21世纪高等职业教育机电类规划教材
21 Shiji Gaodeng Zhiye Jiaoyu Jidianlei Guihua Jiaocai

模具专业英语

（第2版）

王浩钢 曹艳清 主编 王晓华 李海平 刘伟 副主编 涂勇 主审

- 精选模具行业最新资料
- 拓展高职学生专业视野
- 提高职业教育英语水平

人民邮电出版社
POSTS & TELECOM PRESS

精品系列

21世纪高等职业教育机电类规划教材
21 Shiji Gaodeng Zhiye Jiaoyu Jidianlei Guihua Jiaocai

模具专业英语

（第2版）

王浩钢 曹艳清 主编 王晓华 李海平 刘伟 副主编 涂勇 主审

人 民 邮 电 出 版 社
北 京

精品系列

图书在版编目（CIP）数据

模具专业英语/王浩钢，曹艳清主编．—2版．—北京：人民邮电出版社，2008.9
21世纪高等职业教育机电类规划教材
ISBN 978-7-115-18192-3

Ⅰ.模… Ⅱ.①王…②曹… Ⅲ.模具—英语—高等学校：技术学校—教材 Ⅳ.H31

中国版本图书馆CIP数据核字（2008）第090273号

内 容 提 要

模具技术涉及高分子材料、模具金属材料、模具结构、成型加工设备等诸多领域，相关技术设备的引进和国际合作交流很多，该专业所涉及的科技英语词汇、语句等虽常见于各专业文献中，但无法全面、系统地反映材料、设备、工艺的内在联系。本书所选文章涉及模具设备、塑料模具设计、冲压模具设计、工程材料、加工制造及现代模具设计CAD/CAM等方面的内容，专业词汇的选词和释义均围绕工程实际应用，均是模具设备、结构以及数值模拟中常用的概念和专业词汇。

本书可作为高等职业院校、高级技师学院的模具设计与制造等相关专业的教材，也可供相关工程技术人员参考使用。

21世纪高等职业教育机电类规划教材

模具专业英语（第2版）

◆ 主　　编　王浩钢　曹艳清
副 主 编　王晓华　李海平　刘　伟
主　　审　涂　勇
责任编辑　潘新文

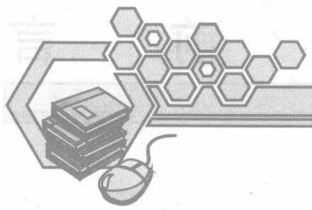
◆ 人民邮电出版社出版发行　　北京市崇文区夕照寺街14号
邮编　100061　　电子函件　315@ptpress.com.cn
网址　http://www.ptpress.com.cn
三河市海波印务有限公司印刷

◆ 开本：787×1092　1/16
印张：12.25
字数：314千字　　2008年9月第2版
印数：11 001－14 000册　　2008年9月河北第1次印刷

ISBN 978-7-115-18192-3/TN

定价：22.00元

读者服务热线：(010)67170985　印装质量热线：(010)67129223
反盗版热线：(010)67171154



丛书前言

目前，高职高专教育已经成为我国普通高等教育的重要组成部分。在高职高专教育如火如荼的发展形势下，高职高专教材也百花齐放。根据教育部发布的《关于全面提高高等职业教育教学质量的若干意见》（简称 16 号文）的文件精神，本着为进一步提高高等教育的教学质量服务的根本原则，同时针对高职高专院校机电一体化、数控、模具类专业教学思路和方法的不断改革和创新，人民邮电出版社精心策划了这套高质量、实用型的教材——“21 世纪高等职业教育机电类规划教材”。

本套教材主要遵循“以就业为导向，工学结合”的原则，以实用为基础，根据企业的实际需求进行课程体系设置和相应教材内容的选取，注重提高案例教学的比重，突出培养机械类应用型人才解决实际问题的能力，满足高等职业教育“社会评估”的教学特征。本套教材中的每一部作品都特色鲜明，集高质量与实用性于一体。

