ability to glide and achieve lift-off from a plain in Paris. In 1917, the autoplane was introduced. It was a flying vehicle with an aluminum body and a fuel-powered engine, and it had the ability to travel short distances.

Currently, modern fixed-wing aerocars are outfitted with wings that have the ability to fold (Figure 4 - 9). These vehicles have the ability to deploy their wings before takeoff and retract them for movement on the ground. The airborne vehicle is propelled by a combustion engine and equipped with a propeller to generate forward motion while in the air. This particular model of airborne vehicle is very economical in terms of energy consumption and has a high speed capability. However, it necessitates a substantial area for takeoff.



Figure 4 - 9 Modern fixed-wing aerocar

4.5.2 Rotor-Wing Aerocar

Helicopter Aerocars achieve lift by rotors rotating at high speeds. These vehicles have the capability to perform vertical takeoff and landing, which allows them to operate in smaller spaces. This makes them the most viable option for takeoff and landing in urban settings. Nevertheless, rotor-wing aerocars are more costly and have greater limitations in terms of range when compared to their fixed-wing counterparts. The early multi-rotor flying vehicles, such as the VZ-8 AirGeep, were equipped with two large vertical propellers positioned in a front and rear configuration. They utilized a tricycle arrangement for land transportation and had the cockpit located in the center of the vehicle. Contemporary rotary-wing Aerocars frequently utilize a multi-rotor configuration, such as quadrotors. Multi-rotor setups provide greater ease of control and offer increased safety margins. In 2021, Airbus introduced the City Airbus Next Gen, which features eight electric propellers and has a maximum range of 80 km and a cruising speed of 120 km/h. The traveler X2 (Figure 4 - 10), manufactured by XPeng



Motors, successfully conducted its inaugural flight in Dubai in 2022.

This model utilizes a quadrotor configuration, enabling seamless integration of aerial and ground transportation. The rotors can be folded up while driving on the road, resulting in a storage size comparable to that of a typical car.



Figure 4 - 10 Xpeng traveler X2 quadrotor aerocar

4.5.3 Ducted Fan Aerocar



Figure 4 - 11 Ducted fan aerocar

A ducted fan is a propulsion system that consists of a fan enclosed in a duct. Aerocars are a specific category of airborne vehicles that rely on ducted fans for propulsion (Figure 4 - 11). A ducted fan is a fan enclosed in a cylindrical casing, known as a duct, that generates propulsion. Its construction makes it safer and less noisy compared to open propellers.

The power system of a ducted fan is situated within the duct itself, allowing the duct wall to properly regulate the airflow effect on the propeller tip. Additionally, the duct wall serves to muffle the noise within the duct, resulting in a quieter operation compared to the rotor-wing aerocar. The efficiency of the propeller is significantly higher than that of other mechanisms.

Words and Expressions

tubeless radial tire

bias-ply tire

drag coefficient

fairing ['feərɪŋ]

alternative fuel

methane ['mi:θeɪn]

octane number

refill [ri:'fɪl]

refilling station

无内胎子午线轮胎

普通斜交轮胎

阻力系数

n. 导流罩

替代燃料

n. 甲烷

辛烷值

v. 重新加注

加气站



methyl tert-butyl ether	甲基叔丁基醚
dimethyl ether	二甲醚
solar vehicle	太阳能汽车
electric vehicle	电动汽车
tram [træm]	<i>n.</i> 有轨电车
trolleybus ['trɒlibʌs]	<i>n.</i> 无轨电车
locomotive [ˌləʊkə'məʊtɪv]	<i>n.</i> 铁路机车
zero emission electric vehicle	零排放电动汽车
hybrid electric vehicle	混合动力电动汽车
fuel cell electric vehicle	燃料电池电动汽车
photovoltaic [ˌfəʊtəʊˌvɒl'teɪk]	<i>adj.</i> 光伏打的
solar panel	太阳能电池板
power density	功率密度
electrical grid	输电网络
solar module	太阳能电池组件

Notes



1. The characteristics of ethanol and methanol closely resemble those of gasoline. Blending gasoline with 20% ethanol or methanol can be done effortlessly without requiring any modifications to the engine. Methanol has been regarded as a fuel, primarily when used in conjunction with gasoline. Methanol has garnered less focus compared to ethanol due to its significant toxicity.

