

# 机械结构合理设计 图册

李希诚 李弦泊 编著



上海科学技术出版社

TH122
7.7

ISBN7-5323-3808-8/TH·70

定 价： 11.20元

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上海科学技术出版社出版、发行

(上海瑞金二路 450 号)

新华书店上海发行所经销 上海东方印刷厂印刷

**开本 787×1092 1/16 印张 10.5 字数 248,000**

1996年5月第1版 1996年5月第1次印刷

印数 1—5,000

ISBN7-5323-3808-8/TH·70

定价:11.20元

# 序

机械设计工作是一项实践性非常强的、综合性的技术工作，其中结构设计涉及力学原理、机械制造工艺、安装、使用、维修、经济、安全等多方面的知识和经验。

统计数字表明：导致机械设备不能正常工作，乃至破坏，由设计计算错误引起的并不多，由结构设计错误引起的则比较多。

通常全面、正确地看，机械设计工作应包括理论分析、模型试验、设计计算、结构设计和制图等步工作，其中结构设计和制图是必不可少的。机械结构合理设计原理在有关机械设计各著作中均有所论述。其中：一般教程大多数只是在绪论中泛泛作说明；专著虽有论述详尽，图文并茂之优点，但欠全面、系统；而一般图册则虽便于设计、校审时查阅参考，可惜版面相当窄，又比较零乱。编者有鉴于此，特就多年搜集散见于各书刊、手册、图纸等文献资料中的图例，及现场实例，经整理汇编成册。

各文献资料对图例的评定术语不一，有好与不好；正确与错误；工艺性与非工艺性等。其同疏切意义是不朴同的。本图册为简化版面，便于排印，特将图例统一成合理、不合理来评述。此处不合理包括错误和不好，两者有质的区别，请查阅时注意区分。此处合理是指符合可靠性、耐久性、工艺性、省料性、安全性、操作以及安装、检修、运输方便性等方面的要求。显然，合理的图例很难乃至不可能完全符合上述这些方面的要求，而是综合考虑了上述这些方面的要求，符合了某些或某一方面的主要要求，并且是与特定的具体条件相联系的。例如零件倒角和提高刚度一般说来是有益的，但前者对密封，后者对防止焊接刚性破坏却是有害的。因此，切不可生搬硬套，用这些图例会束缚创造性的构思，而应该用这些图例来启发构思，拓广思路，如果能不断用这些原理来分析所见的设计实例，那末必将能对现有设计作出成效较大的改进，从而把设计水平提到一个新的高度。

结构因零件等而异，故本图册列举了较多的图例；为了完整而又突出地说明某个或某些方面的合理设计原则，在内容上出现了一些交叉，但所列举的图例却并不相同；另外将钎焊结构、研磨零件与熔焊结构和切削加工零件分章编写。

本图册因系初编，限于编者学识水平，未能将国内外机械设计、制造等方面先进经验很好地、全面地总结进去，颇有挂一漏万之弊病；又图册中的图例未必能完全包括机械结构合理设计原则，个别图例说明合理设计原则未必能确切，实是不足，更难免有谬误，敬请读者批评指示是幸。

本图册承倪新炜高级工程师校阅，承刘力行同志协助整理，在此一并致谢。

李希诚 李弦泊 1994年于上海

AS 11/05

## 内 容 简 介

本图册以正、反图例对照方式，直观地说明了机械结构合理设计原理，指出了错误设计的所在；用较多的实际图例，较全面地、系统地介绍了铸造零件、锻造零件、熔焊结构、钎焊结构、装配和外观等方面的设计原则。并介绍了钎焊结构、轻合金零件、镀涂零件、研磨零件、配管、静设备和防腐结构等方面的设计原理。

本图册供从事机械设计工作的工程技术人员使用，也可供机械专业师生参考，此外尚可供计算机辅助设计(CAD)建立专家系统(ES)使用。

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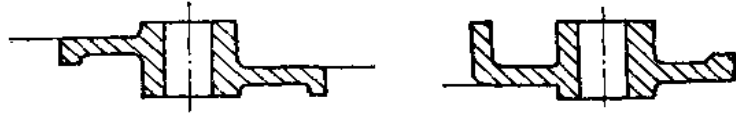
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# 1. 铸造零件

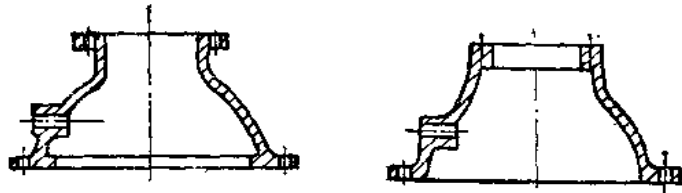
设计原则	不合理设计图例	合理设计图例
1-1 使零件形状简单,便于制模		
1-1.1 采用直线形的轮廓		
1-1.2 减少凹凸部分		
1-1.3 使木模(或芯盒)通用		
1-1.4 复杂零件采用装配结构		
1-1.5 复杂零件采用焊接结构		



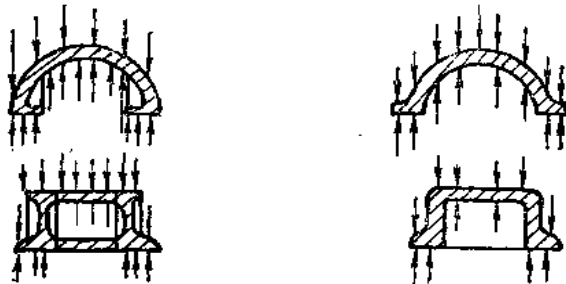
1-2 使零件形状便于造型



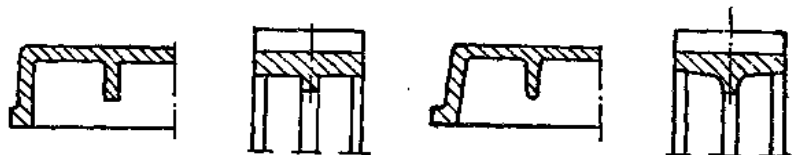
1-2.1 减少分型面的数目



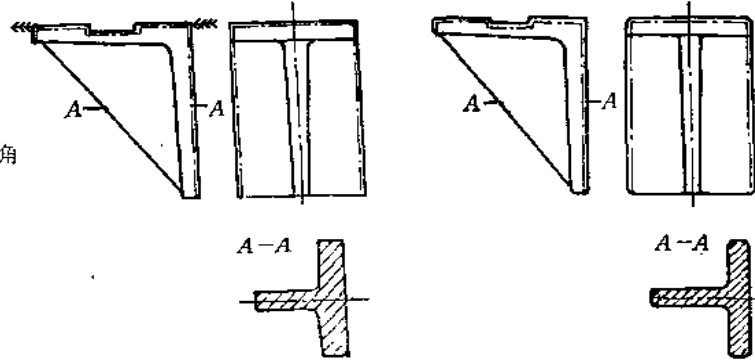
1-2.2 尽可能避免零件有内凹形



1-2.3 制出适当的起模斜度



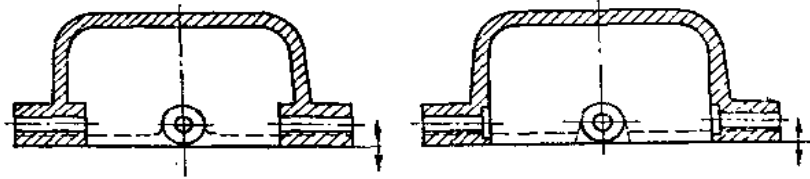
1-2.4 制出适当的圆角



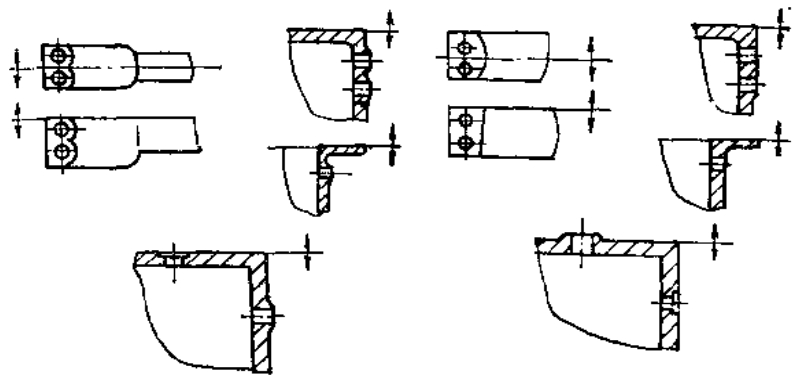
1-2.5 取消肋板,以便采用刮板造型



1-2.6 尽可能不用活块



1-2.7 尽可能减少活块数目

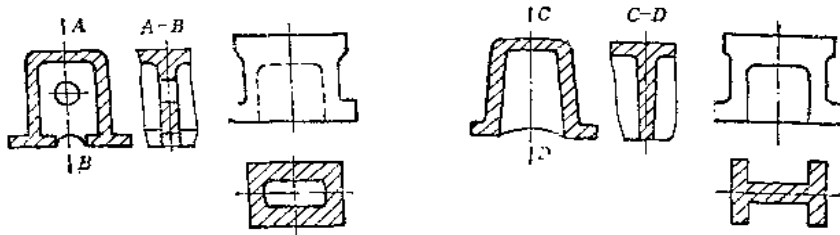


1-3 尽可能不用或少用型芯,以砂型代替型芯

1-3.1 改变内腔形状

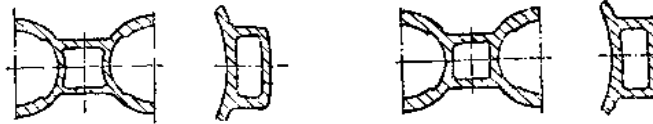


1-3.2 除去内腔

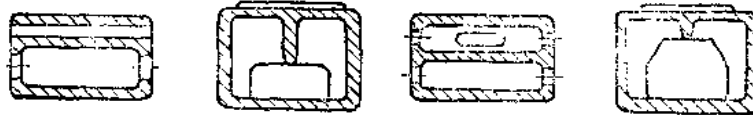


1-4 尽可能让型芯形状简单,便于支撑和安放

1-4.1 使泥芯轮廓为直线形



1-4.2 避免采用狭长的内腔和狭长的筋



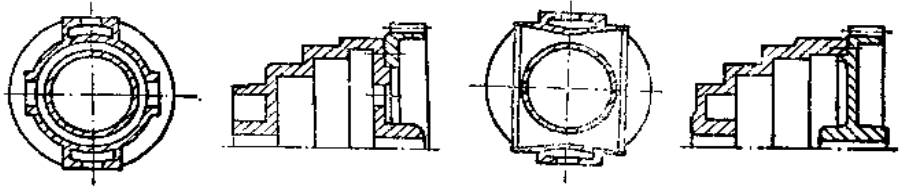
1-4.3 使复杂泥芯分成几个简单的泥芯



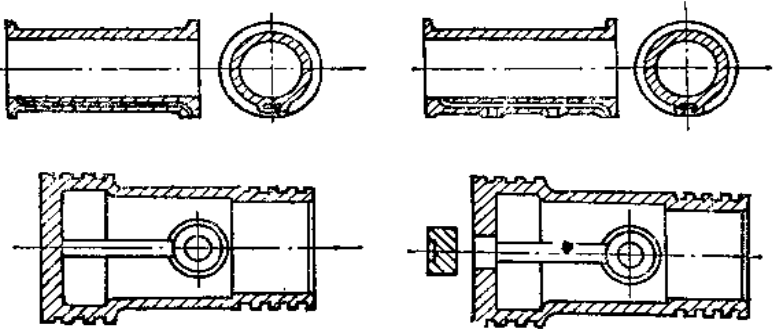
1-4.4 避免使用型芯撑



1-4.5 使型芯撑简单



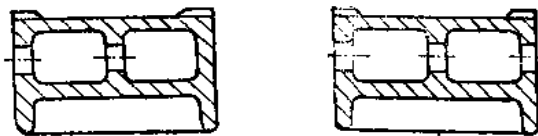
1-4.6 使型芯撑坚固



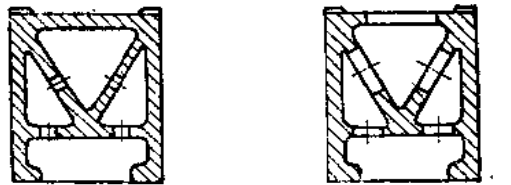
1-4.7 使型芯外形易于安放,并  
紧固在铸型内



1-4.8 将型芯加长,使之直接支  
承在砂型上,避免在液体  
容器的铸件中采用撑钉,  
防止渗漏



1-5 使清砂、铲除型芯、割除  
冒口容易



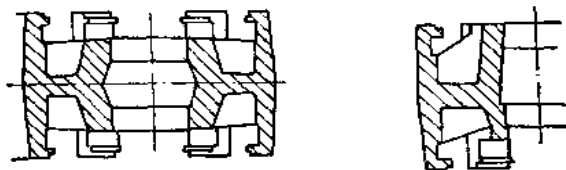
1-5.1 在确保零件刚度条件下,  
适当加大清砂窗口



1-5.2 使零件在各个方向上都暴露



1-5.3 使零件的冒口割除方便

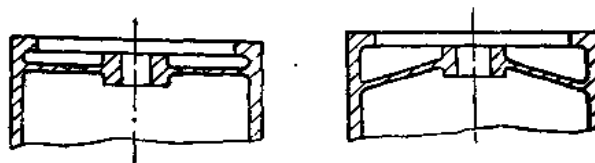


1-6 使型腔内和型芯中的气体能由上部排出, 避免零件产生气孔

1-6.1 零件上部设排气孔



1-6.2 以斜面代替平面



**1-7 保证铸料充分流至型腔的各部分，防止产生缩孔、疏松**

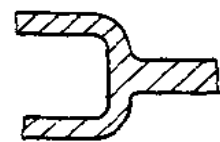
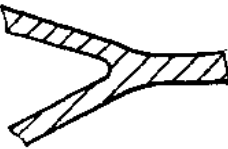
**1-7.1 将肋板错开排列**



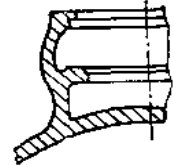
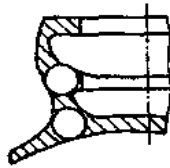
**1-7.2 避免肋壁斜向相交**



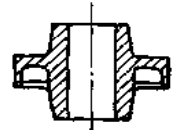
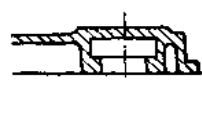
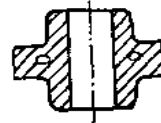
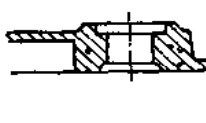
**1-7.3 分散交叉壁**



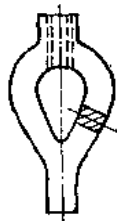
**1-7.4 使零件壁厚均匀(壁厚之比不超过1:1.5)**



**1-7.5 采用加强肋,减小壁厚**



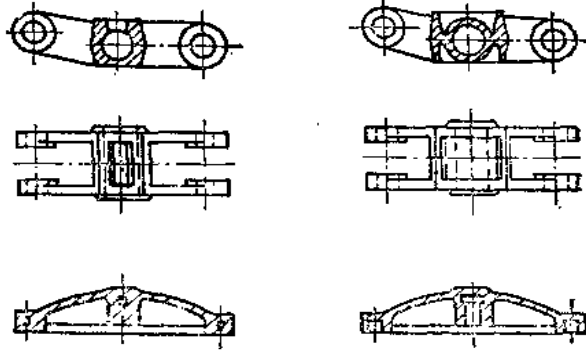
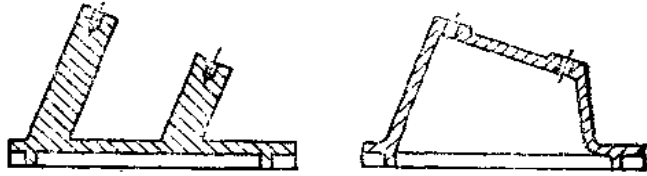
**1-7.6 用工形、T形断面代替矩形断面**



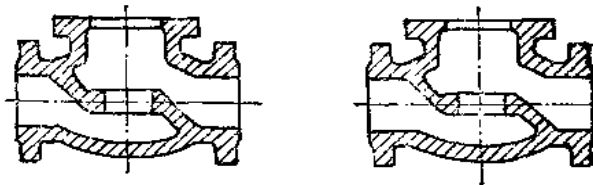
**1-7.7 使T形面汇交处开阔些**



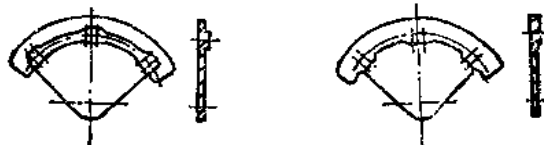
1-7.8 采用等厚度结构

1-7.9 使零件壁厚变化有利于  
顺序冷却

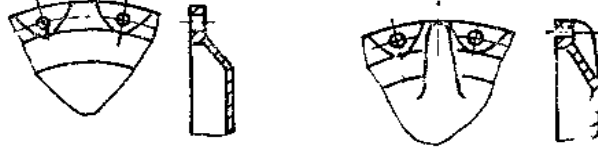
1-7.10 适当减小零件内部壁厚



1-7.11 适当加大靠近冒口的壁厚

1-7.12 分散或消除不宜用冒口  
补缩的热节

1-7.13 将热节移到非重要的部位



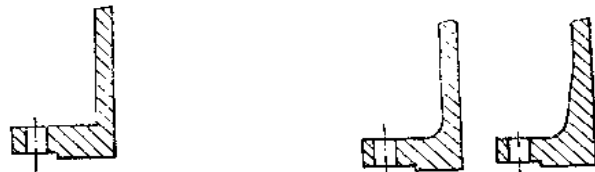
1-7.14 使零件各部分适当散开,同时凝固



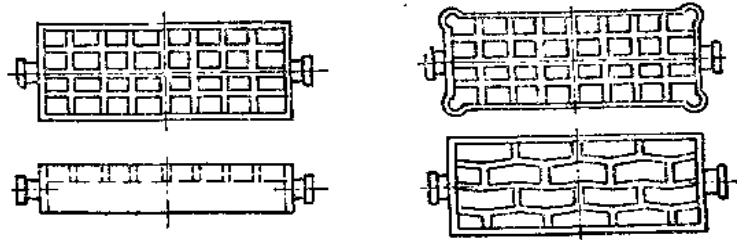
1-8 使零件均匀冷却,自由收缩,以降低铸造应力,避免产生变形和裂纹



1-8.1 使壁厚不一的连接部分平缓过渡

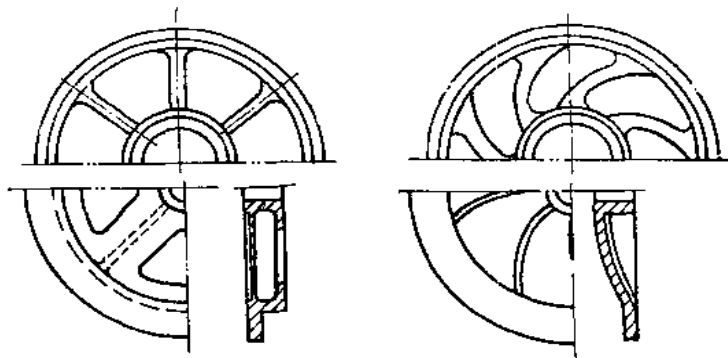


1-8.2 采用弯曲部分和拱形,避免产生热应力

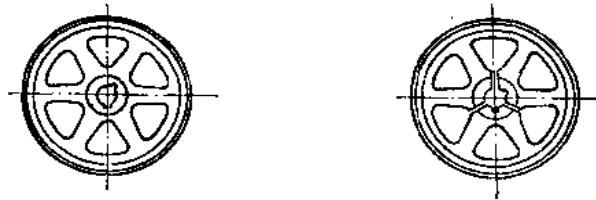




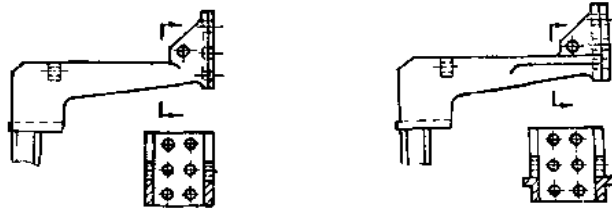
1-8.3 采用曲线轮辐



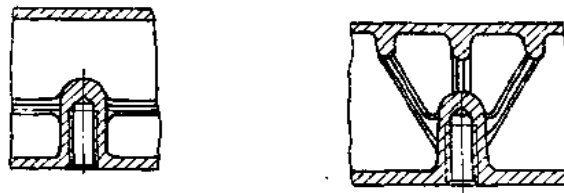
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开卸荷槽

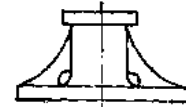
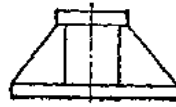
1-8.6 配置加强肋, 并加大圆角, 避免热裂



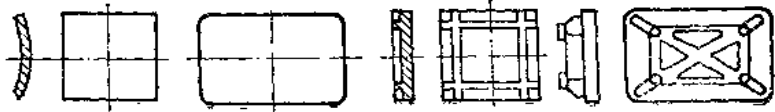
1-8.7 沿力作用方向配置加强肋



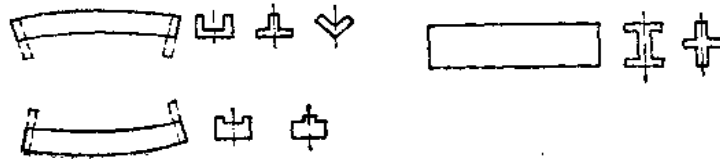
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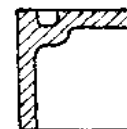
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1-8.10 采用对称的截面,防止细长零件变形

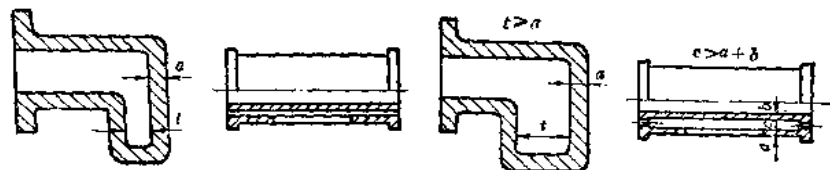


1-8.11 大的零件不可有薄的突出部分,以避免损伤



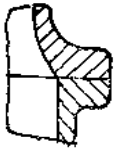

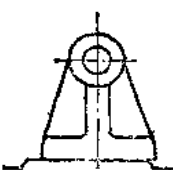
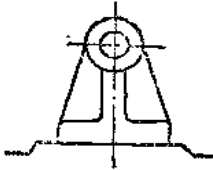
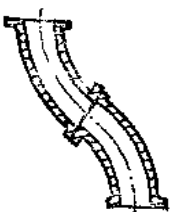
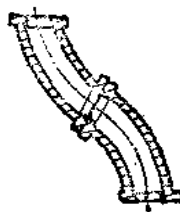
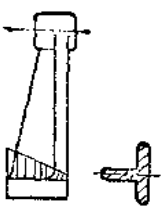
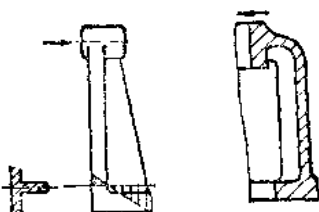
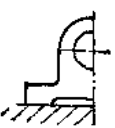

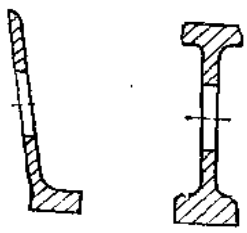
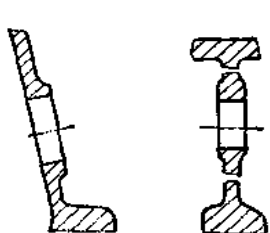
1-9 保证砂型、型芯有足够的强度,防止粘砂、烧结

1-9.1 避免狭小的内腔



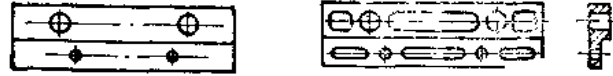
1-9.2 避免太小太深的孔



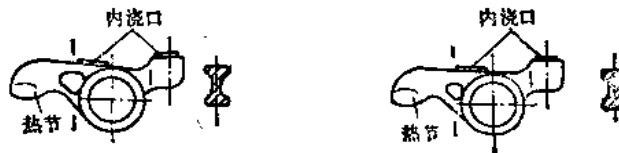
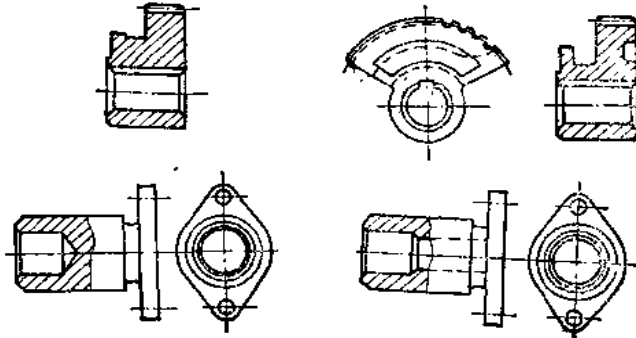
设计原则	不合理设计图例	合理设计图例
<p>1-10 防止铸造偏差引起的缺陷</p>		
<p>1-10.1 凸缘应有与配合面垂直的表面,以便配合</p>		
<p>1-10.2 加宽机座凸台</p>		
<p>1-10.3 使弯头两端内孔成锥形</p>		
<p>1-11 提高零件的强度</p>		
<p>1-11.1 充分利用铸铁的高抗压强度</p>		
<p>1-11.2 避免形成危险的断面</p>		
<p>1-11.3 加强薄壁零件的孔边, 做出凸台</p>		

设计原则	不合理设计图例	合理设计图例
1-11.4 适当布置肋板, 提高零件刚度		
1-12 使硬型铸造的零件能自由收缩, 避免产生热应力		
1-13 使铸造的壳形零件垂直壁不高, 比较平坦		
1-14 使压铸的零件形状更圆浑		
1-15 使镶嵌零件距工作面近些, 避免产生裂纹		
1-16 充分利用熔模铸造可铸出复杂零件的特点, 改组合结构为整体结构, 以减少加工和装配		

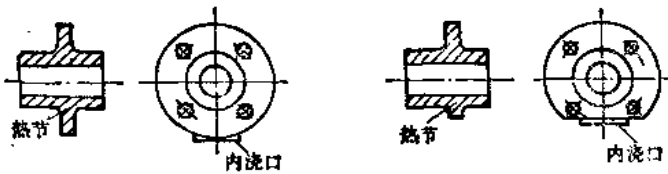
1-17 开工艺孔，使熔模铸造零件壁厚均匀



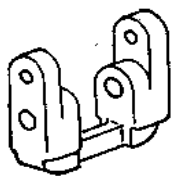
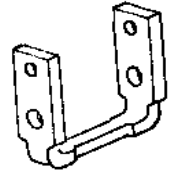
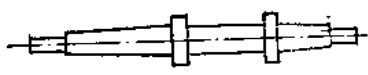