本套教材中绝大多数品种是我社多年来高职高专机电类精品教材的积淀，经过了广泛的市场检验，赢得了广大师生的认可。为了适应新的教学要求，紧跟新的技术发展，我社再一次组织了广泛深入的调研，组织了上百名教师、专家对原有教材做认真的分析和研讨，在此基础上重新修订出版。本套教材中还有一部分品种是首次出版，其原稿也在教学过程中多次使用，是教师们多年来教学经验的总结，集中反映了高等职业教育近几年来教学改革的成果。

本套教材的作者都具有丰富的教学经验和写作经验，思路清晰，文笔流畅。教材充分体现了高职高专教学的特点，深入浅出，言简意赅。理论知识以“够用”为度，突出工作过程导向，突出实际技能的培养。

本套教材配套的教学辅助包充分利用现代技术手段，提供丰富的教学辅助资料，其中包括由电子教案、实例素材、习题库及答案、试卷及答案等组成的一般教辅资料，部分教材还配有由图片、动画或视频等组成的电子课件。

我们期望，本系列教材的编写和推广应用，能够进一步推动我国机电类职业教育的教学模式、课程体系和教学方法的改革，使我国机电类职业教育日臻成熟和完善。欢迎更多的老师参与到本系列教材的建设中来。对本系列教材有任何的意见和建议，或有意向参与本系列教材后续的编审工作，请与人民邮电出版社教材图书出版分社联系，联系方式：010-67170985，maxiaoxia@ptpress.com.cn。

前　言

《模具专业英语》第1版自出版以来，深受广大读者的欢迎，很多读者来信提出许多中肯的意见和宝贵建议。为此，作者针对这些意见和建议，结合自己多年来的教学经验和体会，对原书进行了修订。除了对书中存在的错误之处进行了修正外，同时结合作者长期工程实践经验，对教材内容的编排进行了取舍，重点挑选了在模具企业中应用最为广泛的塑料模具和冲压模具方面的专业文章，并结合模具材料、设备等知识对原有内容进行了扩充。希望修订后的教材能对职业技术学院、高级技工学校模具类专业学生的专业英语水平真正起到提高作用。

本书所选文章内容涵盖注塑机、塑料模具结构、冲压模具、压铸模具、加工设备、加工方式等方面，内容全面，通俗易懂，并附全文翻译，供老师和学生参考。

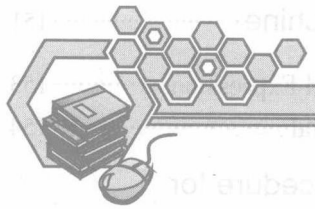
本教材内容在讲授时，各个职业院校的教师可根据自己学校教学计划的实际情况作适当增减，参考学时数可安排在35～50学时范围内。

本教材由河南工业大学王浩钢老师和华立科技职业技术学院曹艳清老师任主编，郑州铁路职业技术学院王晓华老师、河南工业大学李海平老师、刘伟老师任副主编，开封大学朱耀峰老师、郑州职业技术学院许栋刚老师、平顶山工业职业技术学院吕恒志老师、鹤壁职业技术学院孟亚峰老师等参加编写。本教材由河南职业技术学院涂勇老师主审，全书由王浩钢、李海平老师负责统稿工作。郑州铁路职业技术学院戴明宏老师参加了审稿会，并认真地审阅了书稿，对教材的体系和内容提出了许多宝贵意见，在此表示衷心的感谢。本教材在编写过程中，得到了河南科技大学李辉老师、郑州参数技术有限公司刘家渠老师的大力支持与帮助，在此一并致谢！

高职高专模具专业教学改革是一项长期而又艰苦的工作，《模具专业英语》的教学目前仍处于探索阶段。如果本书的出版能对高等职业院校模具专业学生的学习起到一些促进作用，那将是我们最大的欣慰。由于编写时间仓促，书中错误和不妥之处在所难免，恳请广大读者批评指正。

编　者

2008年4月



目 录

Lesson 1

The Injection Molding and Machine

1. The injection molding

Injection molding is principally used for the production of the thermoplastic parts, although some progress has been made in developing a method for injection molding some thermosetting materials. The problem of injecting a melted plastic into a mold cavity from a reservoir of melted material has been extremely difficult to solve for thermosetting plastics which cure and harden under such conditions within a few minutes①. The principle of injection molding is quite similar to that of die-casting. The process consists of feeding a plastic compound in powdered or granular form from a hopper through metering and melting stages and then injecting it into a mold②. After a brief cooling period, the mold is opened and the solidified part ejected. Injection-molding machines can be arranged for manual operation, automatic single-cycle operation, and full automatic operation. The advantage of injection molding are: (i) a high molding speed adapted for mass production is possible; (ii) there is a wide choice of thermoplastic materials providing a variety of useful properties; (iii) it is possible to mold threads, undercuts, side holes, and large thin sections.