乙醇和甲醇的理化特性与汽油极为相似。将汽油与 20% 比例的乙醇或甲醇进行掺混, 无需对发动机结构进行任何改装即可轻松实现。甲醇一直被视作一种有效的替代燃料, 尤其是在与汽油混合使用的工况下。然而, 由于甲醇具有显著的毒性, 其受到的关注度通常不及乙醇。

2. A green vehicle, also known as an environmentally friendly car, is a type of motor vehicle that has a lower negative impact on the environment compared to traditional internal combustion engine vehicles that run on gasoline or diesel. It can also refer to vehicles that use specific alternative fuels.

绿色车辆也被称为环保汽车, 这类机动车相较于传统汽油、柴油内燃机汽车, 对环境造成的负面影响更小, 该概念也可指代使用特定替代燃料的车辆。



Exercises



1. Fill in the blanks

- (1) Duralumin, is one of the alloys. This material is _____ fused with copper, manganese and magnesium.
- (2) In the future, the development of vehicles will be _____, _____, energy-saving and _____.
- (3) The plastics group is commonly divided into thermoplastics and _____.
- (4) The principal attraction of composite materials is that they are _____, stiffer and stronger than most other structural materials?
- (5) _____ that can regulate the speed of the vehicle depending on the relative distance and speed of the vehicle ahead.
- (6) _____ gains fuel economy of 7% reduction compared with conventional bias-ply tire.
- (7) Electric vehicle is classified into zero emission electric vehicle, hybrid electric vehicle (HEV) and _____.

2. Single choices

- (1) What is not a lightweight material for automobile?
A. Ferrum B. Carbon fiber C. Magnesium D. Polyethylene
- (2) Which material does not belong to thermoplastics?
A. Polystyrene B. Polycarbonate C. Resin D. Polyethylene
- (3) Which system is a mechanism designed to warn a driver when the vehicle begins to move out of its lane (unless a turn signal is on in that direction) on freeways and arterial roads?
A. LDWS B. ACC C. ABS D. ESP
- (4) Which methods can improve the fuel economy?
A. Fairings for truck B. Lane detection technology
C. Hydrogen fuel D. GPS
- (5) What is the shortcoming of solar vehicle?
A. Low power density B. Low price
C. Green D. Easy to design

READING MATERIAL

Intelligent Transportation System

Transportation systems are comprised of interconnected networks, and a significant



portion of the network's worth lies in the information it holds. For instance, determining if a traffic signal is aware of the presence of waiting traffic at an intersection; detecting if a vehicle is veering out of its designated lane; predicting the likelihood of a collision between two vehicles at an intersection; assessing the level of congestion on a roadway; evaluating the actual expenses associated with operating a roadway, and so on. Intelligent transportation systems provide actionable information to various actors in the transportation system, including commuters, highway and transit network operators, and traffic devices. This information helps them make better decisions, such as selecting the best route, determining the optimal time to travel, considering mass transit options, optimizing traffic signals, identifying locations for new roadways, and holding transportation service providers accountable for their performance. This data can be utilized to optimize the operational efficiency of the transportation network and to transition towards performance-based payment for transportation systems. ITS is an emerging infrastructure platform that is expected to give rise to a wide range of new products and services, some of which may be difficult to envision at present.

Intelligent transportation systems encompass a broad and expanding range of technologies and applications. The applications of ITS can be classified into five overarching categories: (1) Advanced Traveler Information Systems offer drivers up-to-date information, including transit routes and schedules, navigation directions, and details regarding delays caused by congestion, accidents, weather conditions, or road repairs. (2) Advanced Transportation Management Systems encompass many traffic management systems, including traffic signals, ramp meters, variable message signs, and traffic operations centers. (3) ITS-Enabled Transportation Pricing Systems encompass several systems, including Electronic Toll Collection (ETC), congestion pricing, fee-based express (HOT) lanes, and Vehicle Miles Traveled (VMT) usage-based charge systems. (4) Advanced Public Transportation Systems, such as those implemented in trains and buses, enable the reporting of their precise location. This information is then used to notify passengers about the real-time status of their arrival and departure. (5) Integrated intelligent transportation systems, such as Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) integration, facilitate communication between different components of the transportation system, such as vehicles, roadside sensors, traffic signals, and other vehicles.

Intelligent Transportation Systems (ITS) provide significant advantages in terms of safety, operational efficiency, environmental impact, and economic growth. These benefits include increased safety measures, improved operational performance by reducing traffic congestion, enhanced mobility and convenience, environmental benefits, and increased productivity leading to economic and employment growth.