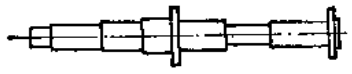
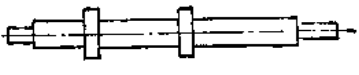
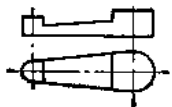
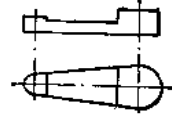
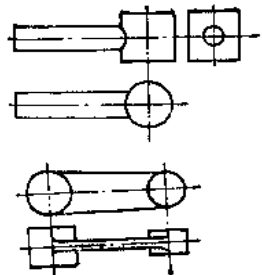
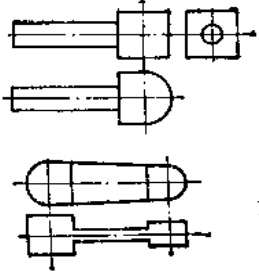
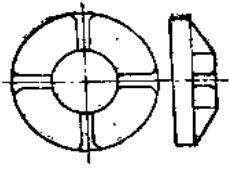
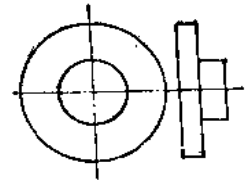
1-18 尽可能减少熔模铸造零件的热节，使其壁厚均匀

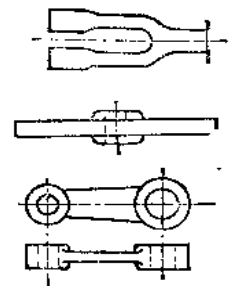
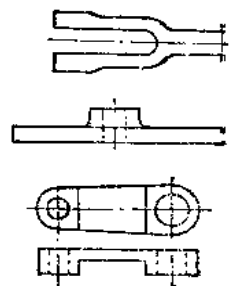
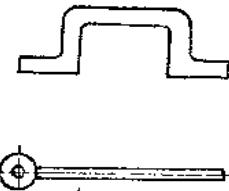
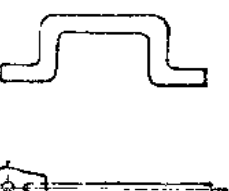
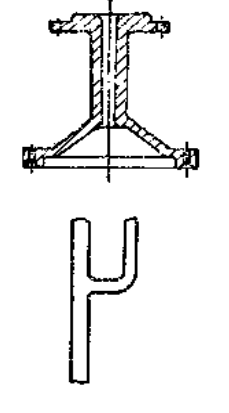
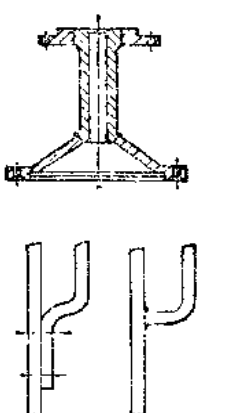
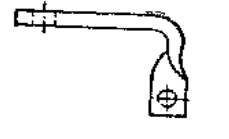
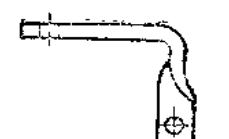
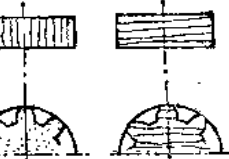
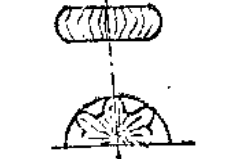


1-19 保证熔模铸造零件顺序凝固



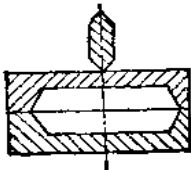
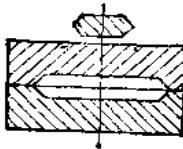

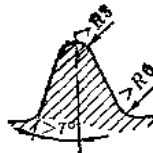


## 2. 锻造零件

设计原则	不合理设计图例	合理设计图例
<p><b>2-1</b> 用锻造零件代替铸造零件</p>		
<p><b>2-2</b> 使零件形状简单</p>		
<p><b>2-2.1</b> 避免锥形</p>		
<p><b>2-2.2</b> 减少零件断面的变化</p>		
<p><b>2-2.3</b> 避免楔形</p>		
<p><b>2-2.4</b> 避免圆柱形表面与圆柱形表面或棱柱形表面交接</p>		
<p><b>2-2.5</b> 避免有加强肋</p>		

设计原则	不合理设计图例	合理设计图例
2-2.6 尽可能将凸台设置至零件的外侧或一侧		
2-2.7 不可使零件有尖的边角		
2-3 整体锻造困难的零件采用组合结构		
2-4 使扭转成90°的锻件有足够的过渡长度		
2-5 重要的齿轮采用锻造毛坯,不可采用热轧钢材制造毛坯		

设计原则	不合理设计图例	合理设计图例
2-6 重要的轴类零件采用伸锻外形		
2-7 使零件各部分流线分布均匀		
2-8 尽可能用一个热模锻零件代替两个形状互为对称的热模锻零件		
2-9 避免零件中间凹入和尾部成锥形		
2-10 避免锻件轴向孔直径变化		
2-11 使分模面与模腔壁面垂直,减小错模影响		
2-12 使分模面为平面,便于锻造		

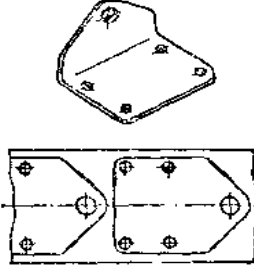
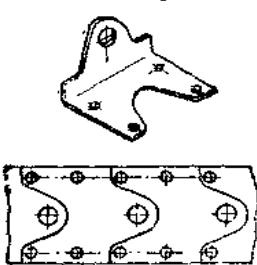



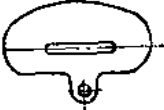

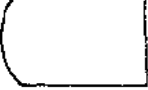
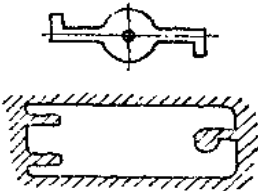
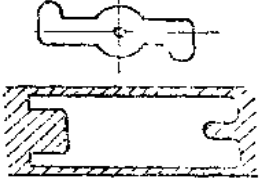
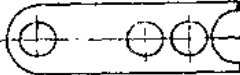
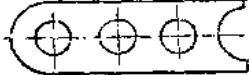




设计原则	不合理设计图例	合理设计图例
<p>2-13 将分模面设在模腔深度最浅、宽度最大的平面上，使金属易于充满模腔</p>		
<p>2-14 锻造齿轮的齿形不可尖细</p>		
<p>2-15 使零件各部分断面的变化平缓</p>		

### 3. 冷挤压零件

设计原则	不合理设计图例	合理设计图例
3-1 使金属易于流动,零件断面平缓变化		
3-2 零件上不得有尖角		
3-3 零件上不得有深孔		
3-4 零件在其垂直于挤压的方向上不得有凹入或凸出部分		
3-5 零件不得有内、外锥面		
3-6 使零件形状对称		
3-7 零件的连皮(内隔板)厚度不小于壁厚		

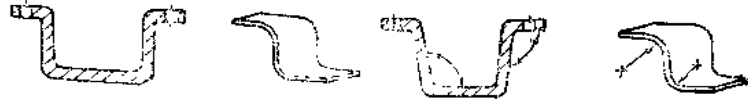
## 4. 冷冲压零件

设计原则	不合理设计图例	合理设计图例
<p>4-1 尽可能使零件外形在板上紧密排列</p>		
<p>4-2 使零件便于冲制</p>		
<p>4-2.1 使零件轮廓为圆弧形, 避免细长尖角</p>		
<p>4-2.2 避免圆弧形周边与过渡部分相切</p>		
<p>4-2.3 避免有长的悬臂和深的开口</p>		
<p>4-2.4 使孔壁间距, 孔壁至零件边缘的距离大于板厚</p>		
<p>4-2.5 使孔在零件平直部分, 不得在圆角部分</p>		

4-2.6 使冲制的孔远离底边



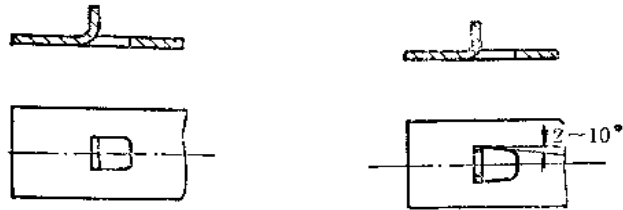
4-2.7 按照材料的弹性变形, 确定零件的形状



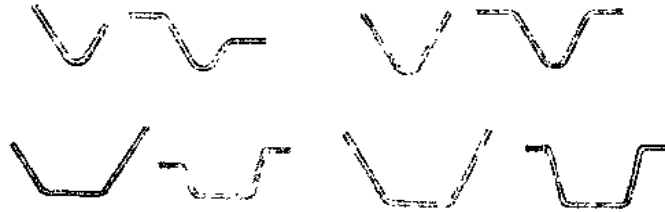
4-2.8 弯折处采用较大的圆角



4-2.9 局部切口带压弯舌部的零件宜有斜度, 以便于退模



4-2.10 尽可能使零件形状对称

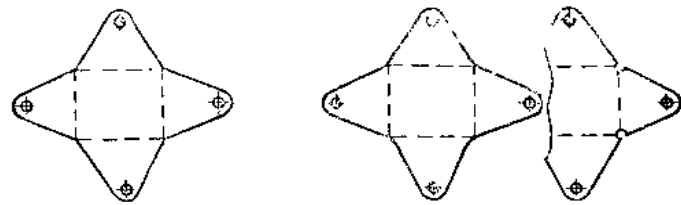


4-2.11 尽可能使零件形状简单



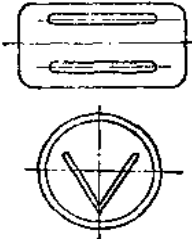
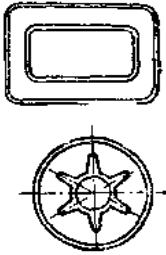
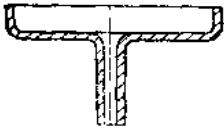
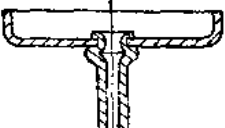


4-3 保证零件强度

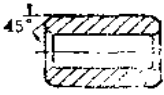
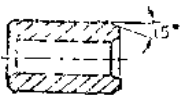
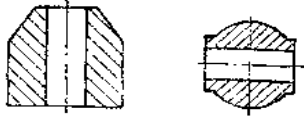
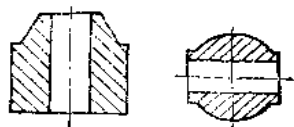
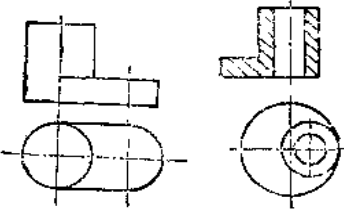
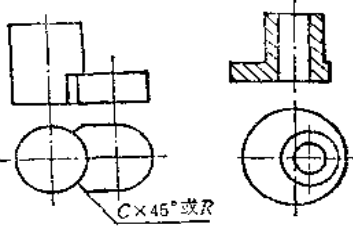
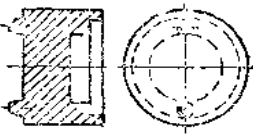
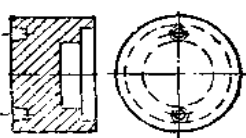
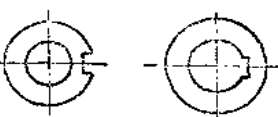
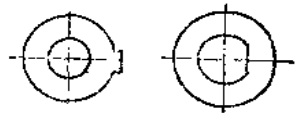
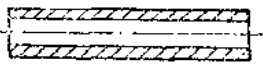
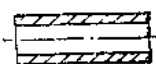
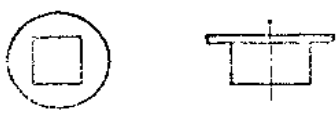
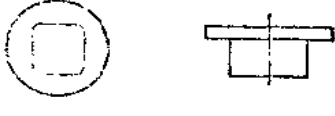
4-3.1 避免座板沿两个方向弯折, 产生裂纹, 转角处应有圆弧过渡



设计原则	不合理设计图例	合理设计图例
<p>4-3.2 避免在槽与弯折处形成危险断面</p>		
<p>4-3.3 避免撕裂,在局部弯曲交接处切槽或将弯曲线移出一段距离</p>		
<p>4-4 防止零件变形</p>		
<p>4-4.1 避免弯曲处附近的孔变形,在零件上应须冲出月牙槽或圆孔</p>		
<p>4-4.2 宽度要求严格的窄料进行小半径弯曲时,在弯曲处切口,应避免弯曲处变宽</p>		
<p>4-5 保证零件的刚度</p>		
<p>4-5.1 保证薄板的刚度,两侧加撑板</p>		
<p>4-5.2 弯曲件的两侧支承边应在弯曲时翘出短边,保证弯曲后同轴线和零件的刚度</p>		

设计原则	不合理设计图例	合理设计图例
<p><b>4-5.3</b> 在弯曲部分冲压出加强肋,提高刚度</p>		
<p><b>4-5.4</b> 使肋的形状与零件外形相近或对称</p>		
<p><b>4-6</b> 采用组合结构,减小零件的延伸深度</p>		

## 5. 粉末冶金零件

设计原则	不合理设计图例	合理设计图例
<b>5-1 保证压坯和模具强度</b>		
<b>5-1.1 零件采用45°倒角</b>		
<b>5-1.2 零件倒角及圆角留一平台或圆柱面</b>		
<b>5-1.3 避免零件有相切的部分</b>		
<b>5-1.4 将模具尖凸部分移到相配的零件上</b>		
<b>5-1.5 改键槽为凸键、平面结构</b>		
<b>5-1.6 避免零件细长</b>		
<b>5-2 防止零件受压变形</b>		
<b>5-2.1 避免壁厚过薄,方孔尖角</b>		

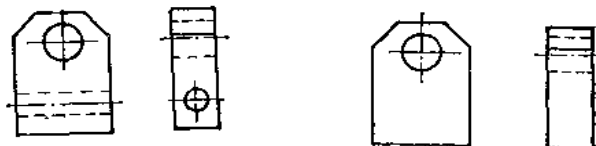
设计原则	不合理设计图例	合理设计图例
5-2.2 使阶差不大于直径的1/16		
5-2.3 使法兰直径不超过轴套直径的1.5倍		
E-3 使成形及出模容易		
5-3.1 不可将齿轮的齿根圆与轮毂重合		
5-3.2 不可使凸缘端内孔为盲孔		
5-3.3 改横刃退刀槽为纵向退刀槽		
5-3.4 避免零件有深窄的凹槽或尖锐的轮廓		
5-3.5 避免滚压花纹采用菱形花纹		
5-3.6 保证零件凹凸部为锥形，凸高或凹深不大于零件总高的1/5		



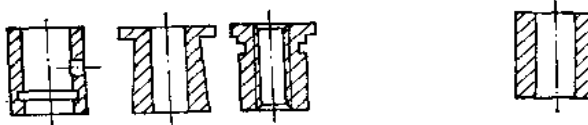
**5-3.7** 使零件压制方向的部分平直



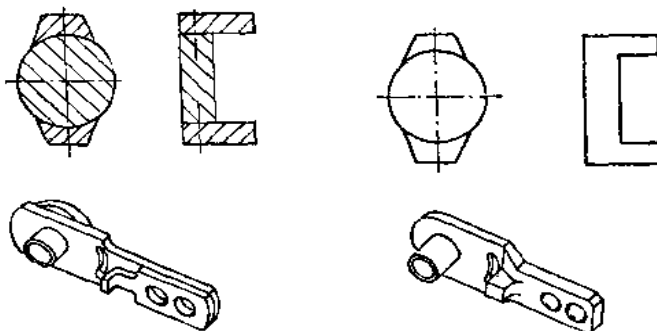
**5-3.8** 不可有与压制方向相垂直的孔和槽



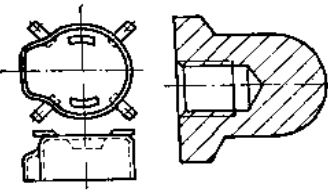
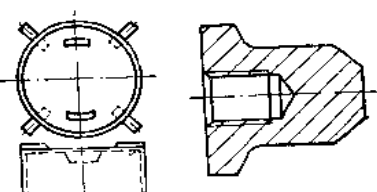
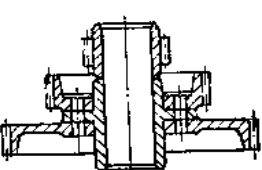
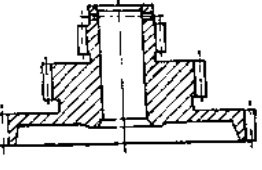
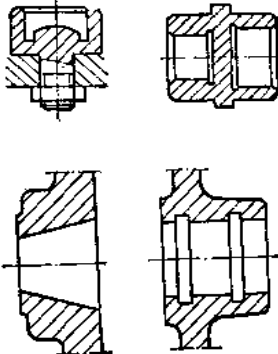
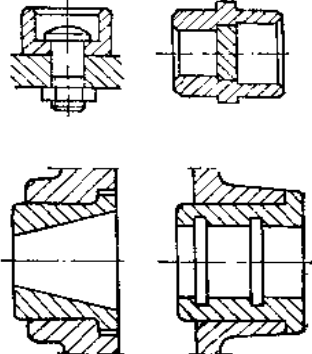
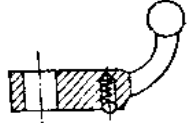
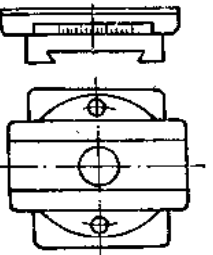
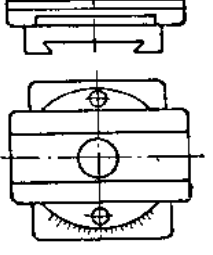
**5-3.9** 不可使零件有径向凹槽、螺纹和倒锥度等

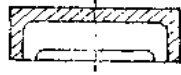
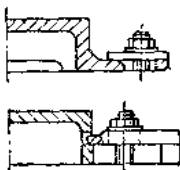
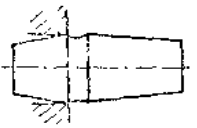
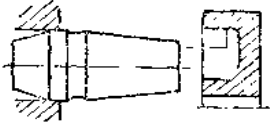
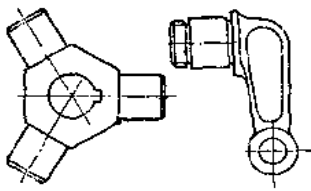
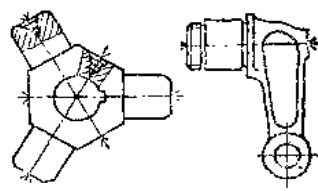
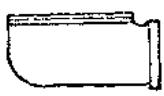
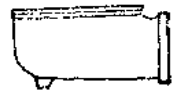
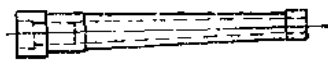
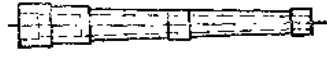
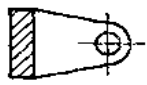
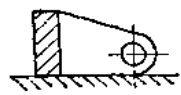
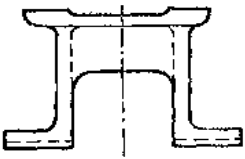
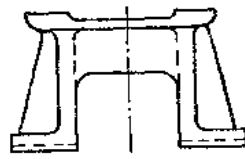


**5-4** 使需要装配的零件一次压制成形

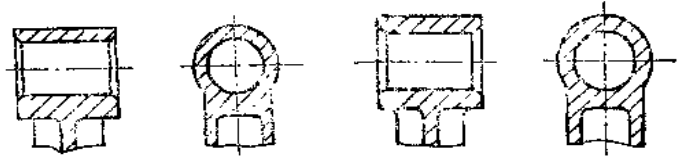


## 6. 切削加工零件

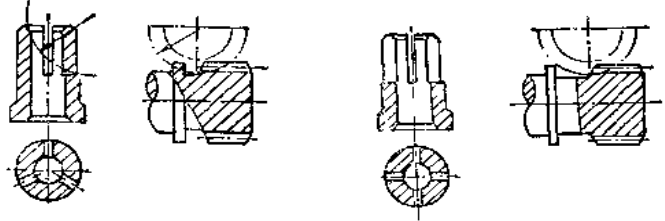
设计原则	不合理设计图例	合理设计图例
<p><b>6-1</b> 尽可能使零件形状简单，以便切削加工</p>		
<p><b>6-2</b> 将几个形状简单的零件合并成一个形状较为复杂、但切削加工较为容易的零件</p>		
<p><b>6-3</b> 将形状复杂、切削加工困难的零件改成组合结构</p>		
<p><b>6-4</b> 简化切削工艺</p>	<p><b>6-4.1</b> 用少、无切削加工的零件代替切削加工零件</p>	
<p><b>6-4.2</b> 用平面刻度代替圆柱面刻度</p>		

设计原则	不合理设计图例	合理设计图例
<b>6-5</b> 使零件便于切削加工时 装夹		
<b>6-5.1</b> 增设夹紧边缘或夹紧孔		
<b>6-5.2</b> 在零件上设置平直的、充 分宽的夹紧带		
<b>6-5.3</b> 为磨削外表面增设中心孔		
<b>6-5.4</b> 外形不规则的零件,应设 置工艺凸台		
<b>6-6</b> 保证零件切削加工时有 必要的刚度		
<b>6-6.1</b> 在细长零件上增设可用 托架支承的轴颈		
<b>6-6.2</b> 使吊耳稳固地支承在平 面上		
<b>6-6.3</b> 增设必要的加强肋		

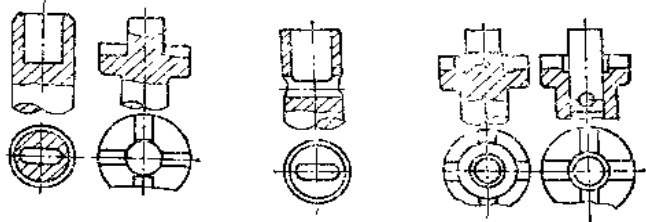
6-7 使零件切削加工部分具有相等的厚度



6-8 使刀具易于进入切削加工面，而不损坏其他部分



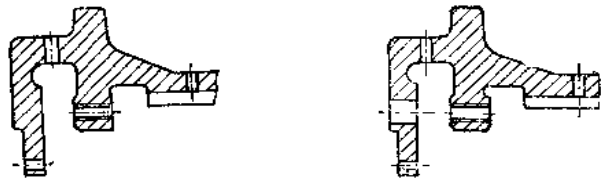
6-8.1 给出退刀的空间或采用组合结构



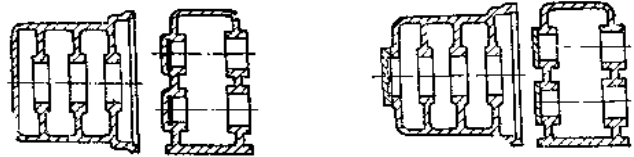
6-8.2 采用大直径圆齿铣刀铣削



6-8.3 设置工艺孔



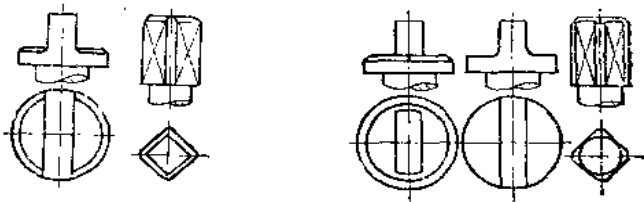
6-8.4 使键杆支承在箱体外面



6-8.5 使切削加工面在切削圆内



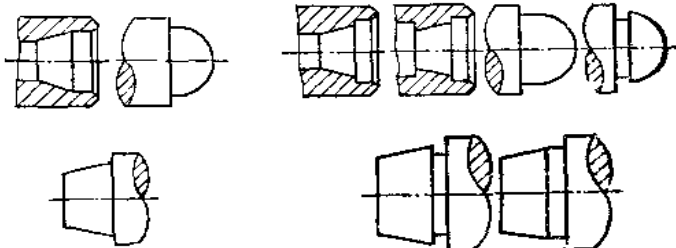
6-8.6 不宜有非圆端倒棱



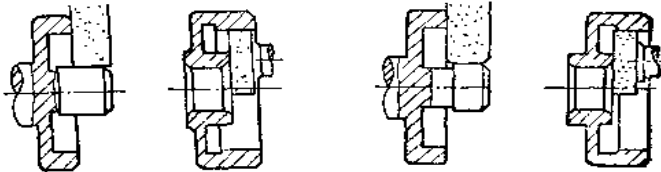
6-8.7 留出内孔切削的退刀槽



6-8.8 留出锥面及球面切削的退刀槽



6-8.9 留出外圆及内孔磨削退刀槽



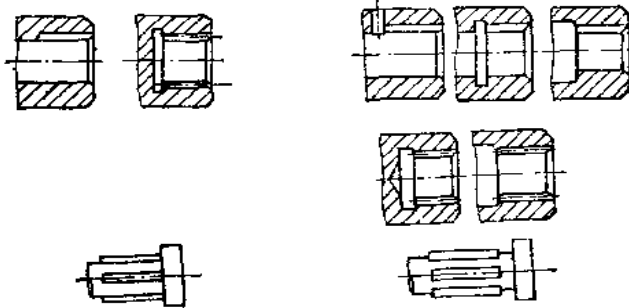
6-8.10 留出凸缘磨削退刀槽



6-8.11 留出槽侧面与弧面磨削退刀槽

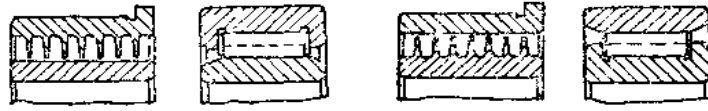


6-8.12 留出键槽与花键槽、花键切削退刀槽

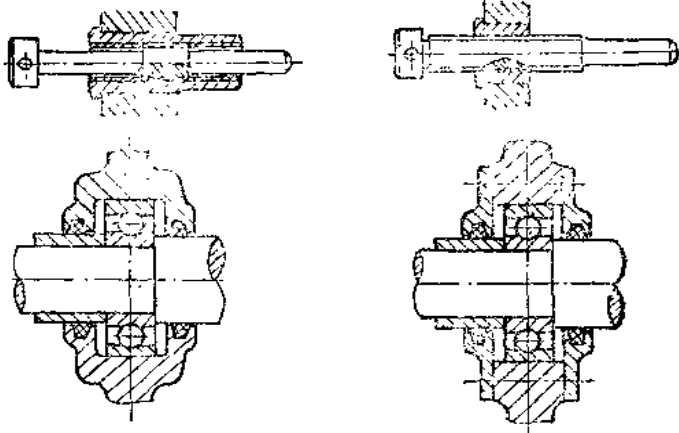


设计原则	不合理设计图例	合理设计图例
6-8.13 留出双联齿轮滚(插)齿退刀槽		
8-8.14 保证铣削加工足够的退刀长度		
6-9 使零件便于切削加工	6-9.1 避免切削加工面在低凹处	
6-9.2 避免切削加工面处有凸台		
6-9.3 以外表面切削加工代替内表面切削加工		
6-9.4 将螺纹外移或采用组合结构		
6-9.5 采用垫块,避免在盲孔内切削加工球底面		