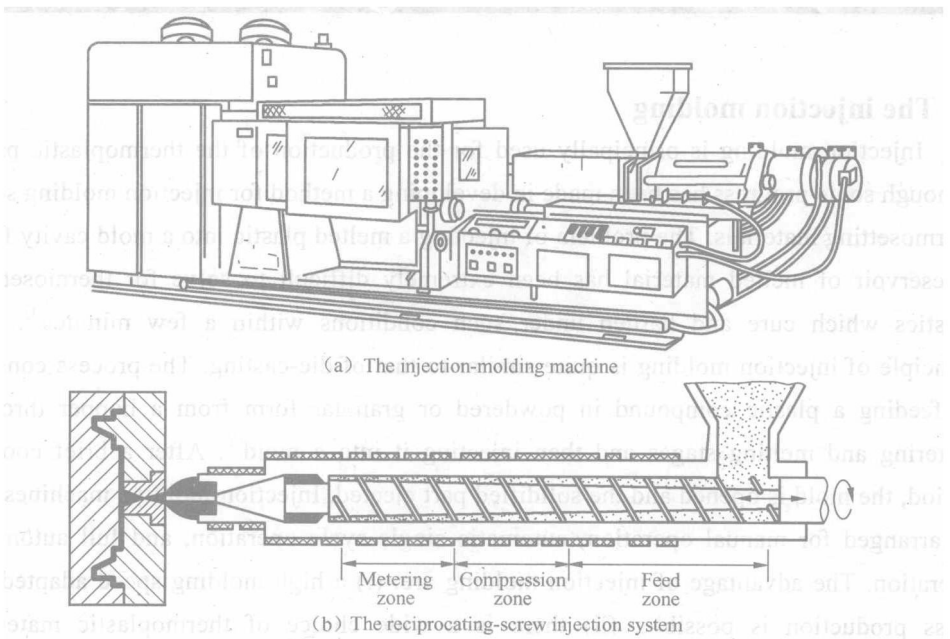
2. The injection-molding machine

Several methods are used to force or inject the melted plastic into the mold. The most commonly used system in the larger machines is the in-line reciprocating screw, as shown in Figure 1-1. The screw acts as a combination injection and plasticizing unit. As the plastic is fed to the rotating screw, it passes through three zones as shown: feed, compression, and metering. After the feed zone, the screw-flight depth is gradually reduced, forcing the plastic to compress. The work is converted to heat by shearing the plastic, making it a semifluid mass. In the metering zone, additional heat is applied by conduction from the barrel surface. As the chamber in front of the screw becomes filled, it forces the screw back, tripping a limit switch that activates a hydraulic cylinder that forces the screw forward and injects the fluid plastic into

the closed mold[3]. An antiflowback valve prevents plastic under pressure from escaping back into the screw flights.

The clamping force that a machine is capable of exerting is part of the size designation and is measured in tons. A rule-of-thumb can be used to determine the tonnage required for a particular job. It is based on two tons of clamp force per square inch of projected area. If the flow pattern is difficult and the parts are thin, this may have to go to three or four tons.

Many reciprocating-screw machines are capable of handing thermosetting plastic materials. Previously these materials were handled by compression or transfer molding. Thermosetting materials cure or polymerize in the mold and are ejected hot in the range of 375℃ ~ 410℃. Thermoplastic parts must be allowed to cool in the mold in order to remove them without distortion. Thus thermosetting cycles can be faster. Of course the mold must be heated rather than chilled, as with thermoplastics.



(a) The injection-molding machine

(b) The reciprocating-screw injection system

Figure 1-1. The injection-molding system

New words and Expressions

injection molding 注射模
principally ['prinsipli] *adv.* 主要地
thermoplastic [ˌθə:mə'plæstik] *n.* 热塑性，热塑性塑料
thermosetting [ˌθə:məu'setiŋ] *n.* 热固性
plastic ['plæstik, plɑ:stik] *n.* 塑胶，塑料
melted *vt.*（使）熔化，使软化
cavity ['kæviti] *n.* 型腔
reservoir ['rezəvwɑ:] *n.* 容器，储存器

extremely [iks'tri:mli] *adv* 极端地，非常地
principle ['prinsəpl] *n.* 法则，原则，原理
die-casting 压力铸造
compound ['kɔmpaund] *n.* 混合物，复合的，混合
powdered ['paudəd] *vt.* 弄成粉的，粉状的
granular ['grænjulə] *adj.* 由小粒而成的，粒状的
hopper ['hɔpə] *n.* 加料漏斗
metering['mi:təriŋ] *vt.* 测量（法），计[配]量，测定
eject [i'dʒekt] *vt.* 逐出，喷射
solidify [sə'lidifai] *vt.*（使）凝固，（使）团结
manual ['mænjuəl] *adj.*手的，手动的，手工的
automatic [,ɔ:tə'mætik] *adv* 自动的，机械的
property ['prɔpəti] *n.*性质，特性
thread [θred] *n.*螺纹
undercut ['ʌndəkʌt] *n.*侧向分型，底切
reciprocating screw 往复螺杆
plasticize ['plæstisaiz] *vt.*使成可塑体
compression [kəm'preʃ(ə)n] *n.*浓缩，压缩
screw-flight 螺杆的螺纹
convert [kən'və:t] *vt.* 使转变，转换
shear [ʃiə] *vt.*剪，剪切
semifluid [ˌsemi'flu:id, ˌsemai～] *adj.*半流质，半流质的
barrel ['bærəl] *n.*桶
chamber ['tʃeimbə] *n.*室，房间
trip [trip] *vt.*松开棘爪而开动；使跳闸；切断
switch [switʃ] *n.*开关，转换，转变
hydraulic [hai'drɔ:lik] *adj.*水力的，水压的
cylinder valve 气缸阀
clamping force 锁紧力
exert [ig'zə:t] *vt.*尽（力），施加（压力）
rule-of-thumb 单凭经验的方法
transfer molding 传递模塑法，转送成形
polymerize ['pɔlimə raiz] *vt.*（使）聚合
distortion [dis'tɔ:ʃən] *n.*扭曲，变形
plunger ['plʌndʒə] *n.*柱塞
spurt [spə:t] *vt.*（液体等）喷射，喷出
sprue [spru:] *n.*浇口，溶渣
optimum ['ɔptiməm] *adj.*最适宜的
foam [fəum] *vt.*起泡沫

Notes

① The problem of injecting a melted plastic into a mold cavity from a reservoir of melted material has been extremely difficult to solve for thermosetting plastics which cure and harden under such conditions within a few minutes.

热固性塑料熔体在很短的时间内就会固化和硬化，在从料斗向模具型腔注入热固性塑料熔体的过程中，也会出现这种情况，这个问题一直非常难解决。

句中的 of injecting a melted plastic into a mold cavity from a reservoir of melted material 介词短语作后置定语修饰 the problem，which cure and harden under such conditions within a few minutes 定语从句作后置定语修饰 thermosetting plastics。

② The process consists of feeding a plastic compound in powdered or granular form from a hopper through metering and melting stages and then injecting it into a mold.

注塑成型的工艺过程包括：首先把料斗中的粉状或粒状的塑料混合物依次输送到定量区和熔化区，然后再注射到模具型腔中。

句中 consist of 意为：由……组成，由 and 连接的三个动名词短语作 of 的宾语。

③ As the chamber in front of the screw becomes filled, it forces the screw back, tripping a limit switch that activates a hydraulic cylinder that forces the screw forward and injects the fluid plastic into the closed mold.