6-9.6 将肋、槽沟和长的螺纹设置在零件的外露部分



6-9.7 避免外小内大的孔



6-9.8 使孔能直通切削加工

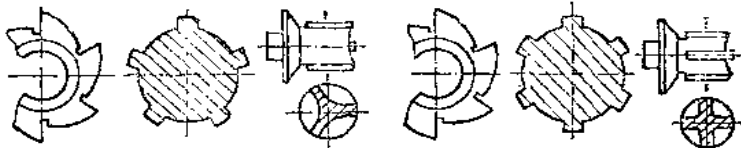


6-10 使零件尺寸测量方便

6-10.1 给出测量环带和平面



6-10.2 尽可能避免采用奇数齿、奇数肋

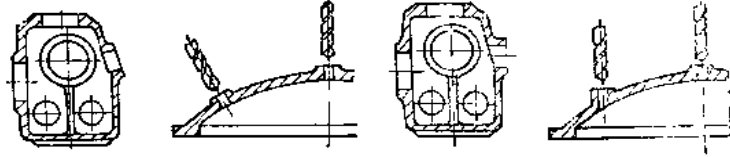


6-10.3 增设便于测量的工艺凸台

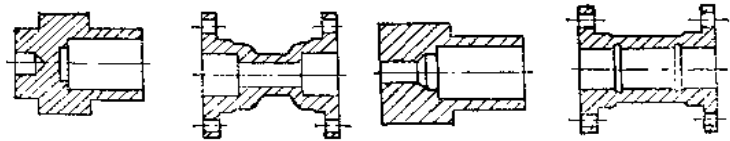


6-11 减少工件装夹次数

6-11.1 尽可能避免倾斜的切削加工面

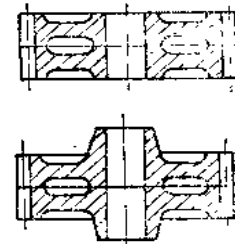


6-11.2 使孔经过一次装夹就能完成切削加工



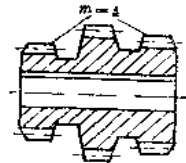
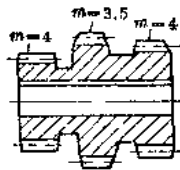
6-12 提高切削加工效率

6-12.1 使零件形状适应切削加工方法

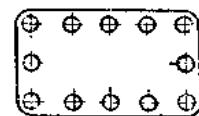


6-12.2 尽可能使尺寸差别不大的结构要素的尺寸相同,例如:

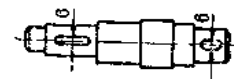
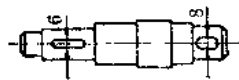
使齿轮模数相同



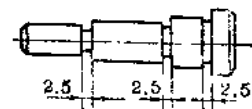
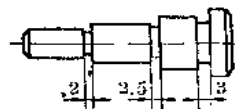
使孔径相同,孔距相等



使键槽宽度相同



使退刀槽宽度相同

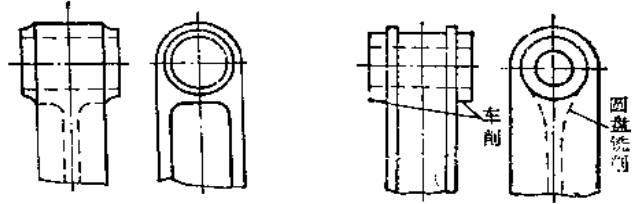




设计原则	不合理设计图例	合理设计图例
<b>6-12.3</b> 使在多刀车床切削加工 的零件各切削加工段的 长度相等或接近行程 $L$ 的整数倍		
<b>6-12.4</b> 使零件的孔径和轴径向 同一方向顺序递减		
<b>6-12.5</b> 减少刀具切削时的空程, 使零件排列成行连续切 削加工		
<b>6-12.6</b> 使在相同的有效行程 $X$ 内能切削加工更多的零 件(链轮)		
<b>6-13</b> 减少走刀次数		
<b>6-13.1</b> 使零件能排列成行连续 切削加工		
<b>6-13.2</b> 减少刀具调整次数, 使 零件锥度相同		
<b>6-13.3</b> 使零件切削加工的表面 在同一平面上		

6-14 采用高效的切削加工方法

6-14.1 采用圆盘铣刀铣削连杆头及连杆叉头



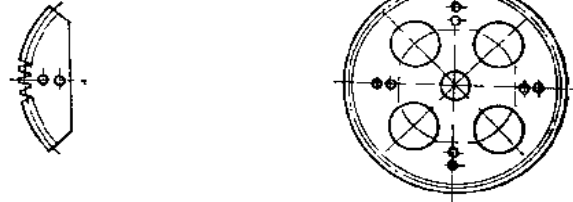
6-14.2 以车削代替铣削



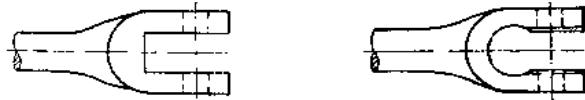
6-14.3 改平面切削加工为回转面切削加工



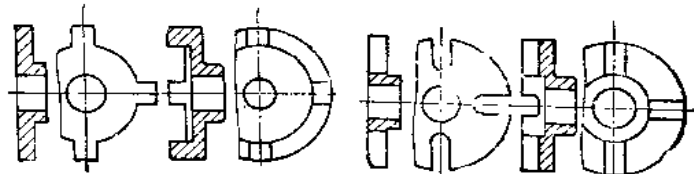
6-14.4 以滚齿代替铣齿，齿块宜从整个齿轮上切取



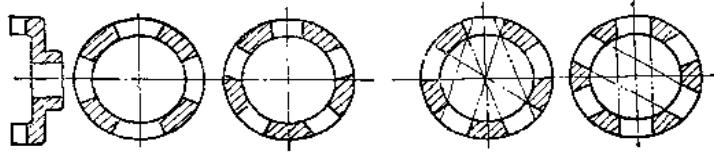
6-14.5 单件加工叉槽可采用钻削的方法，先钻出槽底



6-14.6 改零件的凸爪为凹槽，采用车削



6-14.7 使槽能直通切削加工

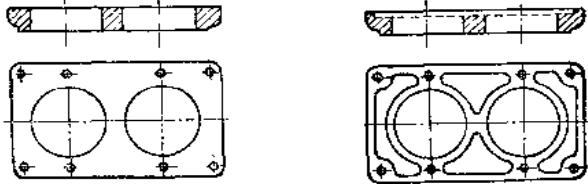


6-14.8 保证能快速钻削零件，留有较大的空间

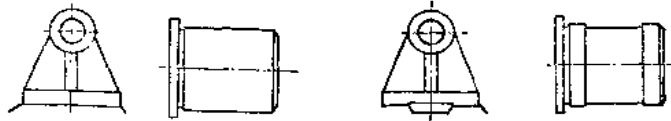


6-15 减少切削加工面数目和切削加工面积

6-15.1 减小磨削面积



6-15.2 缩小切削加工面的尺寸



6-15.3 减小轮辋侧面车光面积，使用钩头车刀直接切削

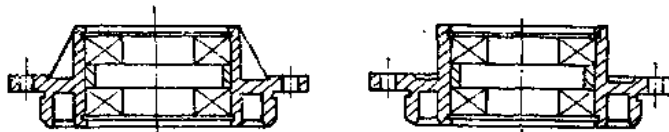


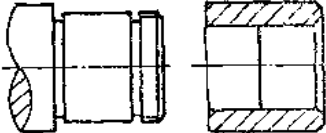
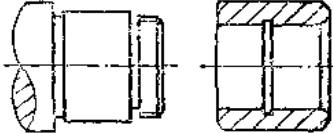
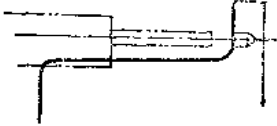
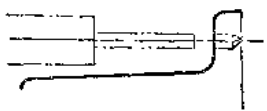
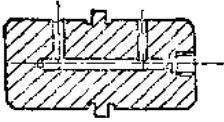
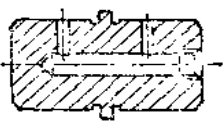
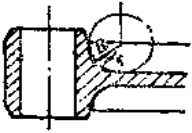
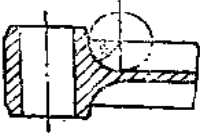
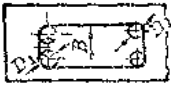
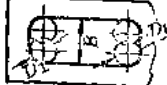
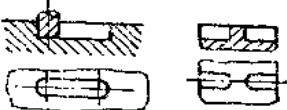
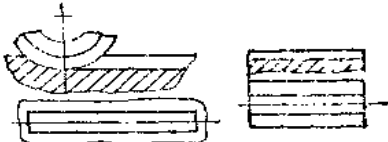
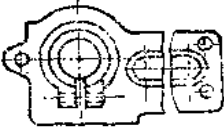
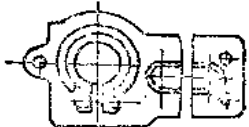
6-15.4 不可使钻孔过深，尽可能使孔深≤50毫米



6-16 提高零件的切削加工精度

6-16.1 使零件一次装夹，直通切削加工，保证同轴度



设计原则	不合理设计图例	合理设计图例
6-13.2 将不同精度要求的各表面分开(开槽或改变孔径)		
6-17 避免使用特殊的刀具		
6-17.1 避免使用加长的钻头		
6-17.2 避免钻细长孔		
6-17.3 尽可能使零件切削加工面与刀具外形相同		
6-17.4 使圆柱面槽的宽度、圆角半径与刀具尺寸相适应		
6-17.5 尽可能采用直通的槽		
6-17.6 避免进刀方向上有前小后大的孔		

## 6-18 改善刀具的工作条件

## 6-18.1 使钻头有良好的导向



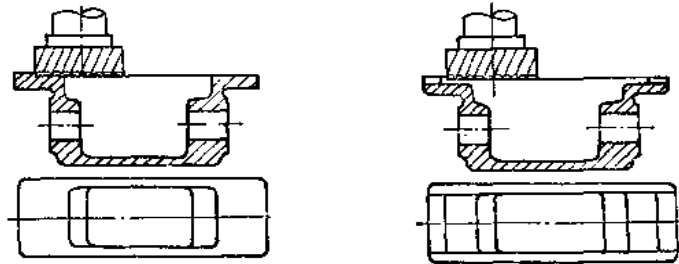
## 6-18.2 采用较大直径的铣刀



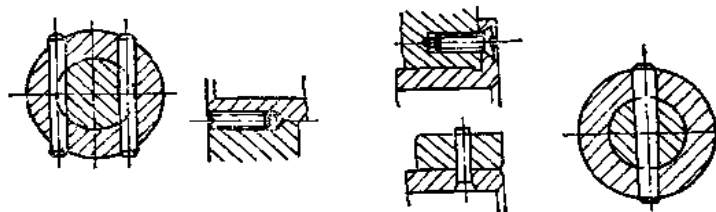
## 6-18.3 用倒斜角代替倒圆角



## 6-18.4 使零件的刃削加工面有相同的宽度



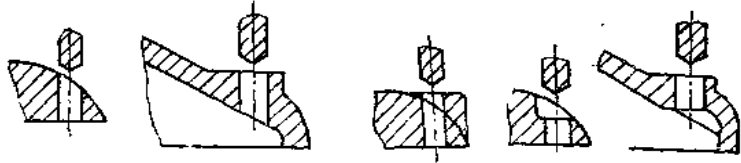
## 6-18.5 不可使硬度不同的材料在周向配钻



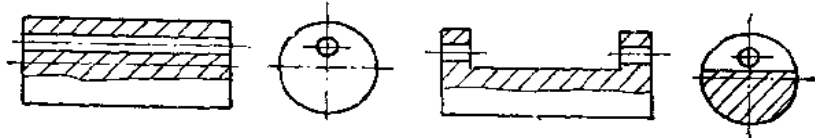
## 6-18.6 倾斜钻孔的倾斜角不得小于60°



6-18.7 避免钻头沿铸造硬皮或  
只是单边钻削



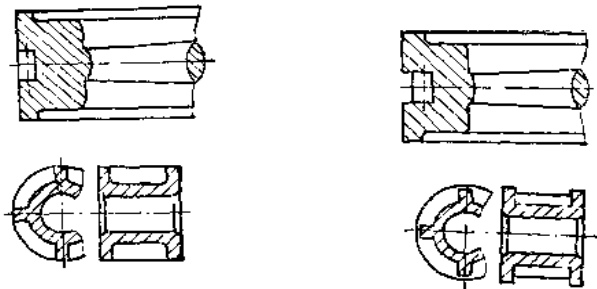
6-18.8 避免钻深孔



6-18.9 在法兰盖上铸出一半圆  
槽,避免铣刀损坏



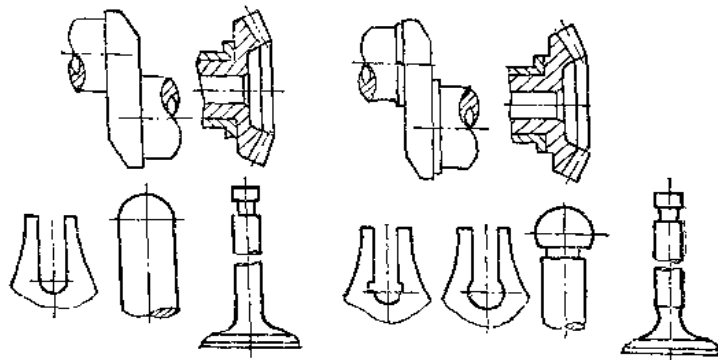
6-18.10 使不切削加工的齿圈  
肋低于切削加工面



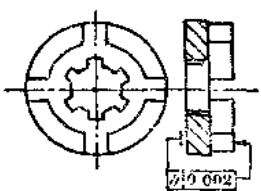
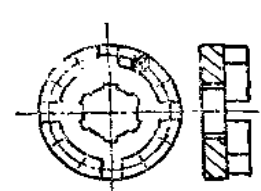
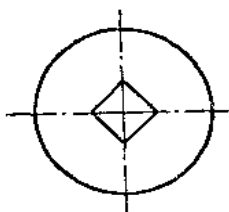
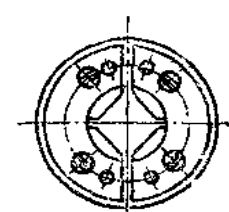
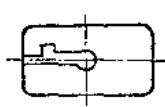

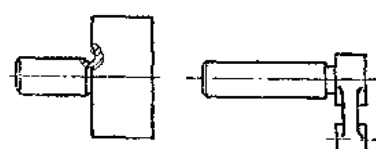
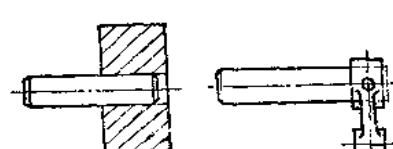
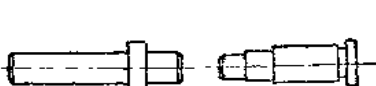
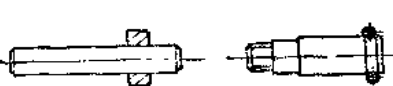
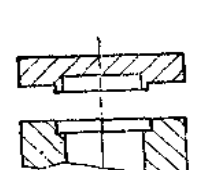
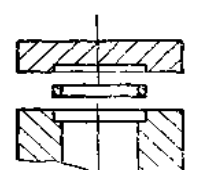
6-18.11 不应使切削加工面与  
非切削加工面平齐

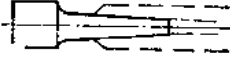

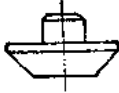
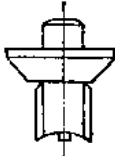


6-18.12 使零件的切削加工面  
与非切削加工面截然  
分开



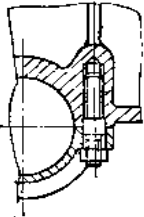
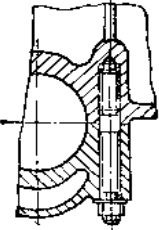
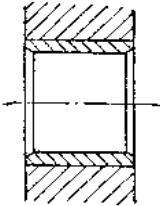
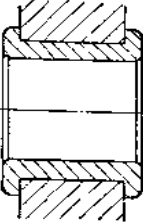
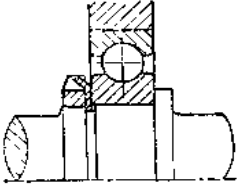
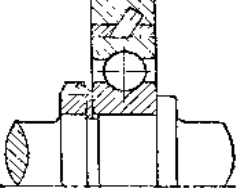
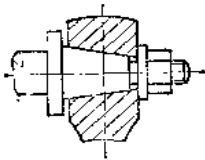
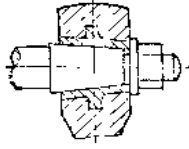
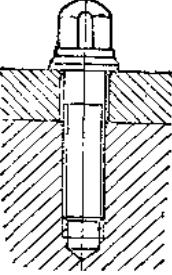
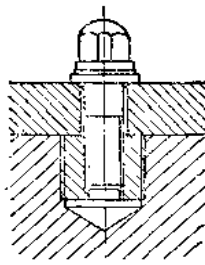
## 7. 研磨零件

设计原则	不合理设计图例	合理设计图例
7-1 采用组合结构代替整体结构		
7-1.1 保证槽底与盘底的平行度		
7-1.2 使方孔能上磨床预磨削，方孔角上开缝便于用直尺研磨		
7-1.3 使卡规窄缝能研磨		
7-1.4 使端面及轴颈研磨方便		
7-1.5 使轴颈可用无心磨床预磨削		
7-1.6 使研磨和修换垫圈方便		

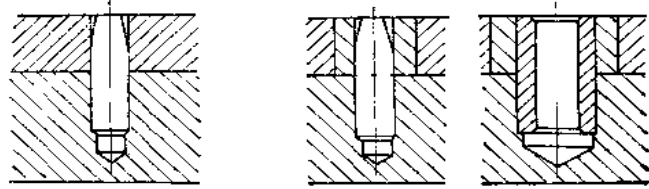
设计原则	不合理设计图例	合理设计图例
7-2 采用圆柱形研磨杆,以便机械研磨		
7-3 使阀瓣有导向肋,便于研磨并使密封可靠		



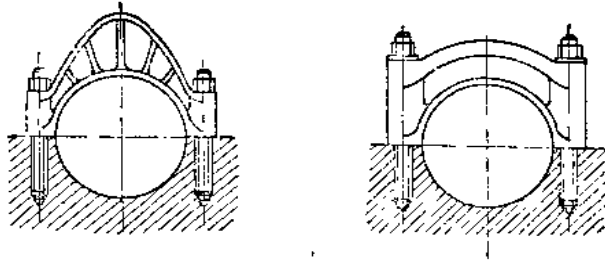
## 8. 轻合金零件

设计原则	不合理设计图例	合理设计图例
<b>C-1</b> 提高零件刚度		
<b>8-1.1</b> 加固轴承盖		
<b>8-1.2</b> 衬套加凸台		
<b>8-2</b> 降低接触表面应力		
<b>8-2.1</b> 在轻合金机座中装配滚动轴承, 镶钢套(或青铜套), 并用销钉固定		
<b>8-2.2</b> 在轻合金零件锥孔内镶入带凸台的衬套		
<b>8-2.3</b> 在轻合金零件中镶入钢套(或者铜套), 避免拧紧螺钉时损伤螺纹		

8-2.4 用钢套或青铜套加强定位销孔



8-3 零件的精密孔, 必须用同一种材料制造, 不可上盖是钢, 下底是铝合金



8-4 避免零件受拉伸、受弯曲

8-4.1 使镁合金零件承受压应力



8-4.2 使螺孔轴线与壁的中心线一致, 避免产生弯曲



8-5 防止应力集中产生裂纹

8-5.1 加强螺栓凸台



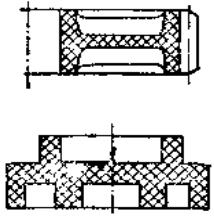
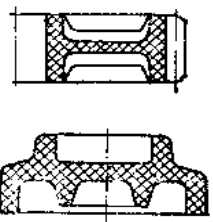
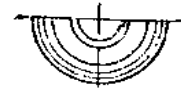

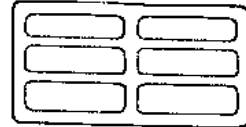
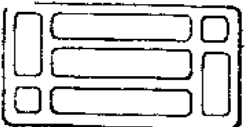




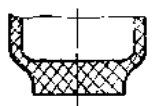
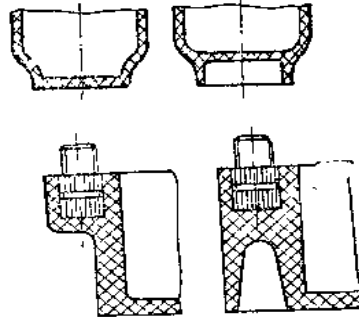
8-5.2 螺栓下加球形垫



8-5.3 稀疏配置小直径螺栓



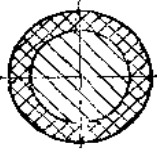
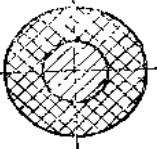
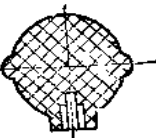

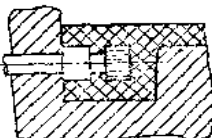

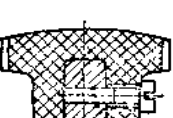



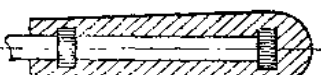

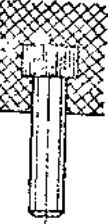
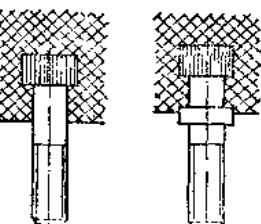
## 9. 工程塑料零件



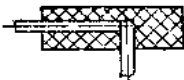


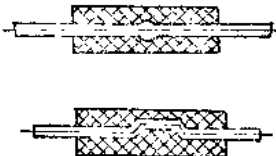


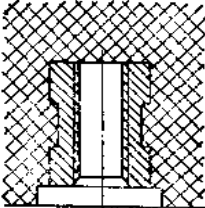
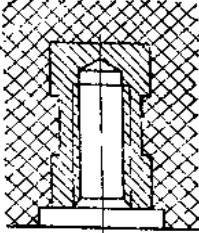
设计原则	不合理设计图例	合理设计图例
<p><b>9-1</b> 使零件易成形，避免锐角、锐棱和过高的肋</p>		
<p><b>9-2</b> 防止零件变形、开裂</p> <p><b>9-2.1</b> 防止收缩不均匀引起的破裂,全塑齿轮与轴采用花键或半圆键联接</p>		
<p><b>9-2.2</b> 使加强肋错开排列</p>		
<p><b>9-2.3</b> 避免零件边缘过厚、过薄</p>		
<p><b>9-2.4</b> 保持零件凸边连续</p>		
<p><b>9-2.5</b> 尽可能使零件各部分厚度均匀</p>		

设计原则	不合理设计图例	合理设计图例
9-2.6 过高的零件应设置加强肋,以减小壁厚		
9-2.7 大型零件直壁应设置凸缘		
9-2.8 大型零件的口边应设置翻边		
9-2.9 紧固件用孔,不宜靠近零件边缘		
9-2.10 凸台宜设置在刚性较好的、与较多面连接的或转角的部位		
9-2.11 避免采用沉头螺钉,以防侧向力使边缘崩裂		
9-2.12 零件上穿长螺栓的孔,须制在实体之中		
9-2.13 凸台高度不应超过直径的2倍		

设计原则	不合理设计图例	合理设计图例
9-2.14 零件上的内螺纹始端应无螺纹		
9-2.15 为提高螺纹联接强度，宜采用圆弧形螺纹		
9-3 适合使用要求		
9-3.1 用于装配的凸台不宜多于三个		
9-3.2 采用凹曲面底或设置凸缘的底		
9-3.3 采用加强肋增强支承面		
9-4 制模简化及成形方便		
9-4.1 零件脱模方向的表面须有脱模斜度(15'~1°)		

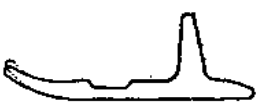

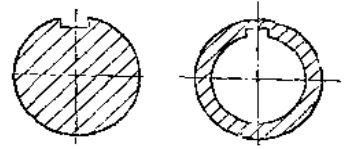
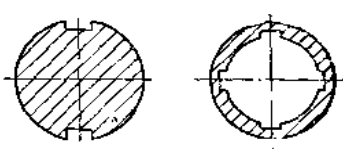
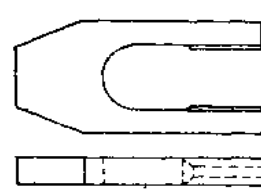
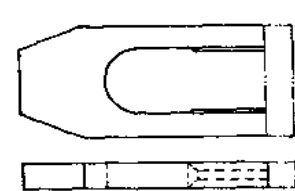
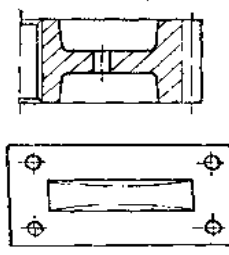
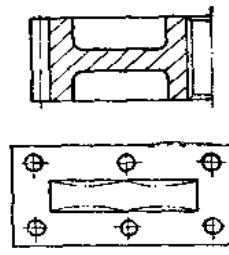
设计原则	不合理设计图例	合理设计图例
9-4.2 避免孔的两端带有圆角		
9-4.3 若不影响使用,用槽代替零件上的侧孔		
9-4.4 若不影响使用,将侧孔设计成上、下抽芯		
9-4.5 避免零件内凹		
9-4.6 变零件的内凸起为外凸起		
9-4.7 变凹面朝外为朝里		
9-5 采用配芯结构		
9-5.1 全塑齿轮轴应在中心设置钢芯		
9-5.2 零件与配芯采用滚花、凹口、鸠尾槽等止动		

设计原则	不合理设计图例	合理设计图例
<p><b>8-5.3</b> 配芯截面不应大于零件的截面</p>		
<p><b>8-5.4</b> 尽可能避免采用实心零件</p>		
<p><b>8-5.5</b> 与压制方向垂直的配芯悬臂长度，超过配芯直径的两倍时应有支撑</p>		
<p><b>9-5.6</b> 全塑零件与钢件的螺钉联接，螺孔不可设计在全塑零件上</p>		
<p><b>9-5.7</b> 配芯应离开加强肋一定距离</p>		
<p><b>9-5.8</b> 长的配芯上不可有长距离的两个止动部分</p>		
<p><b>9-5.9</b> 不可使配芯的螺纹与塑料相联</p>		