当熔体充满螺杆前部区域时，螺杆在熔体压力的作用下后退，触动限位开关使液压缸工作，在液压力的作用下推动螺杆向前运动，将熔融塑料注射到闭合的模具型腔中。

句中 as 引导的时间状语从句，that activates a hydraulic cylinder that forces the screw forward and injects the fluid plastic into the closed mold 为限制性定语从句修饰 a limit switch，that forces the screw forward and injects the fluid plastic into the closed mold 修饰 a hydraulic cylinder。

第 1 课　注塑模和注塑机

1. 注塑模

尽管成型某些热固性材料的方法取得了一定进步，但注塑模主要（还是）用来生产热塑性塑件。（这主要是因为）热固性塑料熔体在很短的时间内就会固化和硬化，在从料斗向模具型腔注入热固性塑料熔体的过程中，也会出现这种情况，这个问题一直非常难解决。注塑成型原理和铸造十分相似。注塑成型的工艺过程包括：首先把料斗中的粉状或粒状的塑料混合物依次输送到计量区和熔化区，然后再注射到模具型腔中，经过短时冷却后，开模，推出成型塑件。注塑机分为手动、半自动及全自动操作。注塑模具有以下优点：（i）较高的成型速度使大批量生产成为可能；（ii）为成型具有不同使用性能的热塑性材料提供了较宽的选择；（iii）可以成型带有螺纹的塑件、侧向凹陷的塑件、带有侧孔的塑件以及较大的薄壁件。

2. 注塑机

熔融塑料注入模具中通常有几种方式。在大型注塑机上常采用往复螺杆式的注入方式，如图 1-1 所示。螺杆同时具有注射和塑化的功能。树脂原料进入旋转的螺杆时，要经过图示的三个区域：喂入区、压实区和计量区。经过喂入区后，为压实树脂原料，螺杆螺旋部分的深度逐渐降低，

同时传递树脂原料间因剪切作用而产生的热量，使原料呈半流动状态。在计量区，螺缸表面的加热装置对熔体进一步加热。当熔体充满螺杆前部区域时，螺杆在熔体压力的作用下后退，触动限位开关使液压缸工作，在液压力的作用下推动螺杆向前运动，将熔融塑料注射到闭合的模具型腔中。防倒流阀能够阻止受压熔体倒流进螺杆的螺旋区。

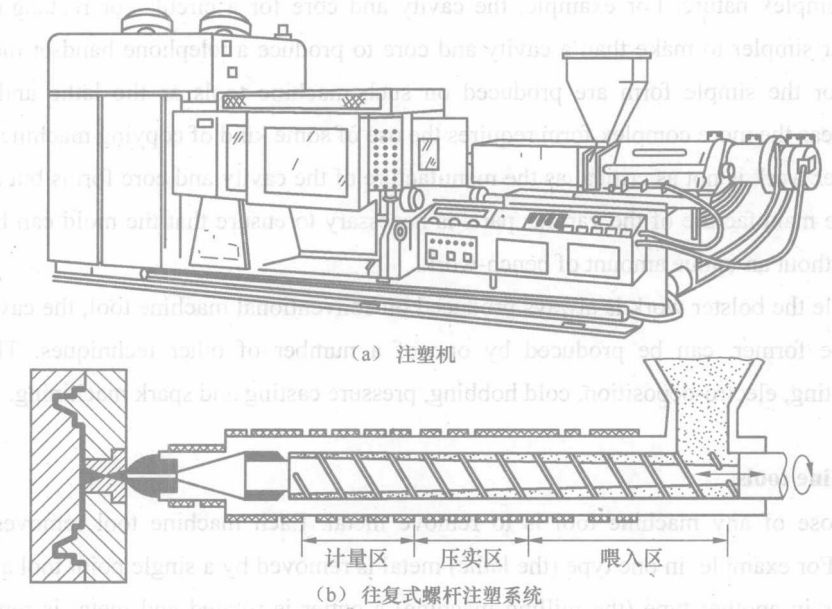


图 1-1 注塑系统

注塑机的锁模系统所提供的锁模力由（塑件在分型面的投影）尺寸决定，锁模力以吨为单位。通常靠经验来决定塑件所需要的锁模力总吨数，一般在塑件投影面积上每平方英寸需要作用两吨锁模力。如果熔体流动困难或塑件较薄，锁模力应提高到三到四吨。

许多往复螺杆式注塑机能生产热固性塑料。以前，热固性塑料由挤出模具或传递模具生产。热固性塑料熔体在模具内固化或发生聚合反应，并在温度为 375℃～410℃范围内推出。热塑性塑料熔体必须在模具内冷却成型，以保证推出时不发生变形。这种热固性循环速度很快。当然，生产热塑性塑件时，模具必须被加热，而不是冷却。

Reading material

A competent mould designer must have a thorough knowledge of the principles of mould making as the design of the various parts of the mould depends on the technique adopted for its manufacture.

This chapter is included primarily for the beginner who does not have a background knowledge of the various machining and other mould making techniques. To cover the topic of mould making thoroughly would require a companion work equal in size to this monograph and therefore this introduction to the subject must, of necessity, be superficial. However, we hope that very fact that it is included in a monograph on design, will emphasize the importance of mould making as a subject and will also encourage the beginner to a further and more complete study in this field.

The majority of moulds are manufactured by the use of conventional machine tools found in most modern toolrooms. From the manufacturing viewpoint we classify the mould into two parts (i)the cavity

and core, and (ii) the remainder of the mould. The latter part is commonly referred to as bolster work.

The work on the cavity and core is by far the most important as it is from these members that the plastics moulding takes its form.

The work on the cavity and core can further be classified depending upon whether the form is of a simple or a complex nature. For example, the cavity and core for a circular or rectangular box-type moulding is far simpler to make than a cavity and core to produce a telephone handset moulding. The mould parts for the simple form are produced on such machine tools as the lathe and the milling machine, whereas the more complex form requires the use of some kind of copying machine.

The bolster work is not as critical as the manufacture of the cavity and core forms but nevertheless, accuracy in the manufacture of the various parts is necessary to ensure that the mold can be assembled by the fitter without an undue amount of bench-work.

Now, while the bolster work is always produced on conventional machine tool, the cavity and core, particularly the former, can be produced by one of a number of other techniques. These include investment casting, electro-deposition, cold hobbing, pressure casting and spark machining.

1. Machine tools

The purpose of any machine tool is to remove metal. Each machine tool removes metal in a different way. For example, in one type (the lathe) metal is removed by a single point tool as the work is rotated,whereas in another type (the milling machine) a cutter is rotated and metal is removed as the work is progressed beneath it.

Which machine tool is to be used for a particular job depends to a large extent upon the type of machining required. There is, however, a certain amount of overlapping and some machine tools can be utilized for several different operations.

The machine tools which will be found in the modern toolroom are as follows:

(i) Lathes for turning, boring and screwcutting, etc.

(ii) Cylindrical grinding machines for the production of precision cylindrical surfaces.

(iii) Shaping and planing machines for the reduction of steel blocks and plates to the required thickness and for "squaring up" these plates.

(iv) Surface grinding machines for the production of precision flat surfaces.

(v) Milling machines for the rapid removal of metal, for machining slots, recesses, boring holes, machining splines, etc.

(vi) Tracer-controlled milling machines for the accurate reproduction of complex cavity and core forms.

In addition to the above list of major machine tools there is, of course, ancillary equipment without which no toolroom would be complete. This includes power saws, drilling machines, toolpost grinders, hardening and polishing facilities, etc.

2. Castings

The manufacture of cavities and cores in steel by the conventional casting method using sand

moulds is not satisfactory owing to the poor finish obtained and to the porosity which occurs on, or just below the surface of the casting. The expenditure involved in plugging, machining and finishing these conventional castings makes this method of mould making uneconomic.

The Shaw investment casting process does not, however, share the disadvantages associated with sand casting and is therefore applicable to the manufacture of cavities and cores. The process is carried out by specialists and the mouldmaker supplies the company with a pattern of the required mould part. As the final casting will be an accurate reproduction of the pattern supplied, this must be manufactured to close tolerances and have a good surface finish. To allow for the contraction of the steel on cooling the pattern is made approximately 0.020 mm/mm(in/in) oversize.

3. Electro-deposition

Electro-deposition is an electrochemical process used to reproduce accurately a cavity or core form from a given pattern. The pattern can be made in an easily worked material and is the reverse form to that required. That is, a male pattern is required for a cavity and a female pattern for a core. Normally it is much easier to machine a male pattern than the reverse cavity form and it is for this reason that most applications for this technique are for intricate cavity work.