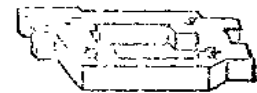
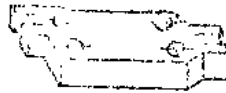
设计原则	不合理设计图例	合理设计图例
<p><b>9-5.10</b> 手柄的配芯应设计成方形的,以防止转动</p>		
<p><b>9-5.11</b> 防止配芯拔脱, 应采用整体配芯</p>		
<p><b>9-5.12</b> 直形配芯中间应设置凸梗或弯折</p>		
<p><b>9-5.13</b> 使嵌件比凸起部分长些</p>		
<p><b>9-5.14</b> 压入零件内的螺纹套不可两端开孔</p>		



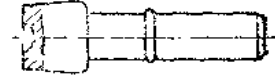
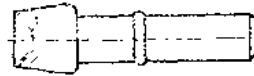
## 10. 热处理零件

设计原则	不合理设计图例	合理设计图例
<p><b>10-1 防止零件变形</b></p> <p><b>10-1.1 尽可能使零件形状简单</b></p>		
<p><b>10-1.2 采用对称结构</b></p>		
<p><b>10-1.3 采用封闭结构</b></p>		
<p><b>10-1.4 开工艺孔</b></p>		

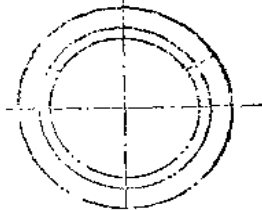
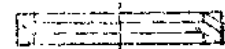
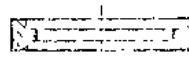
10-1.5 留适当的补偿余量



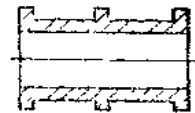
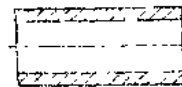
10-1.6 避免断面相差悬殊



10-1.7 采用卷圆结构，从整圆零件中取得非整圆零件

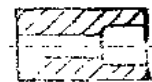
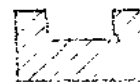
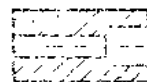
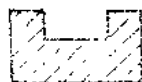


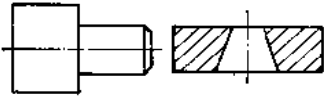
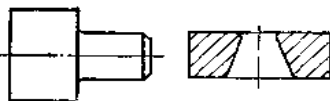
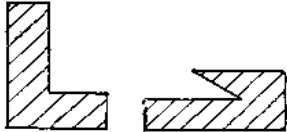
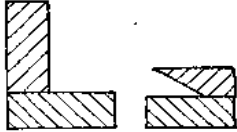
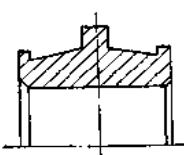
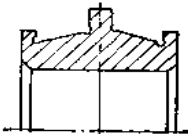
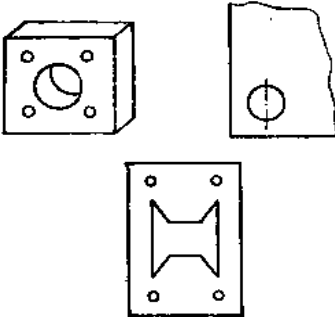
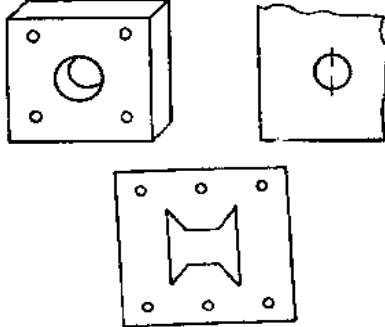


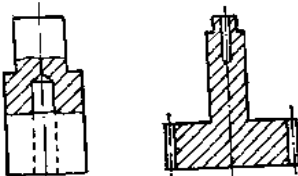
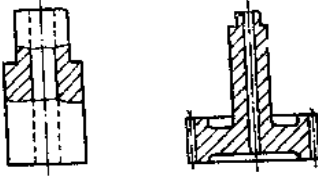
10-1.8 同类零件加肋以提高刚性

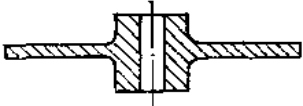

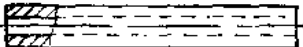
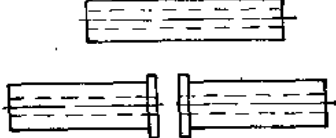
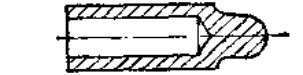
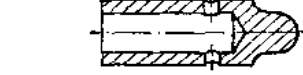
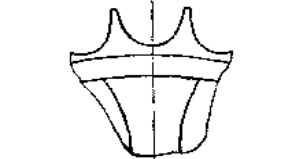
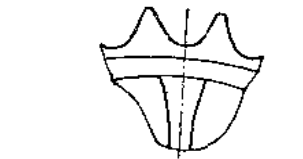
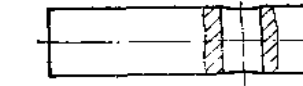
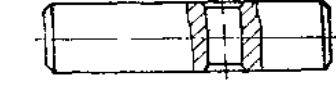
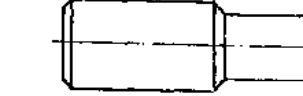
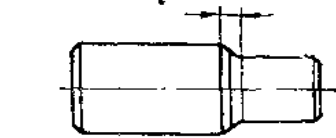


10-2 防止零件开裂

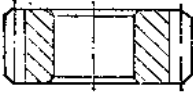

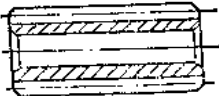

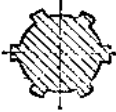

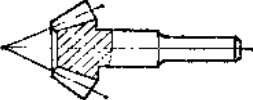
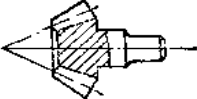
10-2.1 避免内凹尖角，拐角到圆



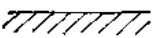
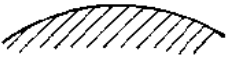
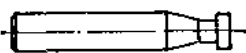
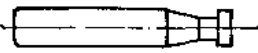
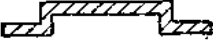
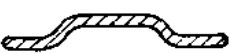


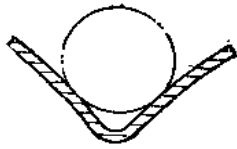

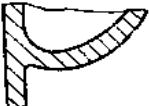
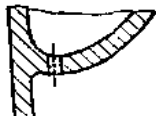
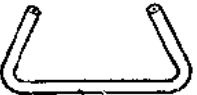





设计原则	不合理设计图例	合理设计图例
10-2.2 避免外凸尖角，拐角倒圆		
10-2.3 避免尖角，采用组合结构		
10-2.4 增大拐角处的圆角半径		
10-2.5 使孔远离危险断面处		
10-2.6 采用匀称的断面，使缺口、键槽错开		
10-2.7 变盲孔为通孔		

设计原则	不合理设计图例	合理设计图例	
<p>10-2.8 易淬裂、工作条件不同的零件，或形状复杂的零件尽可能采用组合结构</p>			
<p>10-2.9 避免长内孔，适当缩短长度，或分成两节</p>			
<p>10-3 防止零件硬度不均匀</p>	<p>10-3.1 设置工艺孔排气</p>		
<p>10-3.2 加厚齿轮的齿，减小轮辐的截面</p>			
<p>10-4 高频淬火零件</p>	<p>10-4.1 防止高频淬火时尖角过热熔化，轴孔和轴端倒角</p>		
<p>10-4.2 两面垂直相交处不淬火，轴的大端、小端过渡部分不淬火</p>			

设计原则	不合理设计图例	合理设计图例
10-4.3 防止键槽熔化，键槽两端附近不淬火		
10-4.4 避免高频淬火两面相距过大		
10-4.5 双联齿轮或三联齿轮两齿接间距离不小于8mm		
10-4.6 内、外齿两齿根圆间的距离应不小于10mm		
10-4.7 齿部和端面距离宜不小于5mm		
10-4.8 沟槽拨叉部分高频淬火的齿轮，要保证其啮合和沟槽一定的宽度		
10-4.9 端面高频淬火的齿轮，端面须突出，过渡处倒角		

设计原则	不合理设计图例	合理设计图例
<p>10-4.10 全部齿一次淬火时,齿 轮齿根不可距离轴孔 太近</p>		
<p>10-4.11 高频淬火的圆柱齿轮 宽度不宜大于齿轮直 径</p>		
<p>10-4.12 高频淬火的花键轴直 径不宜过大</p>		
<p>10-4.13 避免细长的圆锥齿轮</p>		

## 11. 镀涂零件

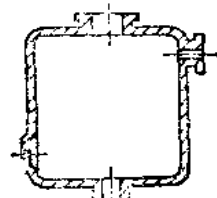
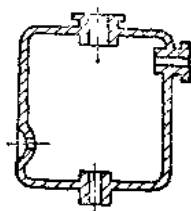
设计原则	不合理设计图例	合理设计图例
11-1 电镀零件		
11-1.1 尽可能采用凸面，凸度不小于15/1000		
11-1.2 改尖角为圆角，半径不小于0.8mm		
11-1.3 尽可能使弯折部分滑溜		
11-1.4 槽的拐角和边角必须有半径不小于1/4槽深的圆角		
11-1.5 弯曲的内凹处必须有直径为25mm的圆角		
11-1.6 零件的槽形部分须预留镀液排放孔		
11-1.7 空心零件须留出排放孔		
11-1.8 采用低矮肋片，增加肋距		
11-1.9 采用U形槽		

设计原则	不合理设计图例	合理设计图例
11-1.10 采用宽而浅的槽,使多个槽相互分散开		
11-1.11 采用通孔,孔径不小于6mm		
11-1.12 必须采用的盲孔拐角、边角均为圆角		
11-1.13 使镀层坚固,螺孔加凹坑		
11-1.14 避免滚压件边缘卷曲过多,以致聚积溶液		
11-1.15 将零件内部的凹腔移至零件外部		
11-2 热浸镀零件		
11-2.1 避免钢零件间形成窄缝		

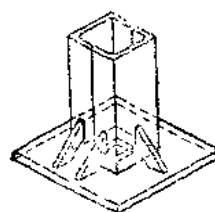
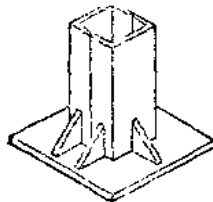


设计原则	不合理设计图例	合理设计图例
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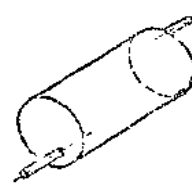
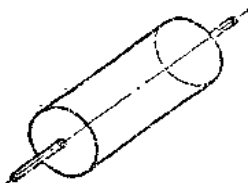
11-2.2 不可使封闭腔中有凸台，以免无法排净其中流体



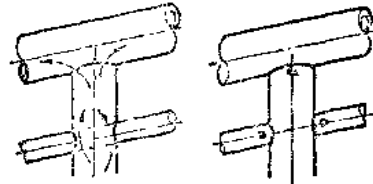
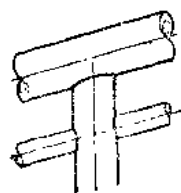
11-2.3 使熔融的金属能够到达工件的各部分，去掉撑板的内部拐角，底板中央开孔



11-2.4 容器的接管必须有助于其中介质放空

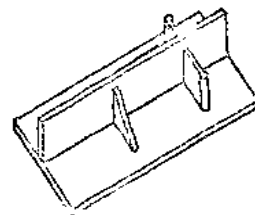
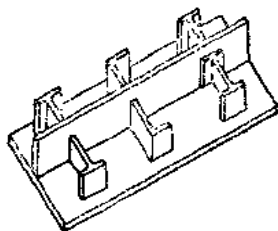


11-2.5 使管形连接件内部介质放空

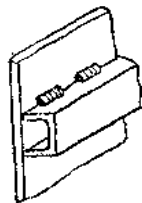






11-3 喷蚀零件

11-3.1 避免采用小截面的加强肋或T形板，采用卡板或圆头平板

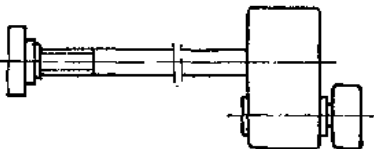
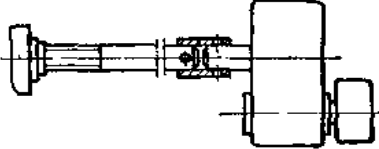
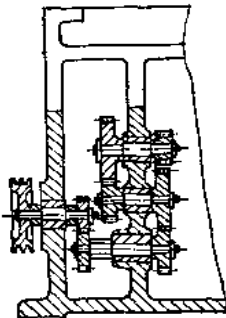
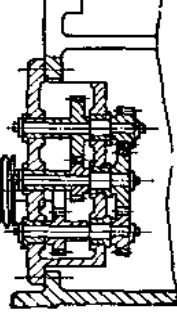
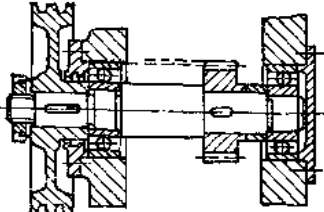
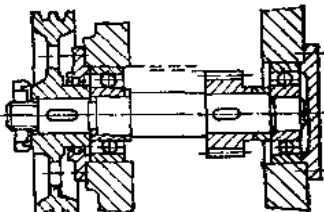
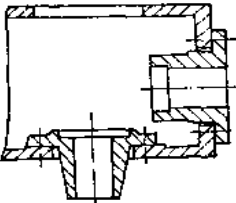
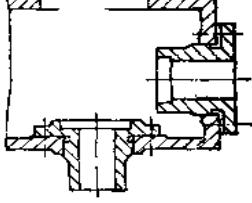
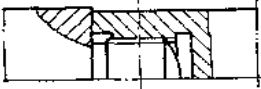



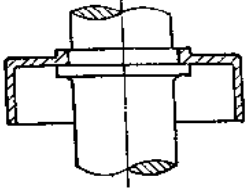
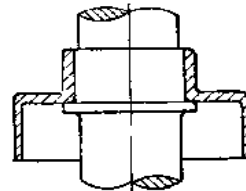
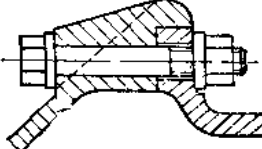
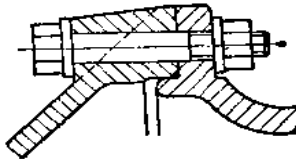
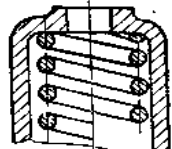
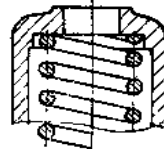
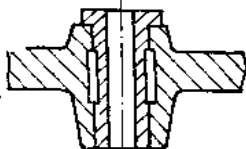

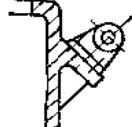
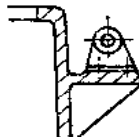
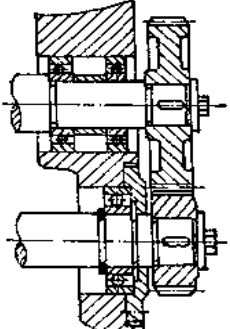
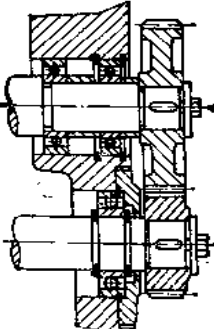
11-3.2 避免死角和连续焊缝



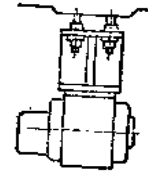
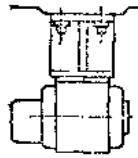
设计原则	不合理设计图例	合理设计图例
<p><b>11-3.3</b> 使搭接接头完全封闭， 采用连续焊缝</p>		
<p><b>11-3.4</b> 尽可能避免角焊缝形成 尖锐的拐角</p>		

## 12. 装 配

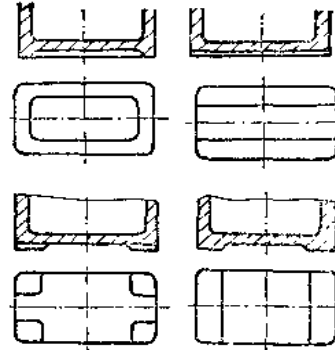
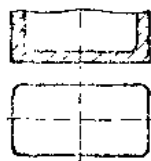
设计原则	不合理设计图例	合理设计图例
12-1 便于进行平行装配工作		
12-1.1 尽可能先组成单独的部分或部件		
12-1.2 同一轴上的零件尽可能考虑从箱体一端成套装卸		
12-2 提供正确的装配基面		
12-2.1 使零件装配有定位基面		
12-2.2 不可采用螺纹定位		

设计原则	不合理设计图例	合理设计图例
<p>12-2.3 防止零件定位时歪斜，使定位有足够的宽度</p>		
<p>12-2.4 提高配合精度，减小定位部分的直径</p>		
<p>12-2.5 使弹簧支承在平面上，保持其位置不变</p>		
<p>12-2.6 内孔需铰光的薄壁轴套与主体镶合处不可有浅槽，避免影响轴套的铰光</p>		
<p>12-2.7 尽可能采用水平的托架</p>		
<p>12-2.8 相互有定位要求的零件，应按同一基准定位</p>		

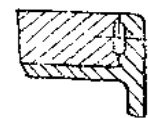
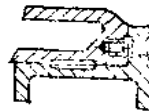
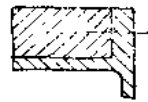
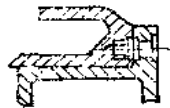
12-2.9 铰链连接的部件可以用  
不加工面作基面



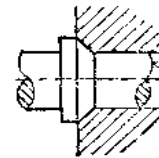
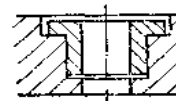
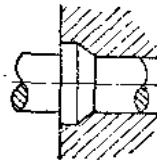
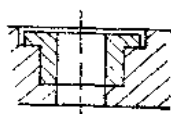
12-3 使装配方便



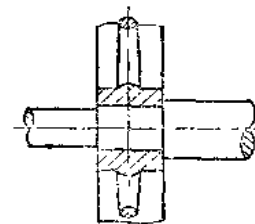
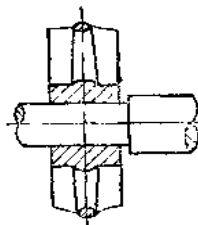
12-3.1 适当地减少接触面积



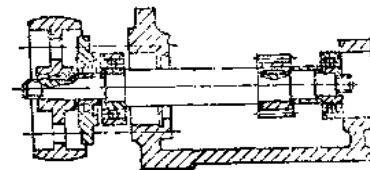
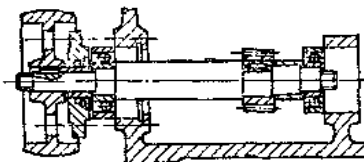
12-3.2 零件只可在一个方向上  
沿一个面接触

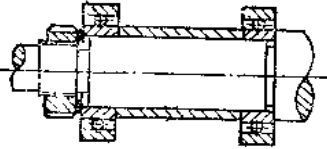
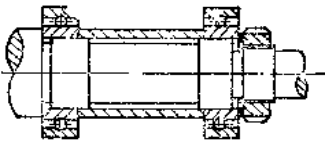
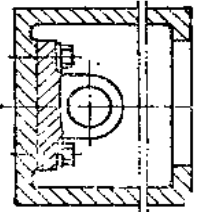
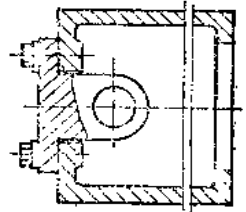
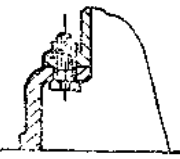
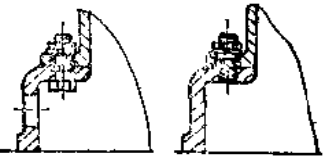
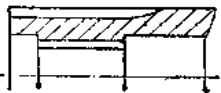
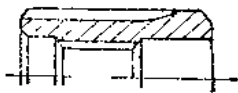
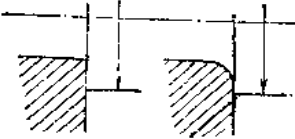
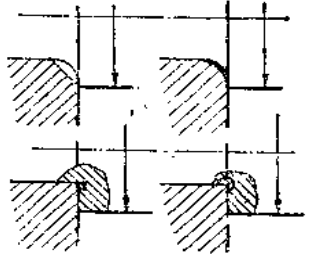


12-3.3 避免拆装时擦伤配合表面，将配合的圆柱表面  
做成阶梯形

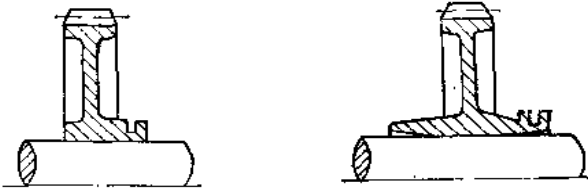


12-3.4 避免两配合部分同时嵌  
入

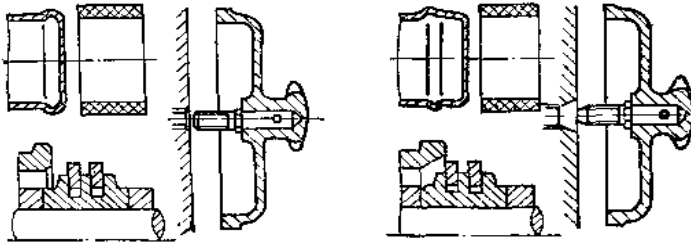


设计原则	不合理设计图例	合理设计图例
<p>12-3.5 轴与套配合部分较长时,留有间隙</p>		
<p>12-3.6 尽可能将紧固件布置在易拆装的部位</p>		
<p>12-3.7 避免铸件圆度误差的影响,使圆形铸件的加工面与相配的铸件非加工面间有足够的装配间隙</p>		
<p>12-3.8 将相配部分倒角</p>		
<p>12-3.9 不可将接触面转折处做成尖角或相同的圆弧</p>		

12-3.10 防止毂在轴上楔住, 增加导向长度

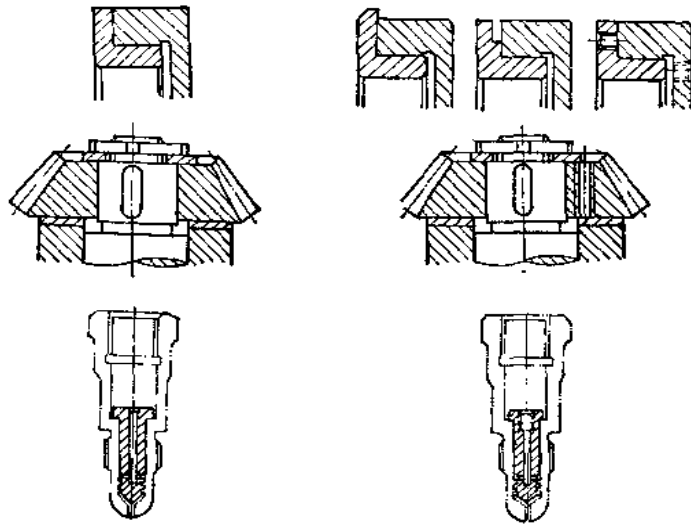


12-3.11 使零件有导向部分

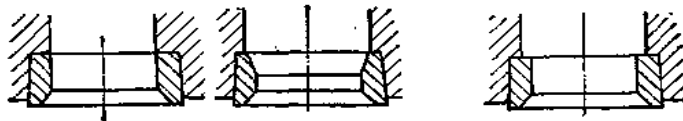


12-4 使拆卸方便

12-4.1 在盖子与凸缘间留下拆卸盖子的间隙、凸边和工艺螺孔



12-4.2 给出安放拆卸工具的位置, 使环突出于孔壁



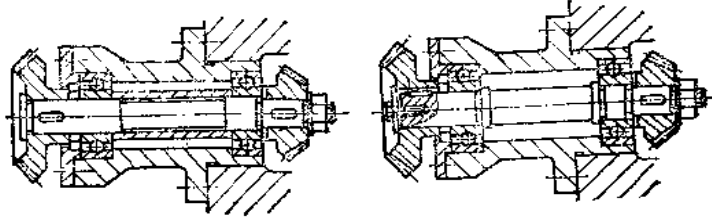
在台肩上钻孔



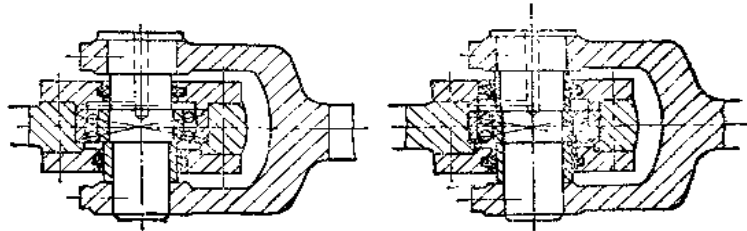
设计原则	不合理设计图例	合理设计图例
在台肩上铣槽		
在轴上铣槽		
<b>12-4.3</b> 给出安放扳手的必要空间		
<b>12-4.4</b> 给出拆卸紧固件的必要空间		
<b>12-4.5</b> 使端盖容易取出，采用双头螺栓和两端盖		
<b>12-4.6</b> 作出适当的拆卸窗、孔槽		