4. Cold hobbing

Cold hobbing is a process in which a hardened steel master hob is forced into a soft steel blank under condiderable pressure.

Hobbing is used for the production of cavities which by virtue of their shape would be difficult to die-sink on conventional machine tools.

5. Pressure casting

Beryllium-copper is a material which is increasingly being used in mould construction because it possesses several desirable characteristics. In particular it has a high thermal conductivity combined with a reasonable hardness (Brinell Hardness Number of about 250), which makes it suitable for certain types of cavity and core, and for other mould parts, such as hot runner unit secondary nozzles.

Its high thermal conductivity means that when beryllium-copper is used for a cavity or a core, the heat from the melt will be transferred away from the impression faster than if a corresponding steel cavity and core are used, and this often results in a shorter moulding cycle.

Beryllium-copper can be machined, in which case the conventional machine tools are used, and it can be cold-hobbed, hot-hobbed or pressure-cast. The last technique offers certain advantages over the hobbing methods, in that cold or hot hobbing of beryllium-copper tends to work harden the material which results in the development of stress concentrations.

Pressure casting (or liquid hobbing) is used mainly for the production of cavities but it can be used, where applicable, for the production of the cores as well. As the terms suggest, it is basically a process which combines the casting and hobbing techniques.

6. Spark machining

This is one of more recent additions to mould making methods and strictly speaking it should come under the machine tool section. However, as the principle of operation is different from that of all other basic machine tools it is preferable to discuss this technique separately.

Spark machining is a process in which steel or other metals can be machined by the application of an electrical discharge spark. The spark is localized and metal is progressively removed in small quantities over a period of time.

7. Bench fitting

Irrespective of the machine tool or technique used to manufacture the various parts of the mould, the final responsibility for the finishing of the individual parts and for fitting them together lies with the bench fitter. The mould parts finishing and assembly procedure adopted by the bench fitter varies quite often from toolroom to individual toolmakers working in the same work; it is therefore impossible to set down a standard pattern for the work. In consequence, we intend only to indicate the general approach to this problem without going into details. We will do this by considering the various stages in the bench fitting involved in the manufacture of a simple mould.

阅 读 材 料

称职的模具设计师必须具有丰富的模具制造方面的知识，因为模具各部件的设计依赖于生产这些部件时所采用的制造方法。

本章主要针对没有任何机加工知识和其他模具制造技术的初学者，介绍模具制造的基本知识。全面且浅显地介绍这部分知识与本文具有同等重要的意义。然而，我们希望论述设计方面的著作，能够强调模具制造的重要性，把它作为一门学科来论述，并且激励初学者更加深入、全面地研究这一领域。

大多数模具是利用经过现代技术改装的传统机床加工制造的。从制造角度，模具分为两部分：（i）型腔和型芯；（ii）模具其他部分。后者通常作为模具的支撑部件。

加工型腔和型芯是（模具制造中）最重要的工作，因为这两部分决定塑件的形状及表面质量。

加工型腔和型芯的工作依据他们的形状进一步划分为简单和复杂两种形式，例如，制造圆（环）形或直角的型腔和型芯要比制造电话机手柄的型腔和型芯的难度大得多。形状简单的模具零件常在车床和铣床（传统）机床上加工，而复杂部件则需要使用仿形机加工。

制造支撑部件并不像制造型腔和型芯那么重要，但是，为使模具在不需要许多钳工工作的基础上顺利装配，确保各部件的制造精度也是非常重要的。

虽然目前支撑件一般在传统机床上制造，但是型腔和型芯，特别是型腔可以由其他技术制造，例如熔模铸造、电解法精炼、冷挤压制模法、压力铸造及电火花加工。

1. 机床刀具

所有机床刀具的用途都是去除金属，（但是）每种机床刀具去除金属的形式各不相同。例如，有的机床（如车床）是工件回转，采用单刃刀具去除金属，有的机床（如铣床）则是以刀具回转，工件进给的方式去除金属。