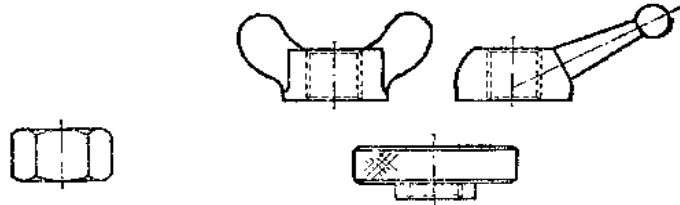
12-4.7 使零件拆装不相互影响，用螺钉和轴向挡圈代替轴肩固定齿轮



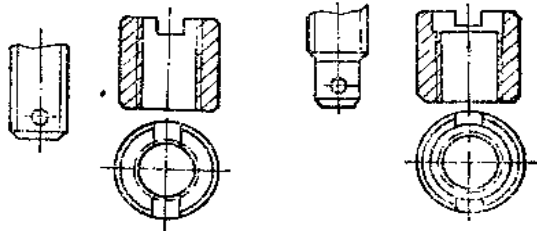
12-4.8 避免轴承拆卸时被损坏，采用销套



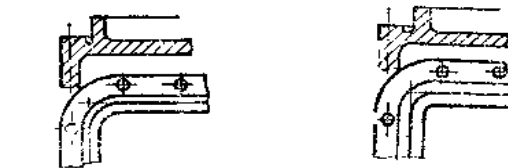
12-4.9 经常拆装，采用手扳、手拧的螺母



12-5 尽可能避免装配时的手工修配

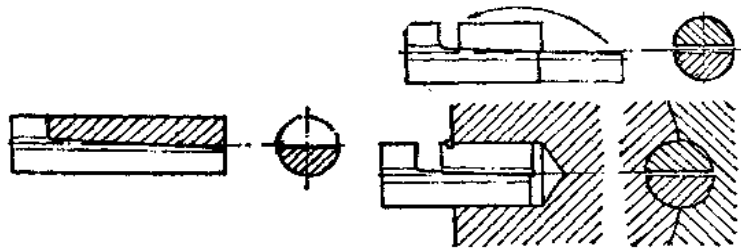


12-5.1 使沾孔和铣槽处无螺纹

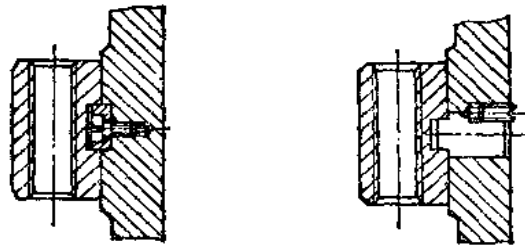


12-5.2 避免形成加工死角

- 12-5.3 采用一次加工斜度的楔代替两个分开加工的楔

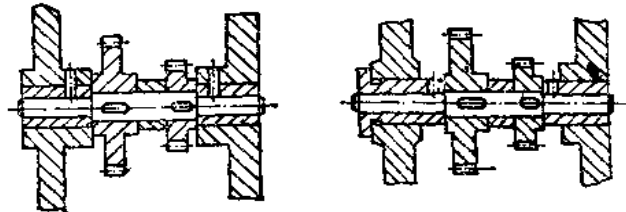


- 12-5.4 用一端部两侧削平的圆柱销代替定位销

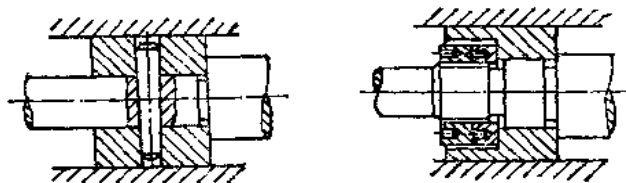


- 12-6 减少装配时的切削加工配作

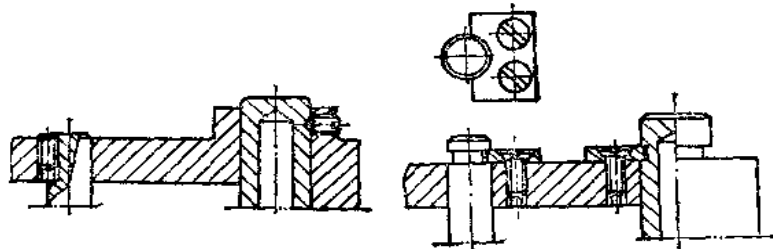
- 12-6.1 将箱体上配钻的油孔，改在轴套上预先钻出



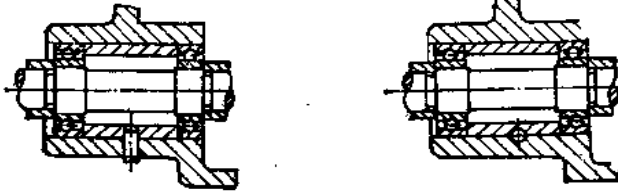
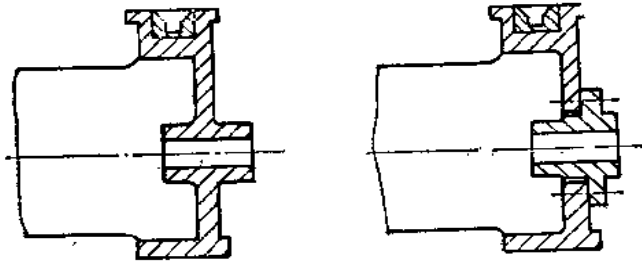
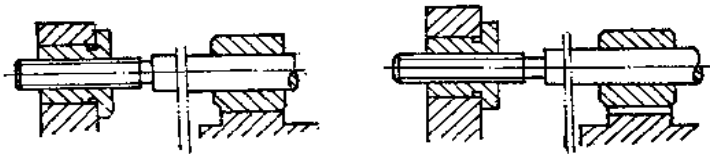
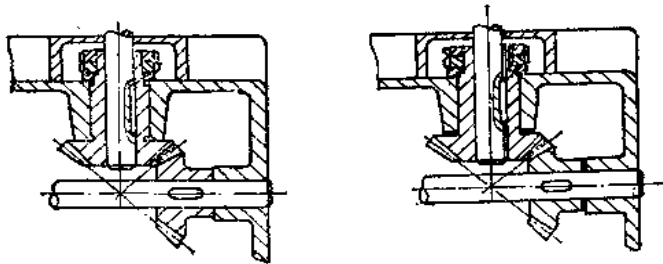
- 12-6.2 改活塞上配钻的销钉联接为螺纹联接



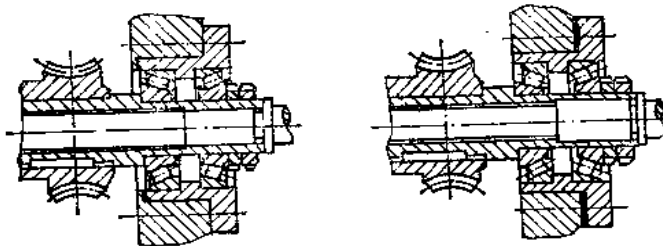
- 12-6.3 避免配作的切屑带到难以清理的内部，改配钻的紧定螺钉为止动卡板



12-6.4 改径向销为切向销

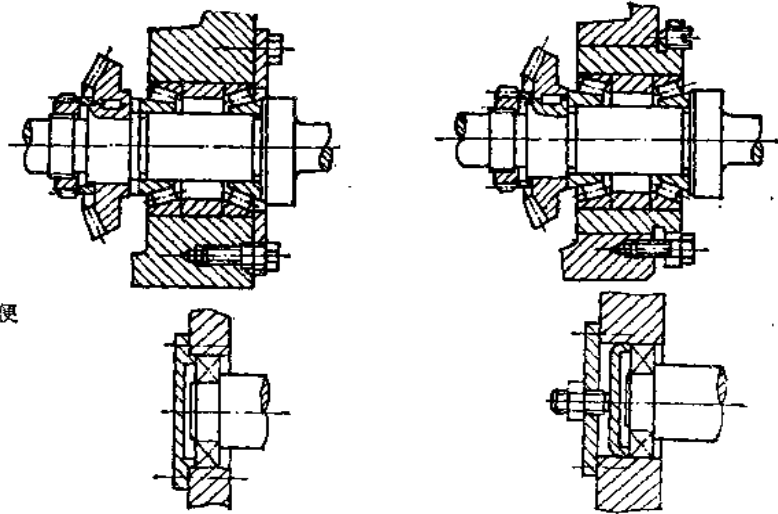
12-6.5 将轴承组装在机座上，  
使装配定位时能调整12-6.6 用调整垫片调整丝杠支  
承与螺母的高轴度12-7 设置调整补偿环，补偿  
尺寸链误差，简化装配

12-7.1 采用调整垫



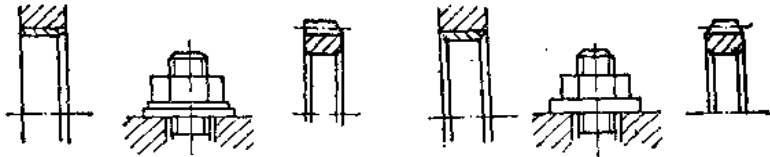
12-7.2 使调整补偿环测量方便

12-7.3 使调整补偿环调整方便

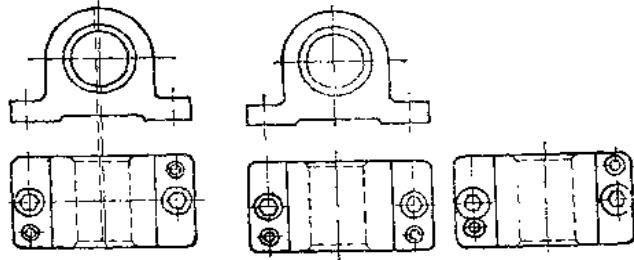


12-8 防止错装

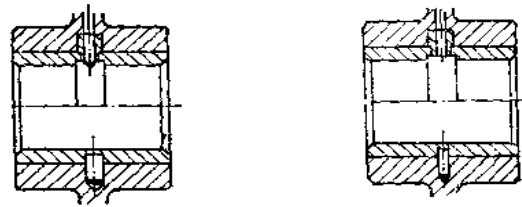
12-8.1 采用对称结构



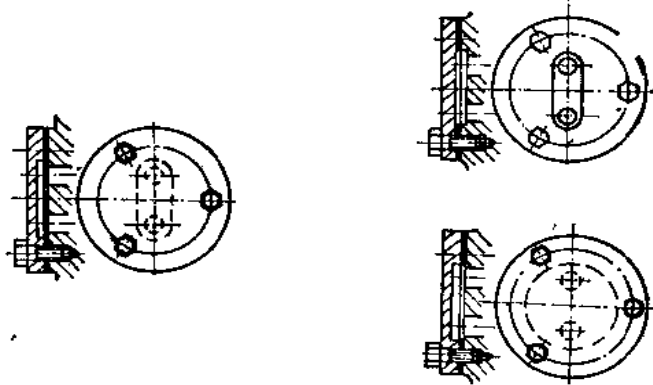
12-8.2 采用非旋转对称结构，  
避免轴承座由于前后位置  
颠倒而使座孔轴线与  
轴的轴线的偏差过大



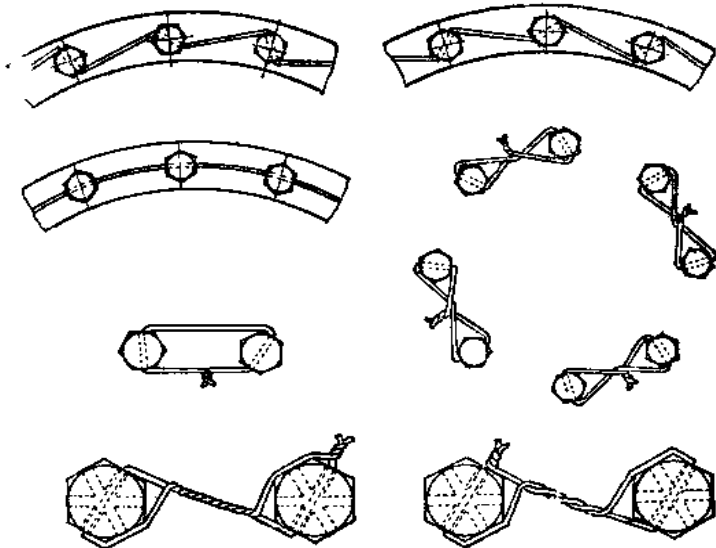
避免由于上下轴瓦装错，  
引起润滑故障，特意将  
油嘴与定位销设计成不  
同直径



12-8.3 使装配时不识别而不致引起差错或故障

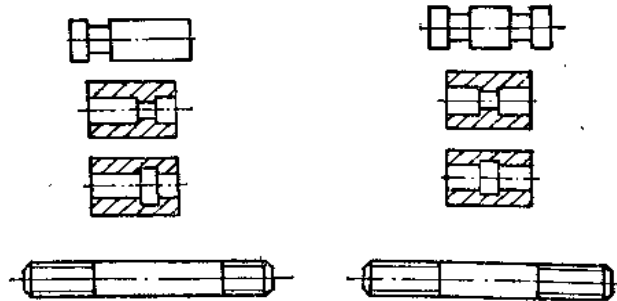


12-8.4 扭紧防松装置的串联钢丝时，使螺钉按顺时针旋转

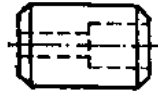


12-9 使自动装配的零、部件易于定位

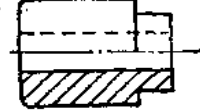
12-9.1 采用对称结构



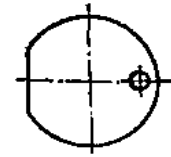
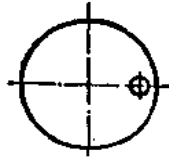
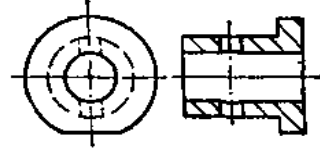
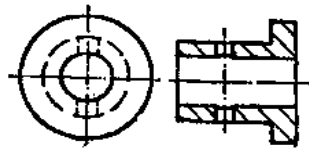
## 12-9.2 小孔径处切槽或倒角



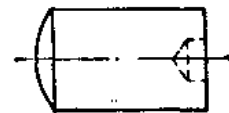
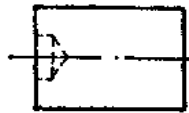
## 12-9.3 避免装配困难，加工夹紧处的外圆，使其与内圆同轴线



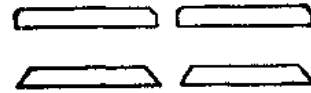
## 12-9.4 保证小孔的一定方向性，在与小孔成一定关系的位置上统一平面，定小孔位置



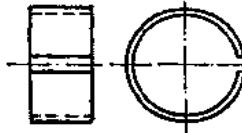
## 12-9.5 便于导向，零件底端作成弧面



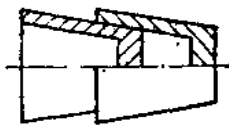
## 12-9.6 避免零件输送时相互错位，增大接触面积或角度



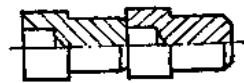
## 12-9.7 避免零件相互缠绕，改通槽为弯折槽或使槽宽小于零件壁厚



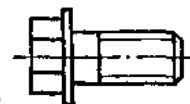
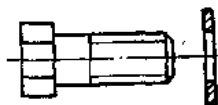
12-9.8 避免具有内、外锥面的零件相互卡死,使内、外锥度不相等或采用内柱面



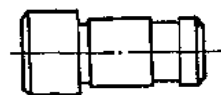
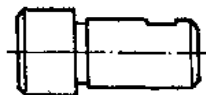
12-9.9 避免零件的突出部分卡在另一零件的孔中,宜使突出部分的直径大于孔径



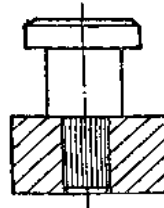
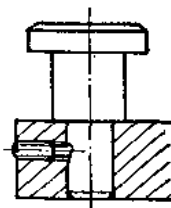
12-9.10 将螺钉与垫圈制成一整体



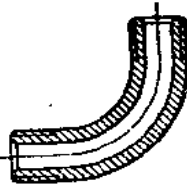
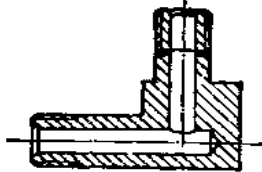
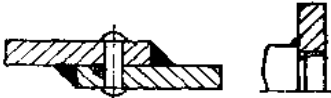

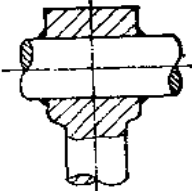
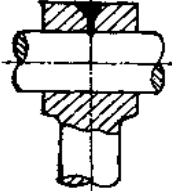
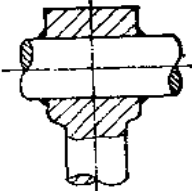
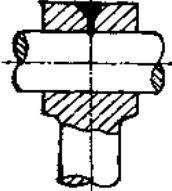
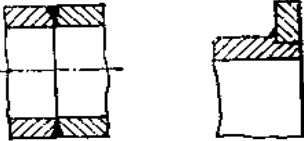
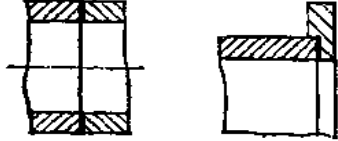


12-9.11 改轴端定位平面为环形槽



12-9.12 改轴、孔配合螺钉紧固的结构为轴端滚花与孔过盈配合的结构



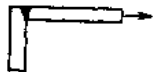
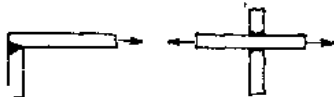


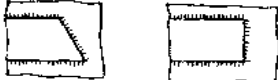
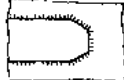
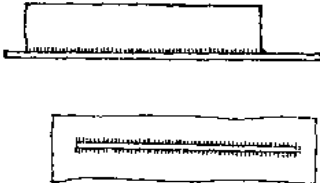
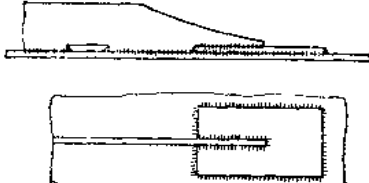


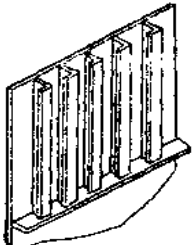
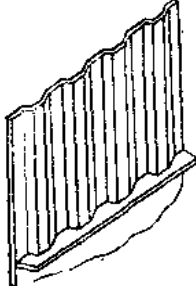
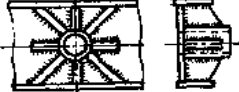



## 13. 熔焊结构

设计原则	不合理设计图例	合理设计图例
<p><b>13-1</b> 充分发挥焊接结构特点，用于减压阀的弯头用焊接结构代替煨弯结构</p>		
<p><b>13-2</b> 不可在同一个接头中采用两种联接结构，避免结构复杂和铆钉、螺栓连接不起作用</p>		
<p><b>13-3</b> 采用简单的和最有效的焊接方法</p>		
<p><b>13-3.1</b> 用电铆焊代替圆周焊</p>		
<p><b>13-3.2</b> 管形零件用电阻对接焊代替电弧焊</p>		
<p><b>13-3.3</b> 用滚焊代替电弧焊</p>		



设计原则	不合理设计图例	合理设计图例
13-4 使结构的应力和变形最小		
13-4.1 尽可能避免采用不对称的焊缝		
13-4.2 避免把焊缝布置在突变的截面上		
13-4.3 相焊接的断面厚度相等或平缓过渡		
13-4.4 避免焊缝过分接近，特别要避免用同一焊缝连接两个以上的零件		

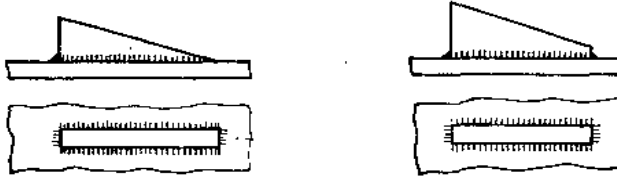
设计原则	不合理设计图例	合理设计图例
13-4.5 避免传力构件上有交叉焊缝		
13-4.6 不可使板在厚度方向上承受拉伸载荷，防止层状撕裂		
13-4.7 使焊缝接近中性轴，或在中性轴的上方		
13-4.8 减小应力集中，避免焊缝端部形成尖角		
13-4.9 减小应力集中，扩展连接板下底面积		
13-4.10 减小应力集中，逐渐减小肋板的横截面以形成柔性部分		
13-4.11 大批量生产时采用压制，减少焊接件数目，避免薄壁件变形		
13-4.12 采用槽钢加固轴承座		

设计原则

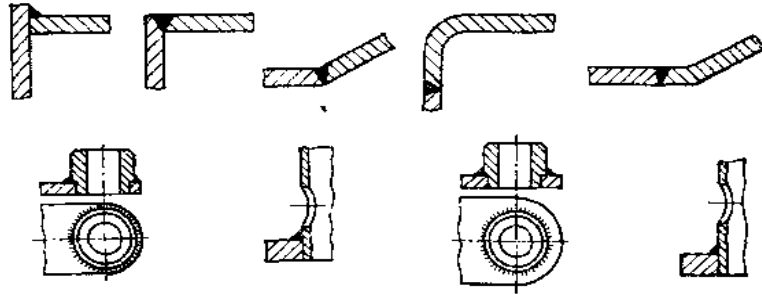
不合理设计图例

合理设计图例

13-4.13 避免采用薄而带锐角的肋板，防止锐角熔化，应力集中



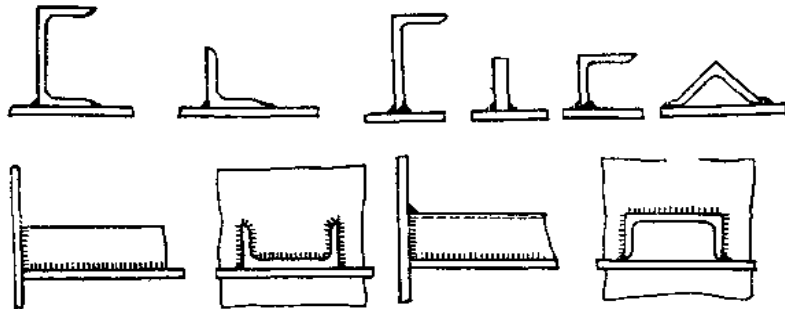
13-4.14 不可把焊缝布置在转角、边缘和孔边，避免局部过热、翘曲和裂开



13-4.15 不可使加强肋错开排列，避免弯曲



13-4.16 在同等刚度条件下，采用重量轻和封闭的加强肋



13-4.17 采用带有45°对角肋板，提高抗扭刚度

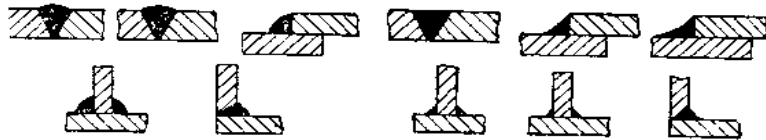


13-4.18 防止刚性变形,给予弹性补偿



13-5 使焊缝有足够的强度,保证连接可靠

13-5.1 保证焊缝形式具有最高的疲劳强度



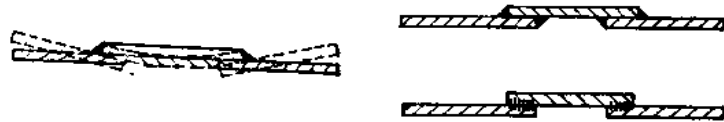
13-5.2 提高直角焊缝的连接强度,采用双面焊接



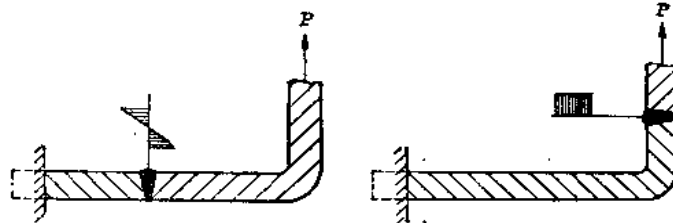
13-5.3 保证搭接部分有足够的长度,减小焊缝中附加弯曲应力



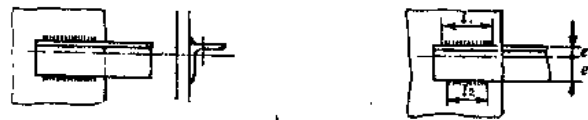
13-5.4 避免焊缝受弯曲撕裂,采用双面焊或采用侧面焊接



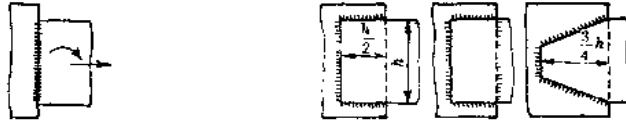
13-5.5 避免焊缝受弯曲,将焊缝布置在受拉伸区



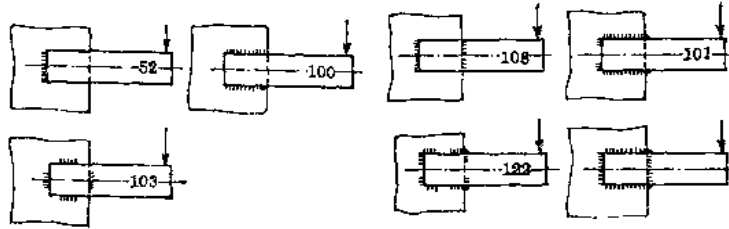
13-5.6 将焊缝布置在最有利位置,使焊接量最小,承载能力最大



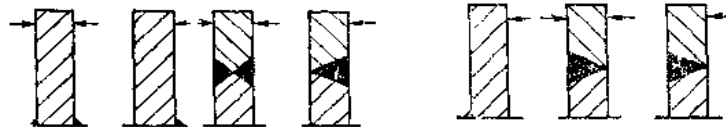
13-5.7 承受弯矩的焊件采用混合焊缝



13-5.8 布置焊缝在最大应力部位(数字表示相当1cm焊缝强度的百分比)



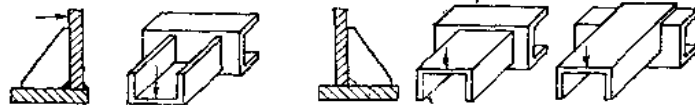
13-5.9 避免焊缝底部受拉伸载荷



13-5.10 用盖板加强底部受拉伸的焊缝



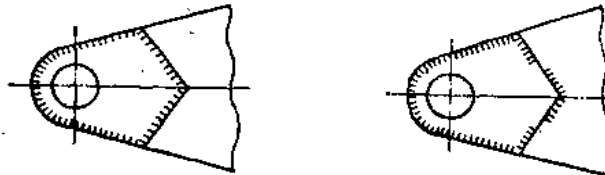
13-5.11 使焊件肋板承受压力



13-5.12 采用台肩承受载荷



13-5.13 减少焊缝长度到焊件所需要的最小限度,避免焊件受到过多的削弱



13-5.14 使焊件尾部两侧均有  
焊缝, 保证固结

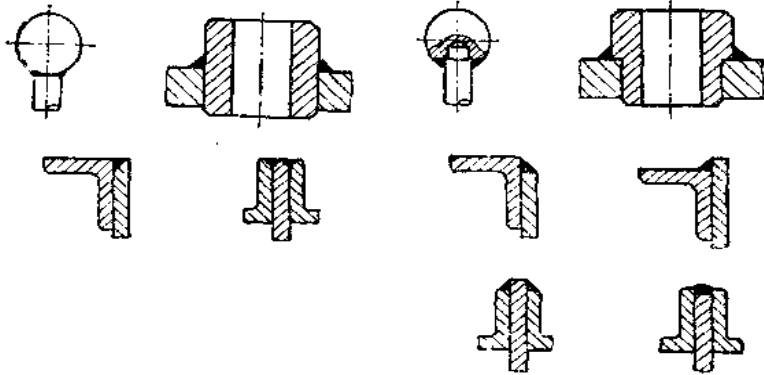


13-6 使焊接和检验方便

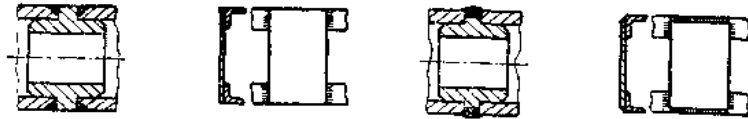
13-6.1 使焊缝在便于焊接的位  
置上



13-6.2 使焊件组对时能定位



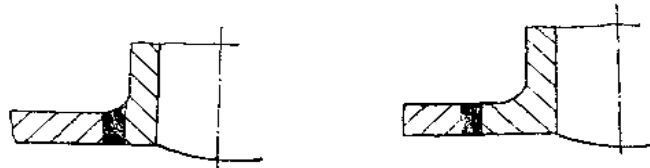
13-6.3 避免坡口加工



13-6.4 将坡口布置在加工简便  
的焊件上

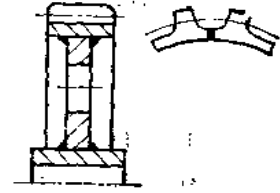
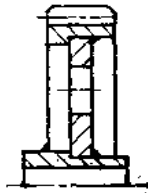


13-6.5 使焊缝位置既便于焊接  
又便于检验

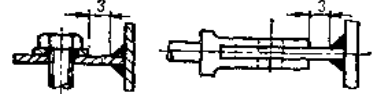


设计原则	不合理设计图例	合理设计图例
<b>13-7</b> 使焊接工作量最小		
<b>13-7.1</b> 尽可能减少焊件和焊缝数目		
<b>13-7.2</b> 用型材代替切削件		
<b>13-7.3</b> 用冲压肋代替焊接肋		
<b>13-7.4</b> 用弯制件代替焊接件		
<b>13-7.5</b> 尽可能采用低焊脚，使接头能用最少的熔敷金属焊接		
<b>13-8</b> 布置焊缝在适当的位置上		
<b>13-8.1</b> 把紧密焊缝布置在容器内部		
<b>13-8.2</b> 不可把焊缝布置在接合面上		

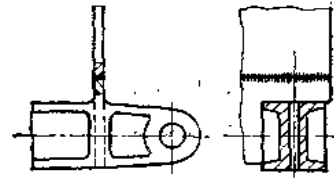
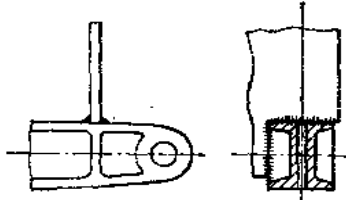
- 13-8.3 焊接由扁钢弯制的对接轮缘，焊缝应布置在轮齿间，焊前不加工



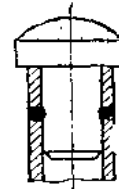
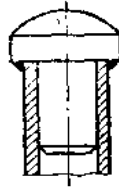
- 13-8.4 使焊缝离开焊件的其他连接部位3mm



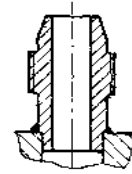
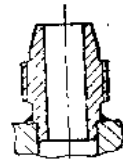
- 13-8.5 使焊缝能在保证焊接刚性的位置上



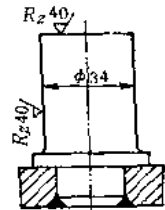
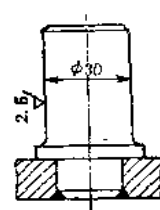
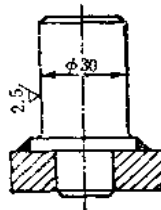
- 13-8.6 使焊缝远离热处理的部位




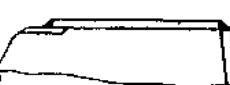
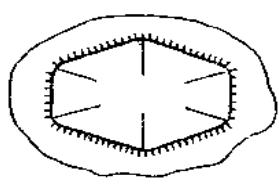
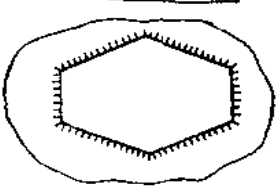
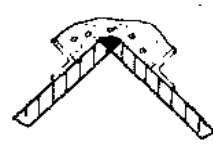
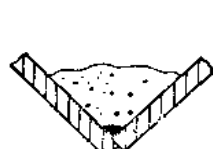
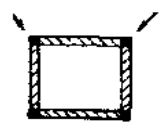
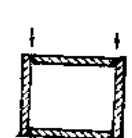

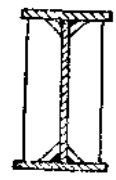
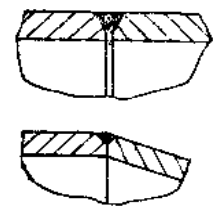
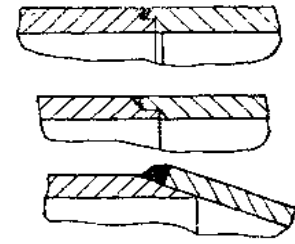

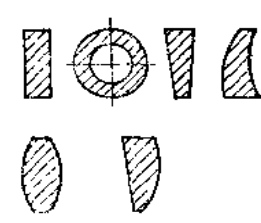

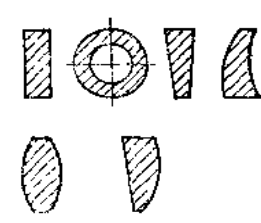
- 13-8.7 使焊缝远离螺纹



- 13-8.8 使焊缝离开加工面，焊后须加工的，焊前须留有加工裕量





设计原则	不合理设计图例	合理设计图例
12-3 埋弧自动焊		
12-9.1 同一焊件上应采用同一形式的焊接接头，并且最好采用直线焊缝		
12-9.2 使焊缝位置便于保存熔剂		
12-9.3 使焊缝在焊件和焊接设备调整次数最少的位置上		
12-9.4 使自动焊机能沿焊缝自由移动		
12-9.5 使接头能防止小直径焊件外部周向焊缝金属熔液渗漏		
12-10 电渣焊		
12-10.1 不可使用不便于电渣焊的对接截面		

13-10.2 避免焊缝中断



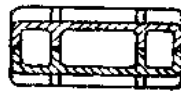
13-10.3 不可在焊件应力最大处分段



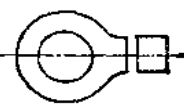
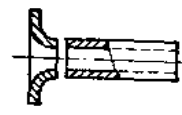
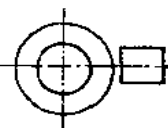
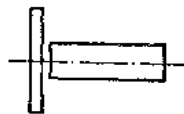
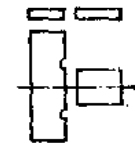
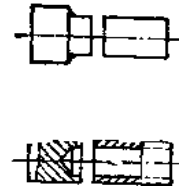
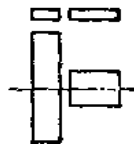
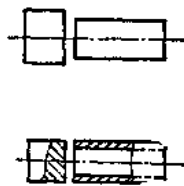
13-10.4 焊件应在焊接变形小的部位分段



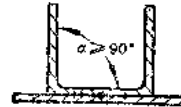
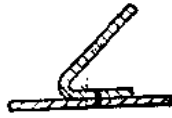
13-10.5 焊件应在焊缝数较少的面上拼接



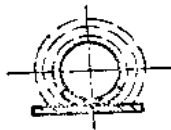
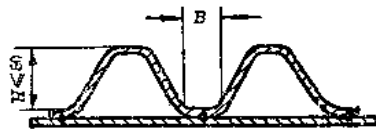
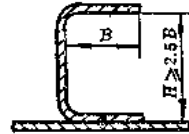
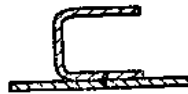
13-11 接触焊焊件对接应截面积相等或相近



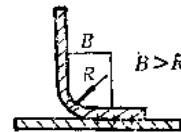
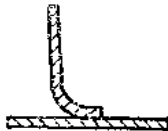
13-2 滚焊



13-12.1 滚焊折叠的板材、型材  
须方便焊接



13-12.2 滚焊焊点不可过于靠近弯曲半径(切点)



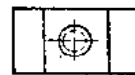
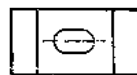
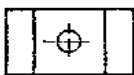
13-12.3 大量生产的冲压件应在适当位置设置台阶、凸台,使焊件易于装配定位




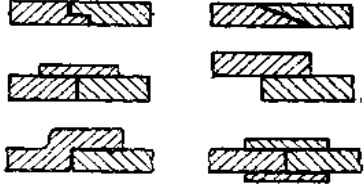






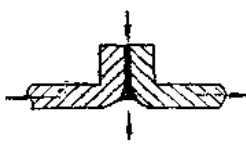
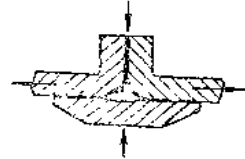

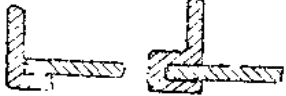


13-12.4 滚焊封闭焊件采用开式接头,便于焊接





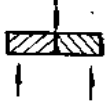
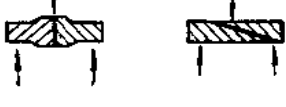


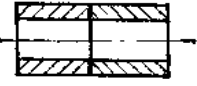
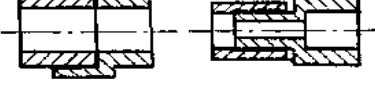
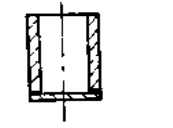
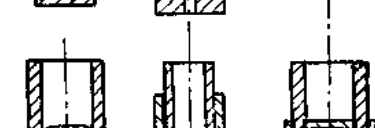
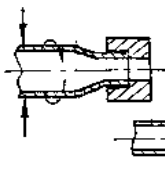
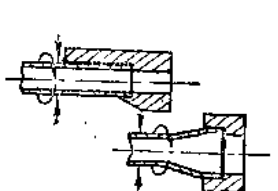


13-13 深的窄焊孔应开坡口,便于排渣

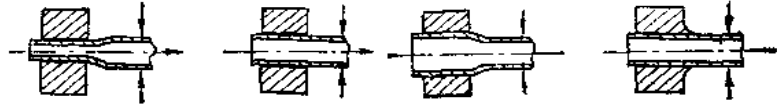


## 14. 钎焊结构

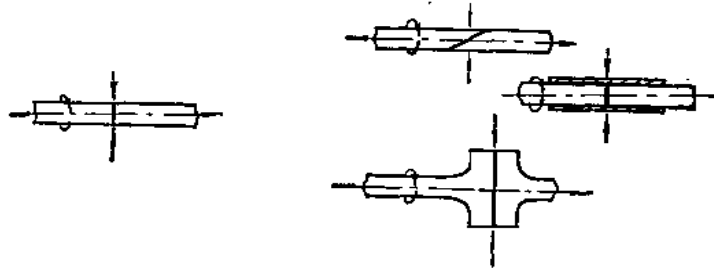
设计原则	不合理设计图例	合理设计图例
<b>14-1</b> 提高接头强度		
<b>14-1.1</b> 增大钎缝面积、板状接头不采用对接、采用斜接、搭接、对接-搭接复合结构		
<b>14-1.2</b> 采用卸荷结构, 使主要工作载荷不是由钎缝承受		
<b>14-1.3</b> 提高搭接接头强度, 并使接头具有柔性		
<b>14-1.4</b> 增大T形接头钎缝面积		
<b>14-1.5</b> 采用盖板承受载荷		
<b>14-1.6</b> 增大角形接头钎缝面积		
<b>14-1.7</b> 采用卸荷结构, 使主要工作载荷不是由钎缝承受		

设计原则	不合理设计图例	合理设计图例
<p>14-1.8 加强受撕裂的结构连接断面, 削薄厚断面, 以降低应力</p>		
<p>14-1.9 避免焊缝受弯曲, 提高板的刚度, 并使之相互贴合</p>		
<p>14-1.10 增大受弯结构的焊缝面积, 采用斜接等结构</p>		
<p>14-1.11 承受振动的梁, 采用盖板, 以提高抗疲劳强度</p>		
<p>14-1.12 提高管形接头强度, 采用承插、套管结构</p>		
<p>14-1.13 提高板与管接头强度, 采用台肩、翻边等结构</p>		
<p>14-1.14 使受扭、受拉的管形接头具有抗弯能力, 采用斜口、胀管结构, 增大焊缝面积</p>		

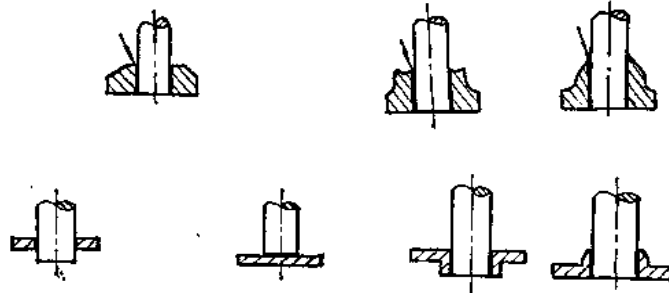
**14-1.15** 使受拉伸的首与板接头具有抗弯能力, 采用扩管和柔性结构, 增大钎缝面积



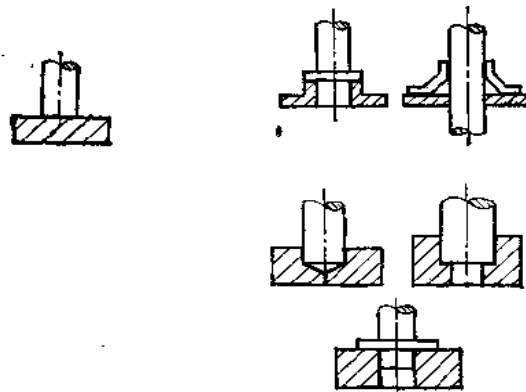
**14-1.16** 使受拉伸接头具有抗扭能力, 采用斜接、套管和大端头结构, 增大钎缝面积



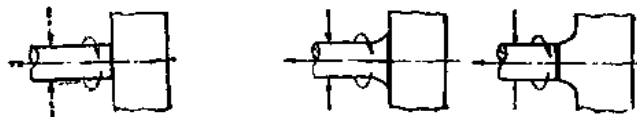
**14-1.17** 使承受冲击载荷的结构套管有适当的柔度, 允许与轴一起轻微弯曲



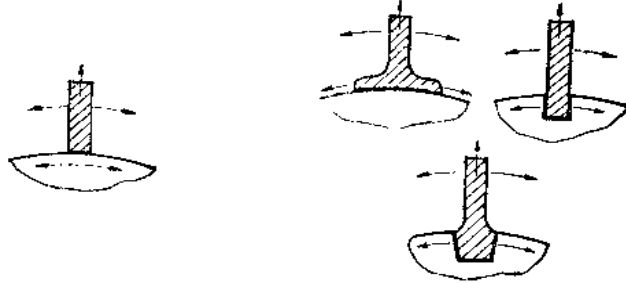
**14-1.18** 增大杆与板接头的钎缝面积, 采用插入、凸合、锥套结构



**14-1.19** 使受拉的杆与板接头具有抗扭和抗弯能力, 增大钎缝面积或使钎缝离开截面突变位置

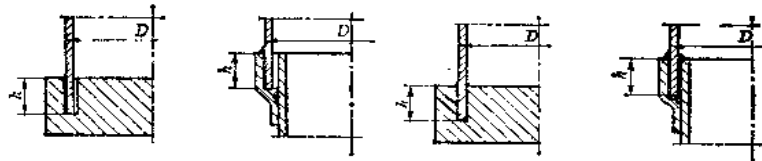


- 14-1.20** 使受拉的叶片与叶轮接头具有抗扭和抗弯能力,加大叶片根部焊缝面积,将叶片插入叶轮,加大叶片根部的尺寸

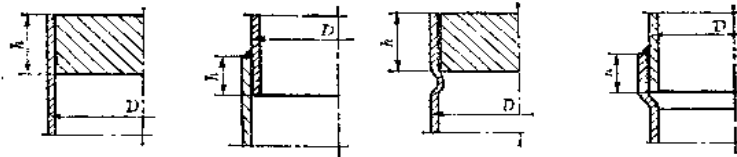


- 14-2** 使接头便于钎焊

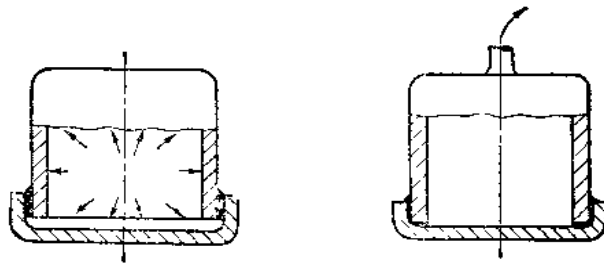
- 14-2.1** 承插结构采用双边钎缝,增大槽宽变,使焊料能进入钎缝内



- 14.2.2** 将环状搭接的零件下部颈缩或锥缩,阻止焊料流出



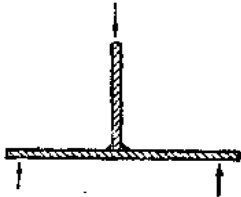
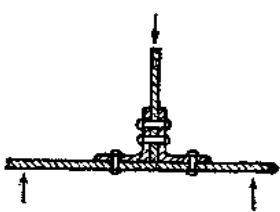
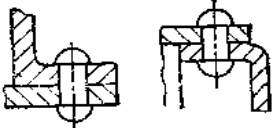
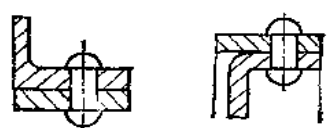
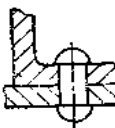
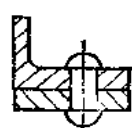
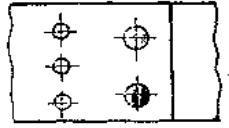
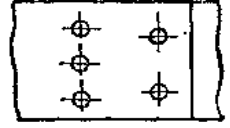


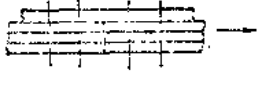
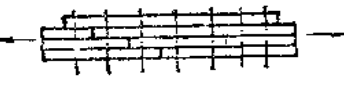
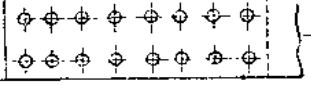



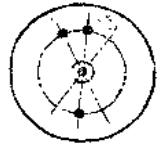
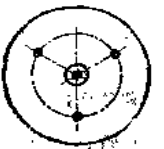
- 14-3** 排除钎焊时循环在容器内的气体



- 14-3** 采用高温钎焊代替锡接 (焊料: 18%Ni, 82%合金, 钎焊温度1000℃, 使离心式压缩机叶轮前盖板与叶片连接有高的强度和良好的抗蚀性



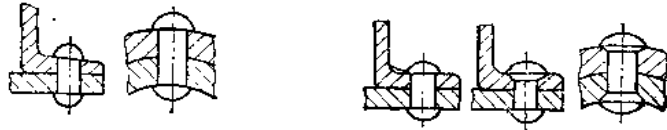
## 15. 铆接结构

设计原则	不合理设计图例	合理设计图例
<p><b>15-1</b> 采用铆接代替焊接，减小应力集中，阻断裂纹扩展</p>		
<p><b>15-2</b> 方便铆接操作，简化铆接工艺</p>		
<p><b>15-2.1</b> 使铆钉孔远离壳壁，铆钉外露</p>		
<p><b>15-2.2</b> 尽可能在同一结构中采用相同直径的铆钉</p>		
<p><b>15-3</b> 使铆钉合理受力</p>		
<p><b>15-3.1</b> 铆钉孔采用交错排列</p>		
<p><b>15-3.2</b> 使多层板铆接中的各层板接口错开</p>		
<p><b>15-3.3</b> 在力作用方向上的铆钉排数不宜超过6排</p>		
<p><b>15-3.4</b> 尽可能使铆钉组的形心与铆缝接合面的形心重合</p>		



15-4 使铆接可靠

15-4.1 使铆钉与板贴合，铆接板紧密接触



15-4.2 不可将铆钉头埋于薄板上



15-4.3 使埋头孔的角度合适



15-4.4 圆头一侧的孔必须倒角

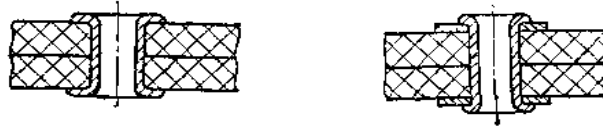


15-5 降低铆接力

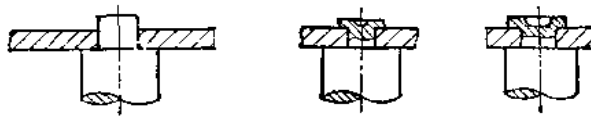
15-5.1 将敛缝处加工出沟槽



15-5.2 增大连接件的支承面



15-5.3 在铆接处的端面上加工出锥形(或截锥形)孔

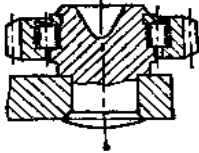
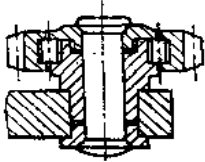
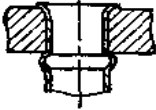
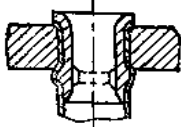


15-5.4 矩形断面的冲压零件的连接采用分铆法

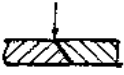

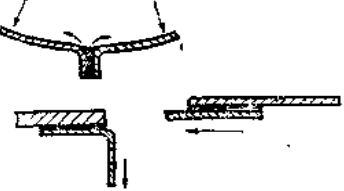

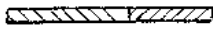
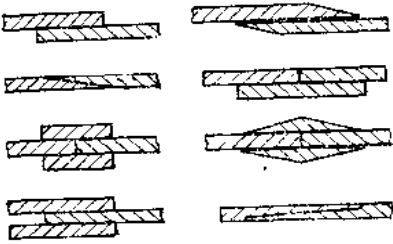
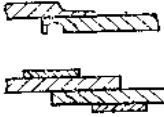
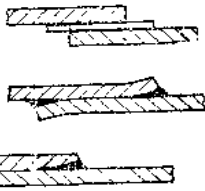


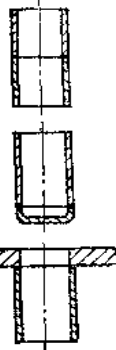
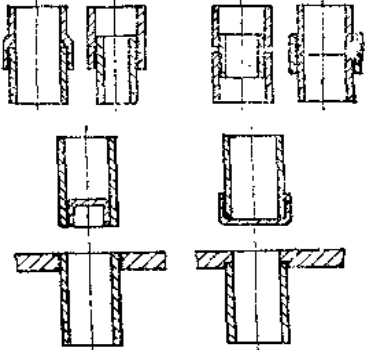


15-5.5 避免铆接金属出现裂纹和断裂,减小变形,封口卷边采用收铆法



设计原则	不合理设计图例	合理设计图例
<p>15-5.6 冷铆时采用高塑性金属的铆钉套</p>		
<p>15-5.7 在薄壁零件密封连接中采用“加固元件”，以保证连接零件紧密接触</p>		

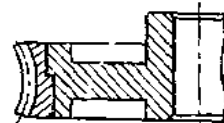
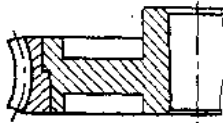
## 16. 胶 接 结 构

设计原则	不合理设计图例	合理设计图例
<p><b>16-1 提高接头强度</b></p> <p><b>16-1.1 使接头主要承受剪切载荷</b></p>		
<p><b>16-1.2 避免接头受撕裂</b></p>		
<p><b>16-1.3 避免板接头承受直拉载荷，增大胶接接缝面积，不采用对接结构，采用搭接、斜接、盖板等结构</b></p>		
<p><b>16-1.4 提高单面搭接接头的强度，使接头具有柔性(E可提高静力强度15%；动力强度25%)</b></p>		
<p><b>16-1.5 较厚工件采用榫槽结构</b></p>		
<p><b>16-1.6 避免管形接头承受轴向拉载荷 (只有固化时不需加压的胶粘剂才能用于管形接头)</b></p>		

设计原则	不合理设计图例	合理设计图例
16-2 便于胶接		
16-2.1 使T形管接头便于对中和加压固化		
16-2.2 采用锥形结构, 使固化时加压两零件自行对准		
16-2.3 使接头盲孔中空气排出		
16-2.4 增大T形接头胶接面积		
16-3 采用加强件减少大面积的金属薄板挠曲、绉纹等		
16-4 减小应力集中		
16-4.1 减小应力集中, 使加强件末端具有柔性		
16-4.2 加强孔及开口的边缘, 以降低其四周的应力		

## 13-5 采用胶接代替其他联接

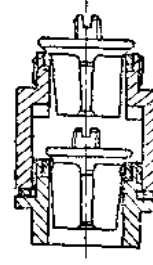
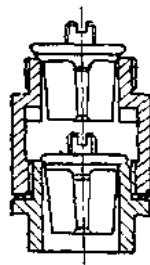
## 16-5.1 采用胶接代替过盈配合



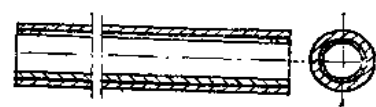
## 18-5.2 采用胶接代替双金属浇注复合



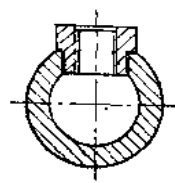
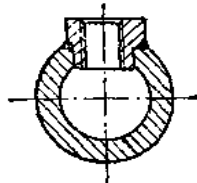
## 16-5.3 采用胶接组合结构代替整体结构, 降低青铜铸造废品率



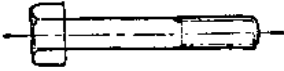
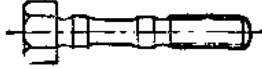
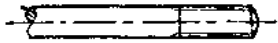
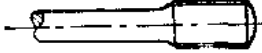

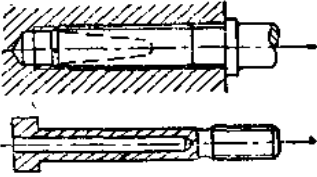
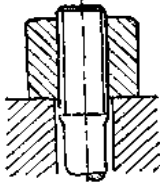
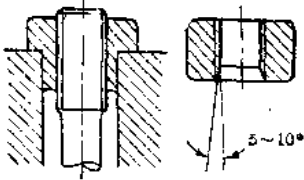
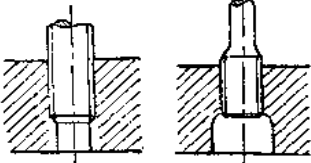
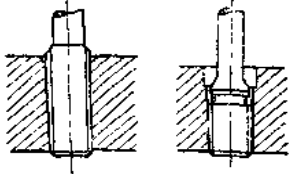

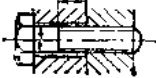
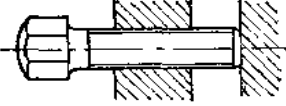

## 16-5.4 采用胶接组合结构代替整体结构, 简化小孔内键槽加工

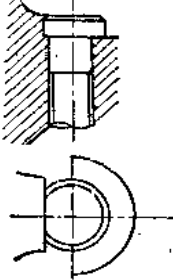
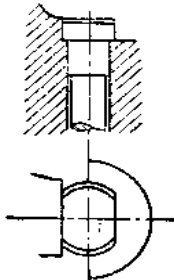
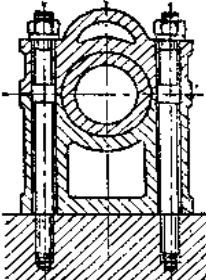
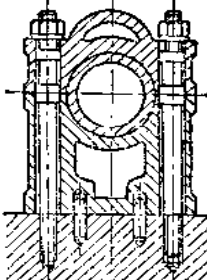
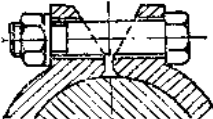
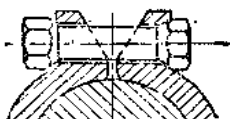
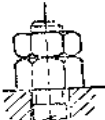