选择哪种机床刀具具备多种加工方式加工工件，很大程度上取决于（工件的）加工要求。一般会存在一定的交叉，一些机床刀具具备多种加工方式。

现代加工过程中应用的机床有如下几种：

（i）车床，用于车削、钻削和螺纹加工等。

（ii）外圆磨床，用来加工表面精度较高的圆柱件。

（iii）牛头刨床，用来将钢坯和钢板加工成所需的厚度，并使这些钢板“长宽尺寸见方”。

（iv）平面磨床，用来生产高精度平面。

（v）铣床，用来加工狭槽、凹陷、钻孔以及花键等，能够快速去除金属（余料）。

（vi）仿形铣床，用来精确再现复杂型腔和型芯的形状。

当然，除上面所述的主要机床外，还有一些附属设备，（如果没有这些设备）机加工装备将不完善。（这些设备）包括电锯、钻床、工具磨、硬化和抛光设备等。

2. 铸造

由于普通砂型铸造方法获得的铸件表面质量差，表层或表层下有孔眼类缺陷，并不适于制造钢制凸凹模。并且这种加工所需的费用包括焊补、机加工和抛光，也使得这种传统的模具制造方法变得不经济。

然而肖氏熔模铸造却没有砂型铸造的这些缺点，因此适用于专业的模具生产，模具制造者将所需要的模具零件的样品提供给熔模铸造公司。由于最终铸件将精确的再现所提供样品（的形状和尺寸），因此，铸件必须具有（与样品）相似的尺寸公差和良好的表面光洁度。考虑到钢制铸件模型冷却时的收缩率为 0.020 mm/mm（in/in），样件应该制作得稍大一些。

3. 电解法精炼

电解法精炼是一种通过精确复制所给出的样模来加工型腔和型芯的电化学方法。样模可用易于加工的材料制作，其形状是所要求的共轭件（的形状）。也就是说，凸模样模用来复制凹模，而凹模样模用来复制凸模。通常，加工凸模样模比加工凹模样模容易得多。因此，这种方法绝大多数用来加工形状复杂的型腔。

4. 冷挤压制模法

冷挤压是指在相当大的压力作用下把（淬硬钢）凸模挤压压入相对较软的钢材坯料的一种加工工艺。

挤压工艺在生产（那些）由传统机床制模比较困难的凹模时具有（一定）优势。

5. 压力铸造

因为铍铜具有一些优良的特性，所以越来越多地被应用在模具结构上。铍铜良好的导热性和合理的硬度（布氏硬度约为 250）尤其适用于（制造）某些类型的型腔和型芯，以及其他模具零件，例如热流道系统的二级喷嘴。

良好的导热性意味着当使用铍铜制造的型腔或型芯时，熔融材料的热量会很快从模腔中传走，热量传递速度高于相应的钢质型腔和型芯，这就缩短了塑件生产周期。

铍铜可以使用机床加工，常规的机床（加工方法）即可，并且可以采用冷挤压、热挤压和压力铸造（等加工工艺）。由于采用冷、热挤压工艺加工的铍铜（件）易于硬化，导致应力集中，因此，与挤压工艺相比，最后这种工艺方法（压力铸造）具有一定的优点。

压力铸造（也称液体挤压）主要用于生产型腔，但也能用于生产型芯。由字面意思可知，这是一种铸造和挤出技术相结合的工艺过程。

6. 电火花加工

这是一种近来才发展起来的模具制造方法。严格地说，这应属于机床装备的范畴，但是，由于其工作原理有别于所有其他机床，所以这种技术还应单独讨论。

电火花加工是指通过电极放电来加工钢件或其他金属材料的工艺方法。电火花的放电位置是固定的，而被加工金属材料是在一定时间内以很小的去除率逐渐加工完成的。

7. 钳工装配

不论采取何种机床和工艺来加工各种模具零件，每种零件的精加工以及将这些零件装配成模具都离不开钳工。由于工具的完备程度不同，钳工用以精加工和装配模具零件的工艺方法是不同的，所以，不可能为此建立一套工作标准。因此，我们将只讨论（钳工工艺）这个问题的一般性方法，而不深入（讨论）细节问题。我们将就一个简单的模具加工（过程）来考察其中钳工工艺的各个步骤。