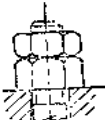

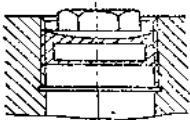
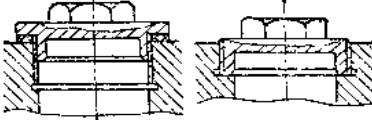
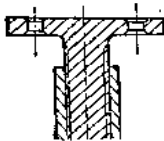
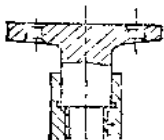
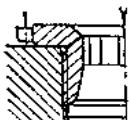
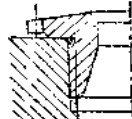


## 16-5.5 采用胶接代替焊接



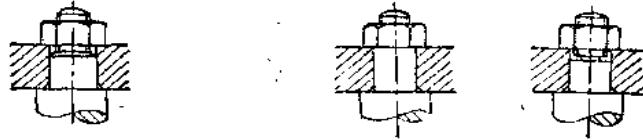
## 17. 螺纹联接

设计原则	不合理设计图例	合理设计图例
<b>17-1 减小应力集中</b>		
<b>17-1.1</b> 截面变化的部位切削成圆弧, 并使螺栓具有柔性		
<b>17-1.2</b> 采用大圆弧过渡		
<b>17-1.3</b> 降低螺栓刚度 and 应力幅度, 采用弹性螺栓, 空心螺栓, 空心螺柱		
<b>17-1.4</b> 提高承受轴向载荷的螺纹强度, 避免由于应力集中而产生的疲劳裂纹, 采用悬挂螺母和一端开成锥形孔的螺母		
<b>17-1.5</b> 降低螺栓刚度, 使螺纹旋到底		
<b>17-1.6</b> 使螺纹终止线离开螺栓联接面有足够距离		
<b>17-2 避免引起附加载荷和弯曲</b>		
<b>17-2.1</b> 螺钉头作成球形, 避免产生附加的偏心力和钉头附近螺纹受挤压		

设计原则	不合理设计图例	合理设计图例
17-2.2 不可采用单边切割的圆形螺栓		
17-2.3 采用定位销承受剪力，保证螺栓在拉力下工作		
17-2.4 采用球形支承面螺母、垫圈		
17-3 使螺纹联接可靠		
17-3.1 加强对顶螺母中的副螺母		
17-3.2 使螺纹总是在张紧状态下工作		
17-3.3 避免螺纹损坏，承受变化横向力的螺纹，必须有支承带		
17-3.4 加强螺母凸缘与本体的过渡部分		

17-4 保证螺纹拧紧

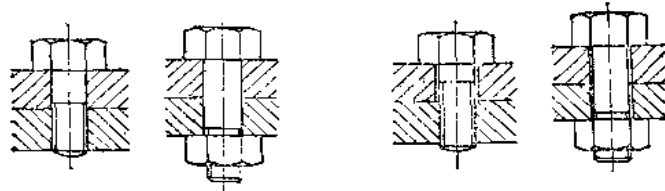
17-4.1 给出足够的螺纹长度



17-4.2 给出间隙和倒角



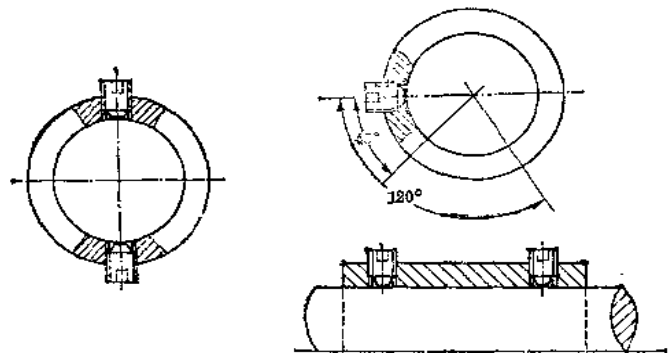
17-4.3 给出间隙，使螺栓不承受剪力，仅承受拉力



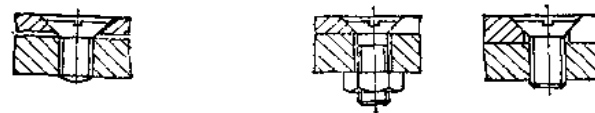
17-4.4 采用铰孔螺栓，不采用铰孔螺钉



17-4.5 使紧定螺钉的夹持力最大，不采用同一直径上的径向对置，采用在同一圆周上 $45^{\circ}\sim 120^{\circ}$ 夹角配置，尽可能采用轴向并列配置（设左图夹紧力为1.0；则右上图为1.1~1.35倍；右下图为1.5倍）

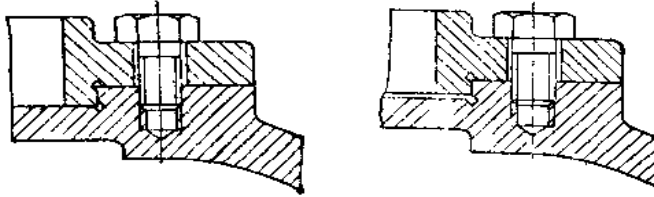


17-4.6 避免螺钉的沉头拧入螺孔



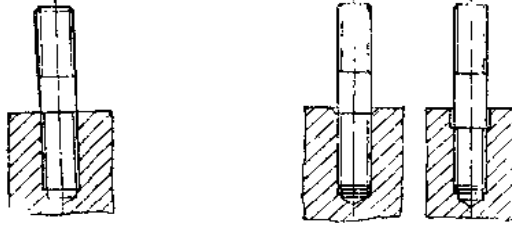


## 17-4.7 非接触面必须留出间隙



## 17-5 正确使用螺纹联接

## 17-5.1 避免端部螺纹损伤和孔口胀出, 螺孔倒角



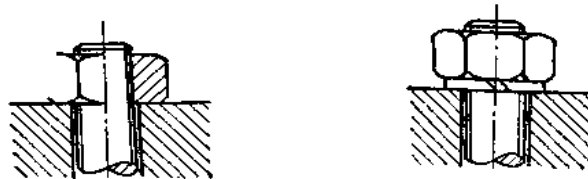
## 17-5.2 避免采用攻螺纹不到底的通孔



## 17-5.3 使无密封要求的螺孔为通孔, 便于攻螺纹和排净空气、油污

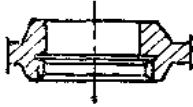

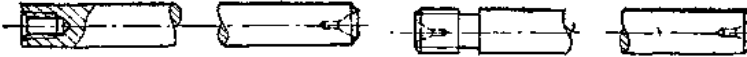
17-5.4 采用  $\alpha = 15^\circ \sim 20^\circ$  的螺尾, 保证联接的密封性、防止松脱

## 17-5.5 采用弹簧垫圈, 防止螺母松脱

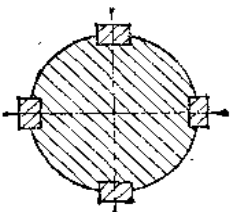
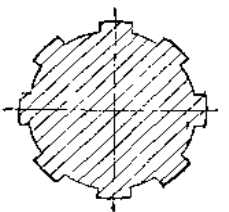
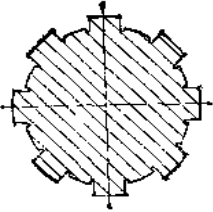
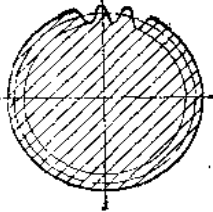
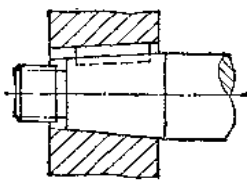
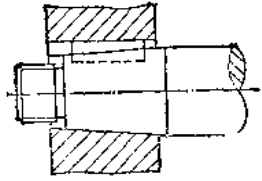
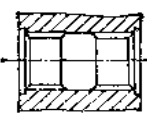
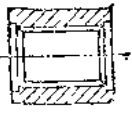
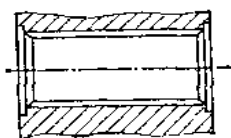
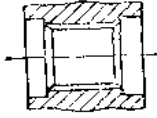
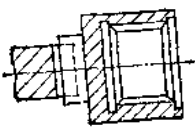
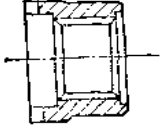
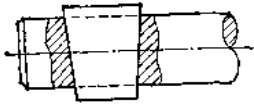



## 17-5.6 不可用紧定螺钉代替定位销



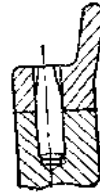
设计原则	不合理设计图例	合理设计图例
17-5.7 避免采用大直径螺纹		
17-5.8 尽可能避免在长杆上采用内螺纹		

## 18. 键、楔、销、过盈联接

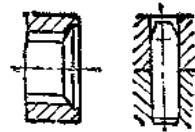
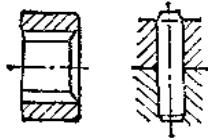
设计原则	不合理设计图例	合理设计图例
<b>18-1 键联接</b>		
<b>18-1.1 重要的键联接应采用花键</b>		
<b>18-1.2 承受大载荷（特别是交变载荷）时不宜采用矩形花键，应采用渐开线花键或三角形花键</b>		
<b>18-1.3 不可将锥形轴上的键斜放</b>		
<b>18-1.4 采用连续的花键</b>		
<b>18-1.5 避免采用太长的花键</b>		
<b>18-1.6 避免采用不通的花键孔</b>		
<b>18-2 楔联接</b>		
<b>18-2.1 采用单边倾斜的楔</b>		

设计原则	不合理设计图例	合理设计图例
<p>18-2.2 楔的两端作成截棱锥， 棱边带圆角，避免形成 毛刺</p>		
<p>18-3 销联接</p>		
<p>18-3.1 尽可能不削弱销轴</p>		
<p>18-3.2 采用槽销，保证地尾榫 联接紧配合</p>		
<p>18-3.3 采用螺尾锥销，以便拆 卸</p>		
<p>18-3.4 尽可能使销孔是通孔</p>		
<p>18-3.5 异形法兰采用定位销， 不采用凸台定位</p>		
<p>18-3.6 小零件采用销定位</p>		

## 18-3.7 定位销孔采用配钻

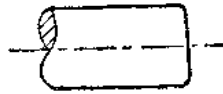


## 18-3.8 保护销、键槽不受损坏

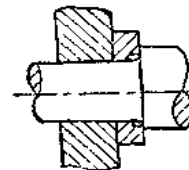
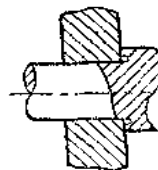
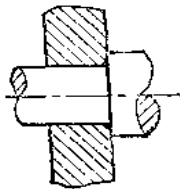


## 18-4 过盈配合

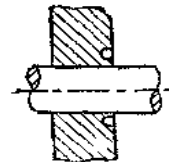
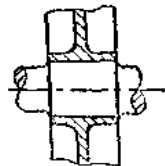
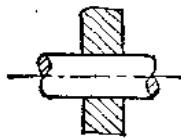
## 18-4.1 保证过盈配合联接可靠，被包容件端部作成圆弧形



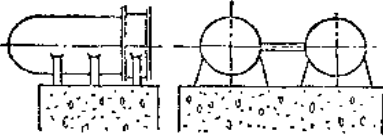
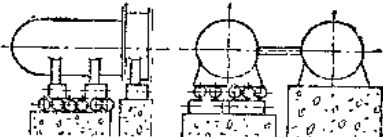
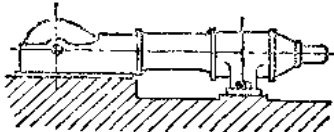
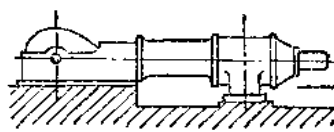
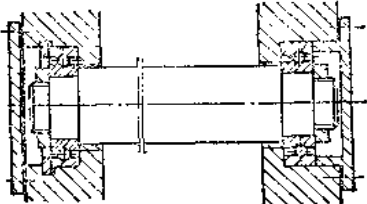
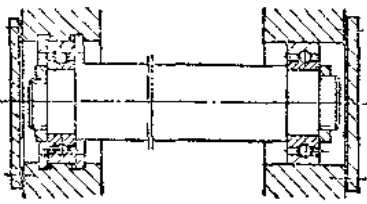
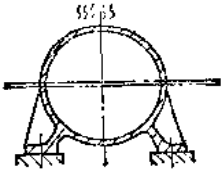
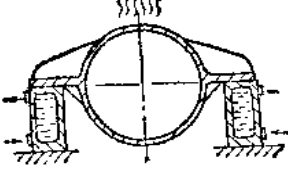
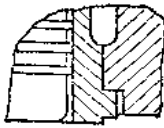
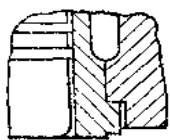
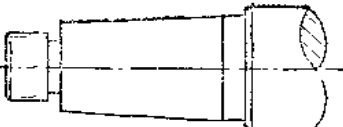
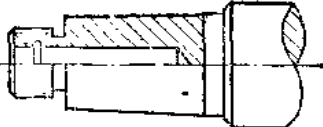
## 18-4.2 降低过盈配合联接的轴上应力集中，采用凹圆角和闷环



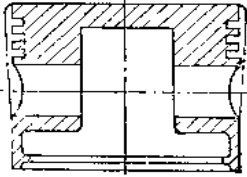
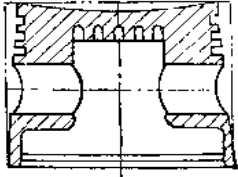
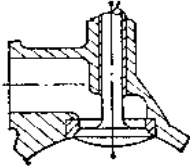
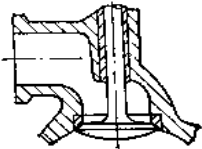
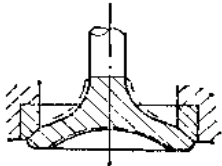
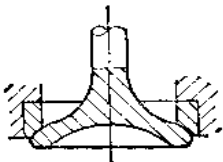
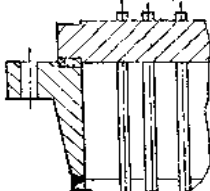
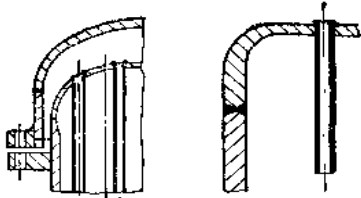
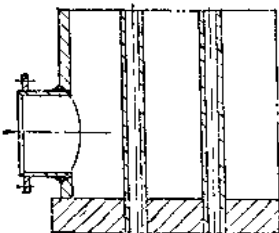
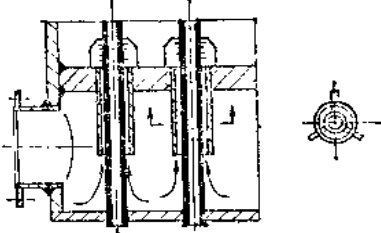
## 18-4.3 使过盈配合联接的轴上压力逐渐增大，将轴毂减薄，轮辐上开均压槽



## 19. 热影响及热应力

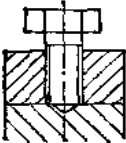
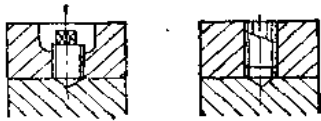
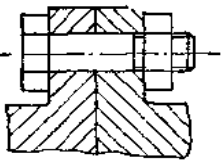
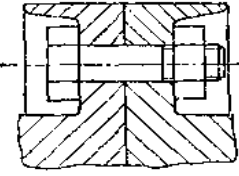
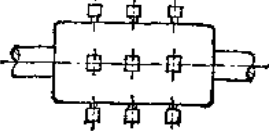
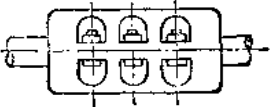
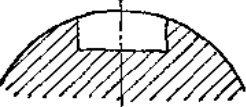
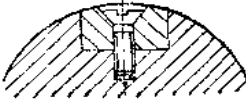
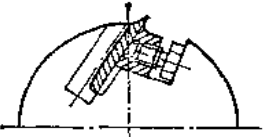
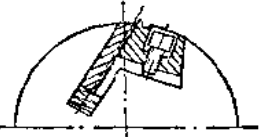
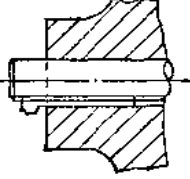
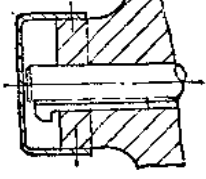


设计原则	不合理设计图例	合理设计图例
<p><b>19-1</b> 使受热设备、机件自由膨胀</p>		
<p><b>19-1.1</b> 多台串联的高压换热器必须在两个方向上能移动</p>		
<p><b>19-1.2</b> 使卧式压给机气缸下的支承能滑动</p>		
<p><b>19-1.3</b> 使轴的一端沿轴向移动</p>		
<p><b>19-2</b> 避免高温机器，设备中心标高变化过大，采用水冷套支承</p>		
<p><b>19-3</b> 减小热负荷，使第一道活塞环槽在冷却水套范围内</p>		
<p><b>19-4</b> 采用空心轴头，降低热传导（如在鼓风机进风温度为近500℃时，采用风冷却以保证轴承正常工作）</p>		

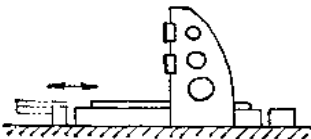
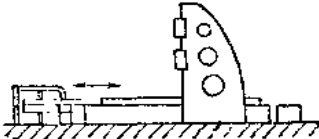
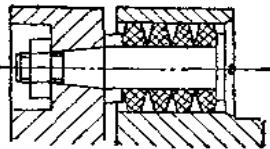
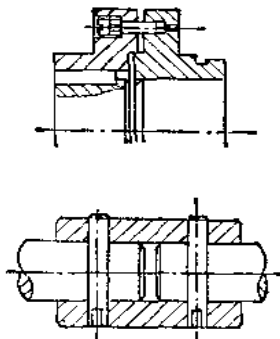
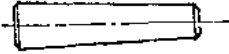
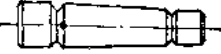
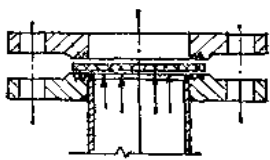
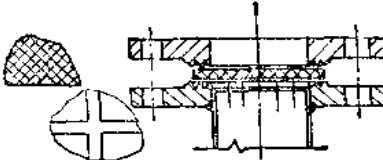
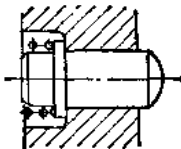
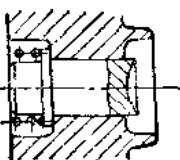
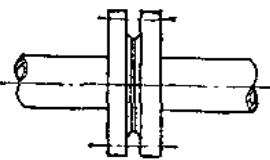
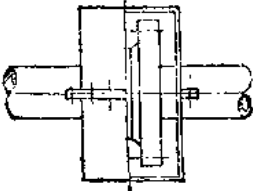


设计原则	不合理设计图例	合理设计图例
19-5 隔热和降低热传导		
19-5.1 将支座与高温设备隔热		
19-5.2 防止列管与管板联接处受热冲击、热疲劳和金属脆化作用, 设置防热套管		
19-5.3 防止由接管进入的高温介质对壳体热冲击和热疲劳作用, 设置防热套		
19-6 使放热、传热容易		
19-6.1 排气阀阀口增设散热翅片		
19-6.2 使轴瓦与轴瓦座全部接触		
19-7 减小热膨胀的影响		
19-7.1 把定位凸台设在热膨胀系数小的零件上		

设计原则	不合理设计图例	合理设计图例
<p>19-7.2 使热变形得到补偿, 尽可能减小热变形, 内燃机活塞采用锥形体和弧形顶面</p>		
<p>19-7.3 尽可能使阀口壁厚相等, 膨胀均匀, 保持圆柱形不变</p>		
<p>19-7.4 使冷态下阀的倒角比阀座上的倒角大一点(30' ~ 1°)</p>		
<p>19-8 降低热应力</p>		
<p>19-8.1 采用加厚管板等挠性管板代替厚管板</p>		
<p>19-8.2 采用双层管板代替厚管板</p>		

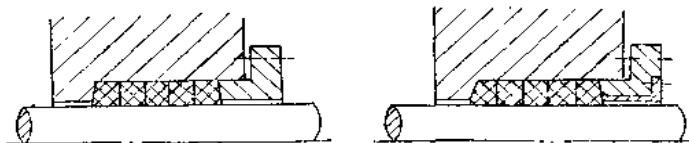


## 20. 结构安全性

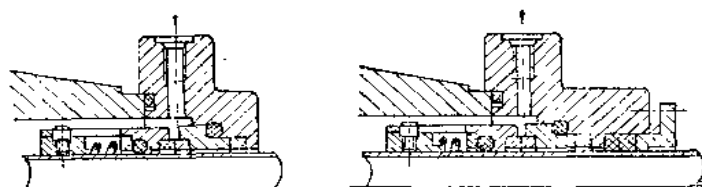
设计原则	不合理设计图例	合理设计图例
<b>20-1</b> 防止回转件凸出部分伤害人体		
<b>20-1.1</b> 将紧定螺钉凹入安装		
<b>20-1.2</b> 使刚性联轴器的联接螺栓被凸缘包起来		
<b>20-1.3</b> 使夹壳式联轴器的联接螺栓藏于联轴器的凹坑内		
<b>20-1.4</b> 将轴端外露的键槽用沉头螺钉固定平键堵塞		
<b>20-1.5</b> 改变刨刀压铁位置, 使压铁填满空隙		
<b>20-1.6</b> 将钩头楔键的外露钩头用罩包起来		
<b>20-2</b> 防止往复运动机件外露伤人		
<b>20-2.1</b> 活塞杆自由端加安全罩		

设计原则	不合理设计图例	合理设计图例
20-2.2 移动工作台影响人身安全的部位装安全栅栏		
20-3 防止机械过载		
20-3.1 采用安全联轴器		
20-3.2 使安全销准确地在规定载荷下被剪断，将销子受剪处车削成槽形		
20-3.3 使防爆膜准确地在规定压力下破裂，将膜的周边车削成圆周沟槽，或沿膜的中心线开十字槽		
20-4 防止误触控制器按钮，按钮外加护圈		
20-5 防止通过重要过道的管道法兰漏液毒害人，将法兰加罩并密封		
20-6 采用双层视镜玻璃，防止一层玻璃破裂时设备内介质吹出伤人		

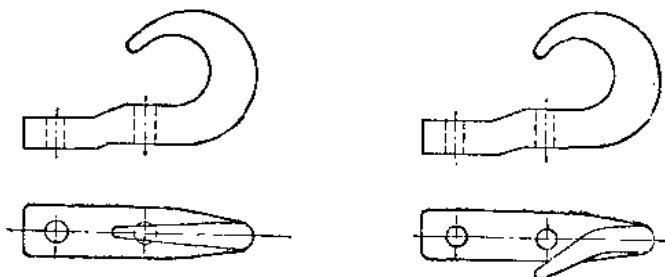
**20-7** 防止罩壳金属磨损起火，输送易燃易爆介质的泵的真料压系统衬套



**20-8** 防止机械密封损坏泄漏引起事故，增设轴动填料密封



**20-9** 防止水平牵引的钢丝绳扣滑脱，拉钩应变向一侧



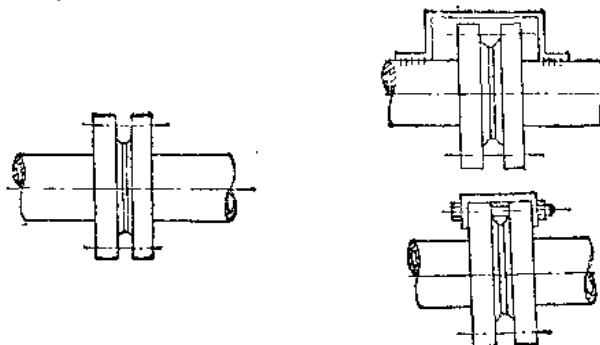
**20-10** 防止铅直牵引的钢丝绳扣滑脱，吊钩应装弹性锁片



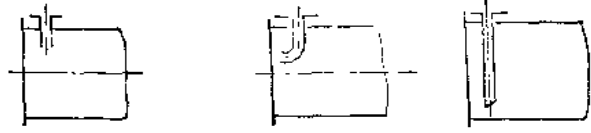
**20-11** 防止螺栓折断脱落引起破坏事故，应采用环首螺钉并用素链系住



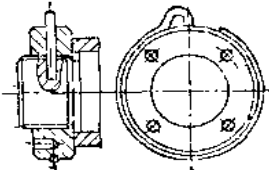
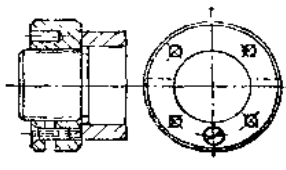
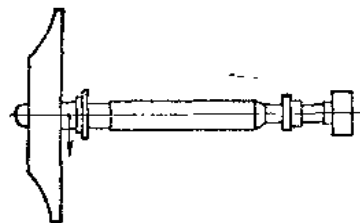
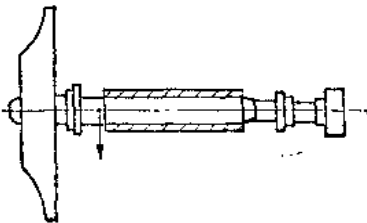
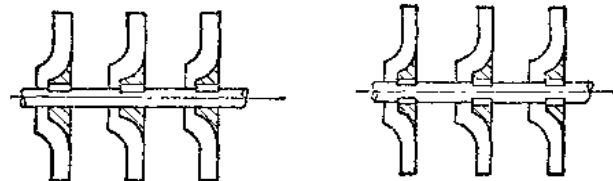
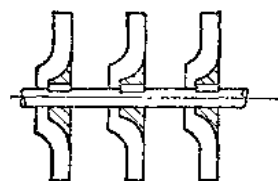
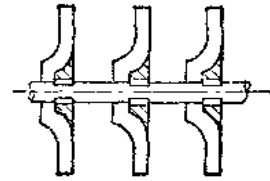
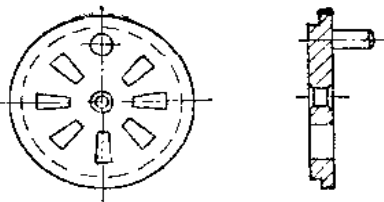
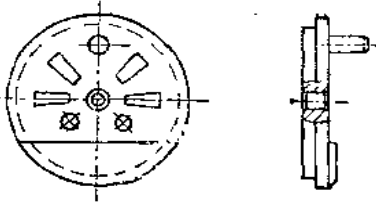
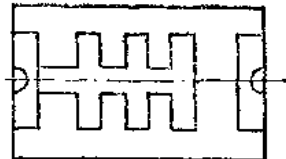
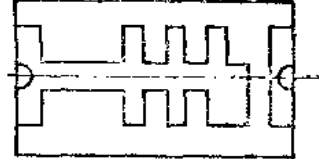
**20-12** 防止静电积聚，金属管连接处应装金属连接片



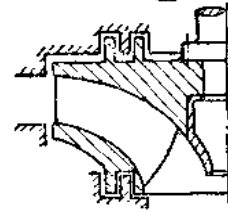
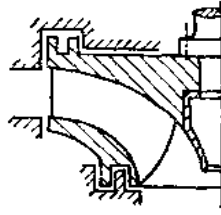
**20-13** 防止不导电的易燃液体因静电放电而爆燃，使加料管深插液体内，或紧挨内壁



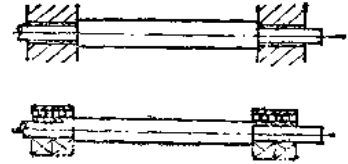
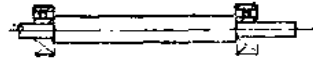
## 21. 运转平稳性

设计原则	不合理设计图例	合理设计图例
<p><b>21-1</b> 防止由于离心惯性作用而引起零件失效，高转速轴上的圆螺母不用弹性环，而用止退垫圈</p>		
<p><b>21-2</b> 将转子的重心设计在两轴承之间，以保持转子平衡</p>		
<p><b>21-3</b> 防止不平衡引起振动</p>		
<p><b>21-3.1</b> 保持转子静平衡，对称布置键槽</p>		
<p><b>21-3.2</b> 保持曲柄轮静平衡，对称配置平衡重</p>		
<p><b>21-4</b> 消除油膜自激振动，采用不对称油槽（亦可采用椭圆轴瓦、多油楔轴瓦）以破坏油膜推动轴颈甩转的连续性</p>		

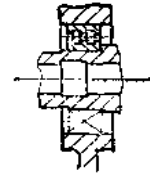
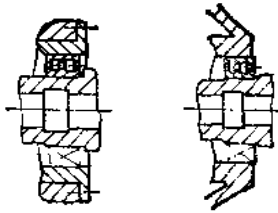
- 21-5 避免高速转轮自激振动, 将转轮上止漏环移向中心, 降低侧向推力



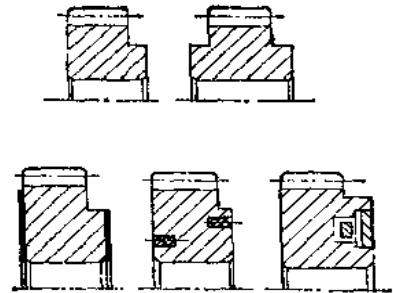
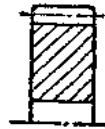
- 21-6 提高轴承抗振能力, 采用滑动轴承或双列向心滚动轴承



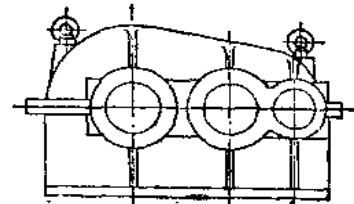
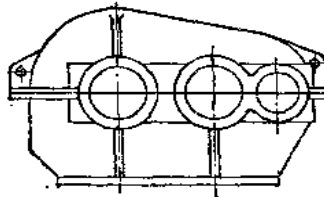
- 21-7 提高轴承的刚度, 尽可能避免采用衬套、外伸结构, 并将轴承直接支承在箱体中



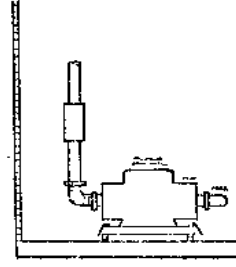
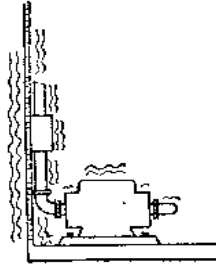
- 21-8 提高齿轮刚度, 采用阻尼材料, 以降低齿轮振动噪声



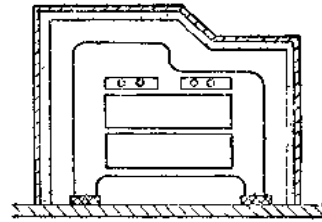
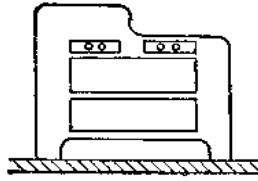
- 21-9 提高齿轮箱刚度, 降低振动



- 21-10** 使泵不与辐射面、基础直接接触,采用软管、减振器和消音器降低振动和噪声

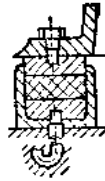


- 21-11** 采用减振器和消音罩降低振动和噪声

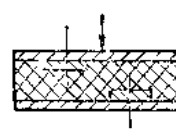
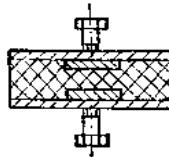


- 21-12** 使减振器功能可靠

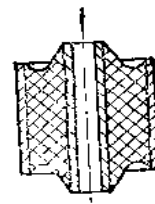
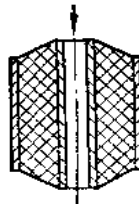
- 21-12.1** 使减振器橡胶变形具有可让性



- 21-12.2** 使减振器整个的橡胶截面具有弹性作用,并将金属加强板交错布置



- 21-12.3** 将边端削薄,降低橡胶边端收缩时产生的应力

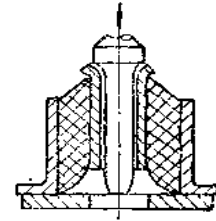
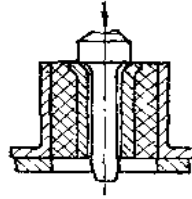


设计原则

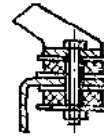
不合理设计图例

合理设计图例

21-12.4 降低峰值应力使橡胶凹入并支承在板上

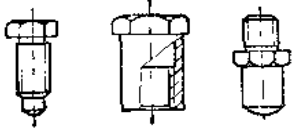
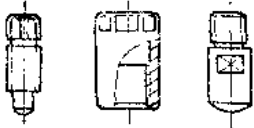
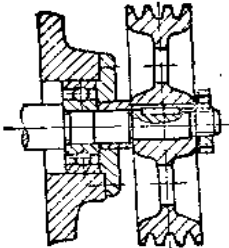
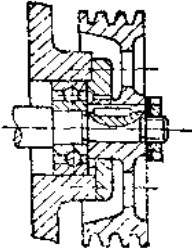
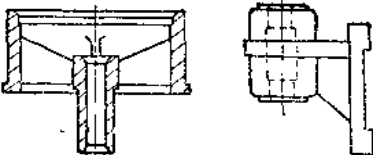
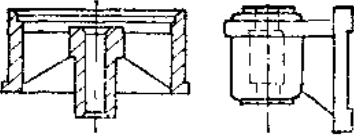
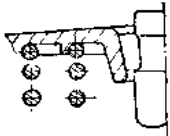
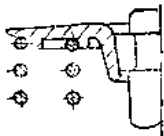
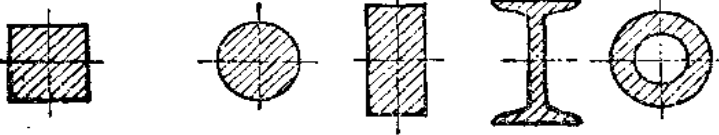
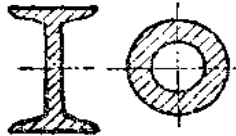
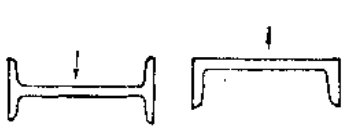



21-12.5 避免机器与基础直接接触，基础上下两侧垫入橡胶块

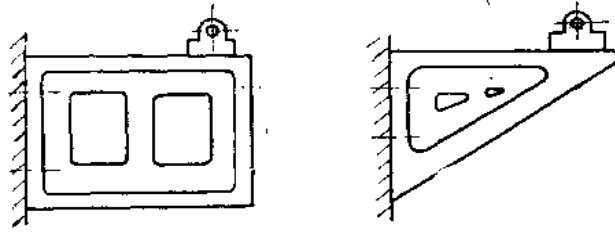




## 22. 减轻重量、节约材料

设计原则	不合理设计图例	合理设计图例
22-1 缩小外形尺寸		
22-1.1 采用小六角头螺栓等零件		
22-1.2 使带轮靠近轴承		
22-1.3 避免外伸突出或过于外伸		
22-1.4 按弹簧的内径确定弹簧座定心凸台		
22-2 使零件有受力合理的断面形状		
22-2.1 尽可能选用相对刚度、相对弯曲强度最大的断面形状		
22-2.2 使零件在最大刚度、最大强度方向上承受载荷		

## 22-2.3 采用等强度梁

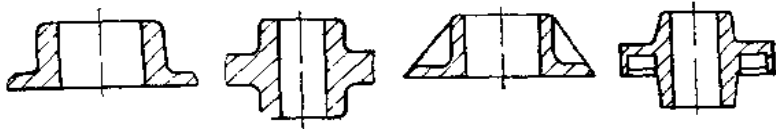


## 22-3 减轻重量

## 22-3.1 采用冲压件，并以冲孔孔口的变形增加孔的深度，保证螺纹拧入长度



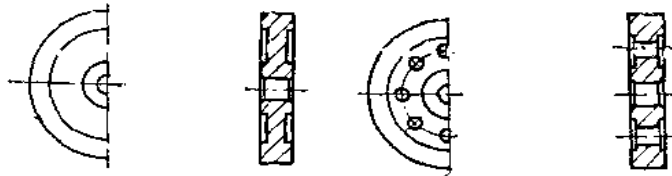
## 22-3.2 利用加强肋减薄壁厚



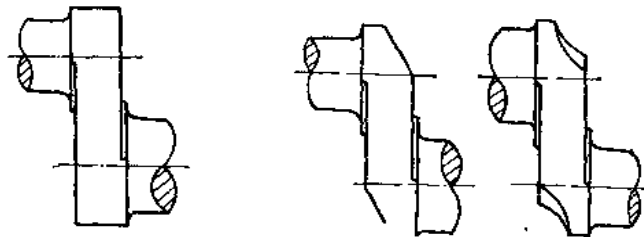
## 22-3.3 在零件不受力的部位减薄壁厚



## 22-3.4 在带轮上做出孔

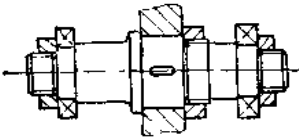
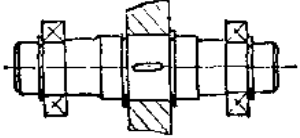
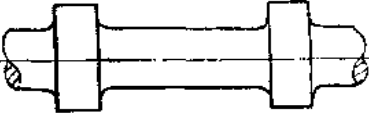
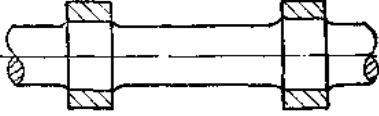
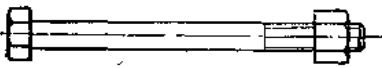
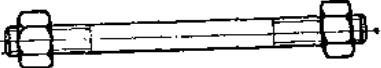
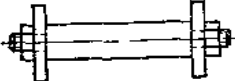
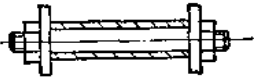
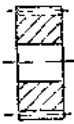
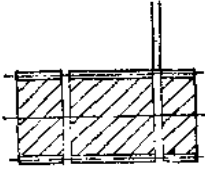
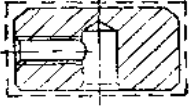
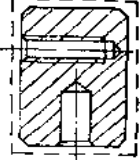

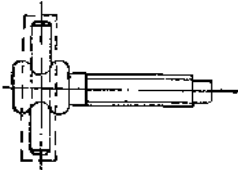
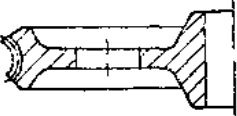
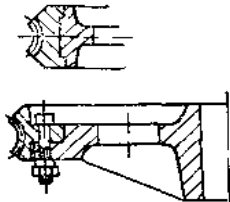


## 22-3.5 去掉曲轴上非受力部分的材料

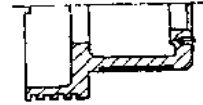
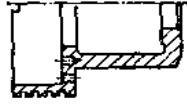


## 22-3.6 采用圆锥形壳体

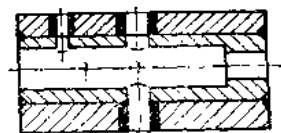
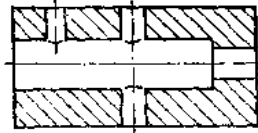


设计原则	不合理设计图例	合理设计图例
22-4 避免使用大的和贵重的材料		
22-4.1 采用轴用弹性挡圈代替轴上凸套		
22-4.2 采用轴套代替整体锻造凸肩		
22-4.3 采用双头螺栓代替螺栓		
22-4.4 采用套筒代替定位凸台		
22-4.5 采用精密切割出齿轮坯料		
22-4.6 将螺孔向上移, 缩小直径, 加大长度		
22-4.7 采用组合手柄代替整体手柄		
22-4.8 采用青铜-灰铸铁组合蜗轮代替青铜整体蜗轮		

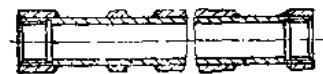
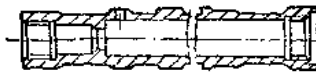
22-4.9 采用青铜衬套活塞代替青铜活塞



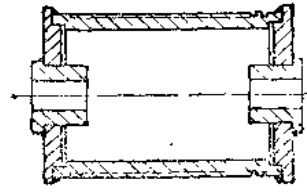
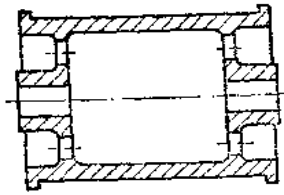
22-4.10 采用不锈钢-碳钢焊接组合泵体代替整体锻造泵体



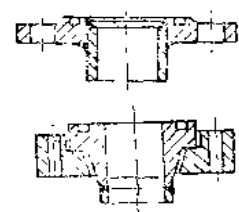
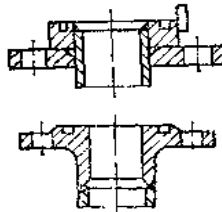
22-4.11 采用无缝钢管焊接结构代替整体结构



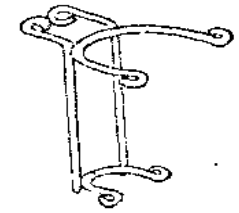
22-4.12 采用焊接卷筒代替铸造卷筒



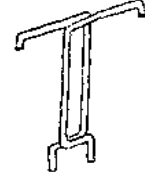
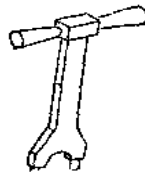
22-4.13 用活塞或堆焊不锈钢法兰代替整体不锈钢法兰



22-4.14 采用金属线材成形支架代替铸造支架

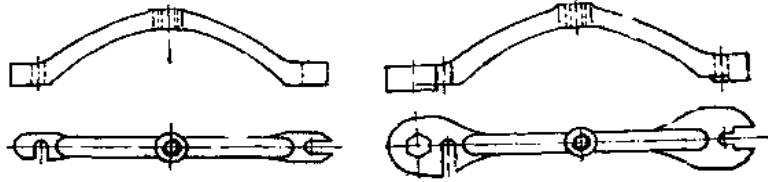


22-4.15 采用金属线材成形扳手代替锻造扳手

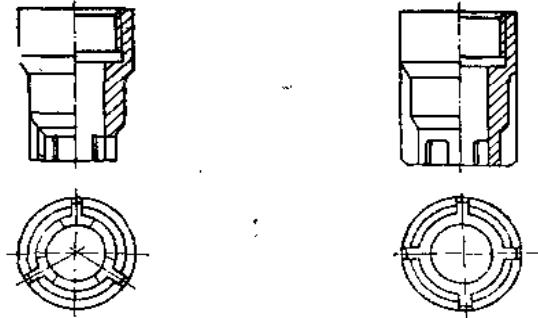


## 22-5 使零件具有多种功能

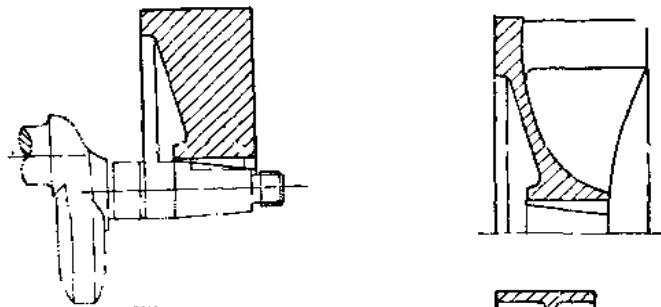
## 22-5.1 将扳手做在压板上



## 22-5.2 将泵支脚设计成兼作拆装叶轮的专用工具，为四点式



## 22-5.3 将压缩机的飞轮改作风扇叶轮，并保持原来的飞轮惯性矩不变



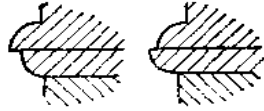
## 22-5.4 使弹性联轴器带有制动鼓



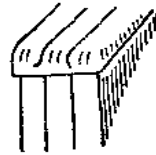
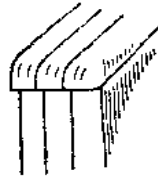
## 23. 结构外观

设计原则	不合理设计图例	合理设计图例
<p><b>23-1</b> 保持机器的均衡性,使相对于对称轴线两侧的惯性矩大致相等</p>		
<p><b>23-2</b> 保持机架支承稳定,宜扩大支承面并竖直支承载荷</p>		
<p><b>23-3</b> 保持压缩机中体对称</p>		
<p><b>23-4</b> 避免铸件孔与铸件外形偏差过大而影响外观,将铸件型腔置于一个砂箱内</p>		
<p><b>23-5</b> 避免因制造偏差影响凸起箱盖的外观,宜采用平整箱盖</p>		
<p><b>23-6</b> 不可在盖上钻孔处设置凸台,以避免凸台铸造偏差影响箱盖钻孔与箱体钻孔的同心</p>		
<p><b>23-7</b> 部件接合处适当地采用装饰性凸边,以掩盖外形不吻合误差,减少加工和修改外形的工作量</p>		

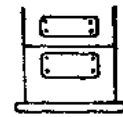
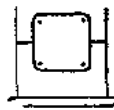
23-8 避免在铸件外观结合面的圆滑过渡处分型



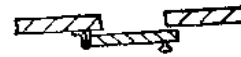
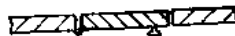
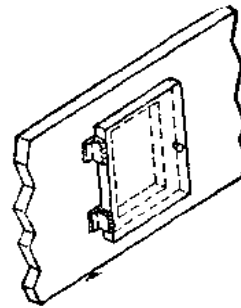
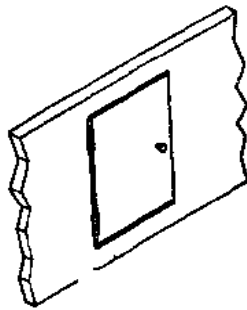
23-9 避免铸件表面的装饰性肋条直接对缝相联



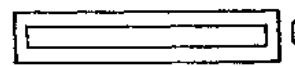
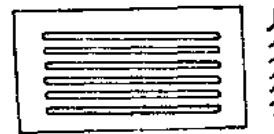
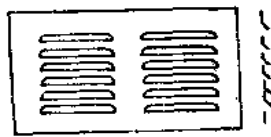
23-10 不可在两个箱体或部件上用同一个盖(或罩)相联



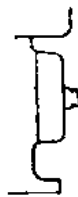
23-11 避免因制造偏差、配合不良和变形引起门与门孔错位, 不采用平整关闭的门, 应采用交叠的门



23-12 使罩壳等薄板的装饰性凸凹线整体工整, 将凸边置于内面, 不可线条过多、过密和零乱



23-13 不可使凸凹变化太多, 以保证整体性强



设计原则	不合理设计图例	合理设计图例
<p><b>23-14</b> 采用活动挡板或宽型材压条将繁杂的零件遮蔽</p>		
<p><b>23-15</b> 将地脚螺孔缩入机座，以避免影响整体性</p>		



## 24. 防腐结构

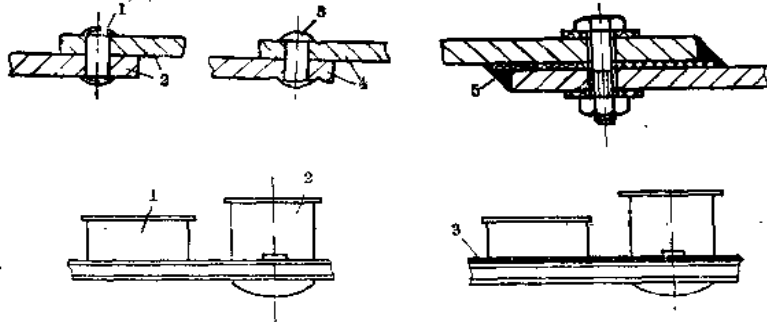
设计原则

不合理设计图例

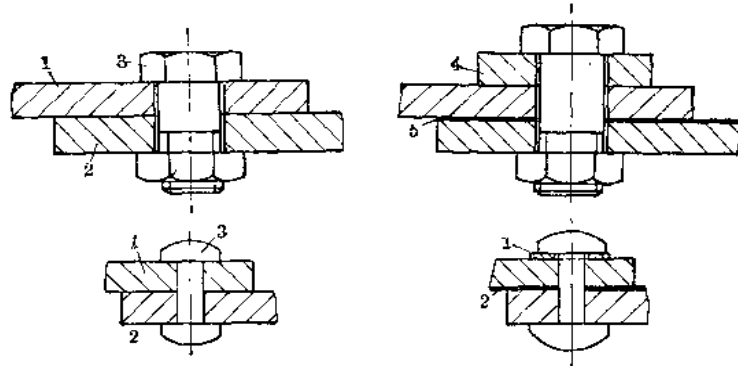
合理设计图例

### 24-1 防止电化学腐蚀

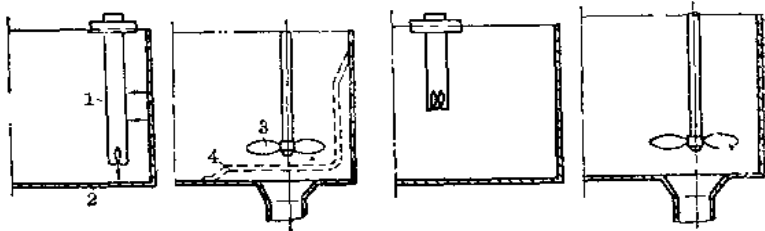
24-1.1 电位不同的金属相联时要衬绝缘垫并用绝缘胶密封。图中 1—铝, 2—钢, 3—铜, 4—铝, 5—绝缘



24-1.2 用牺牲垫圈保护连接中的阳极金属。图中 1—钢, 2、3—铜, 4—锌牺牲垫圈, 5—绝缘垫



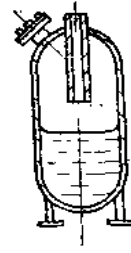
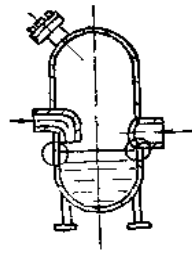
24-1.3 不能绝缘时加长电解路线(增加内电阻)。见图应增大铜蛇管 1 与钢容器 2 的间距, 去掉铜搅拌器 3 与钢容器 2 之间的金属筛板 4



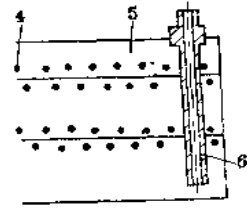
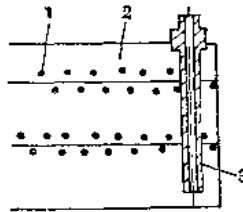
24-1.4 避免形成局部高温(或温差), 将加热器置于容器中央



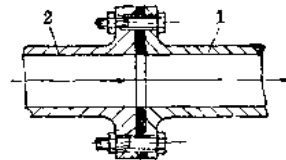
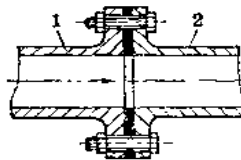
**24-1.5** 避免形成溶液的浓差区 (画圈处), 将加料口置于容器中央, 容器内为稀溶液, 加入容器中的为浓溶液



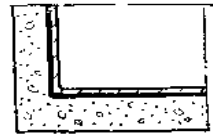
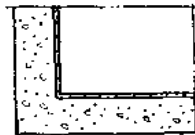
**24-1.6** 不可使阳极面积小, 阴极面积大。图中 1—钢铆钉(阳极), 2—蒙乃尔合金板(阴极), 3—镀锌钢板(阳极), 4—蒙乃尔合金钢钉(阴极), 5—镀锌钢板(阳极), 6—铜管(阴极)



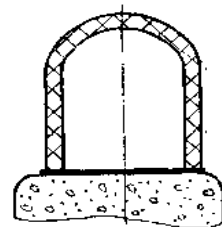
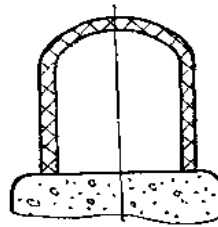
**24-1.7** 避免介质流动加剧电化学腐蚀, 将阳极材料置于下流。图中 1—阳极, 2—阴极



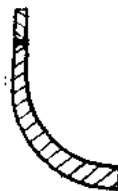
**24-1.8** 避免铅设备与混凝土或石棉直接接触

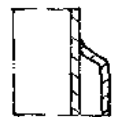

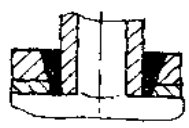
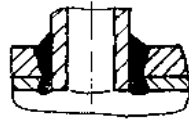
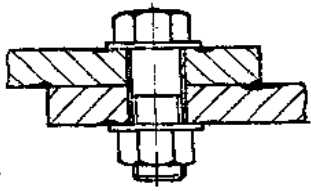
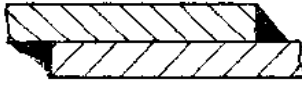
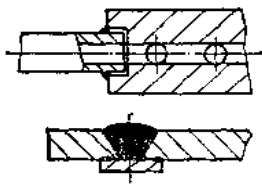
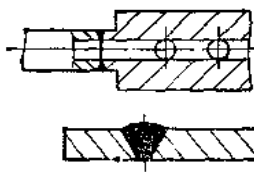
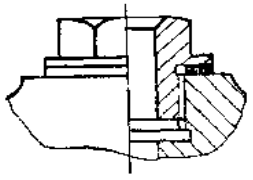
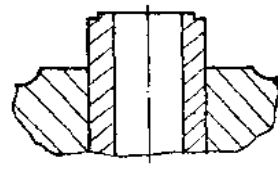
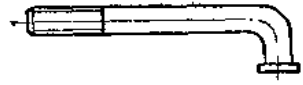
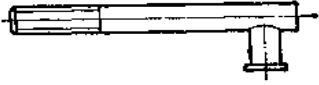
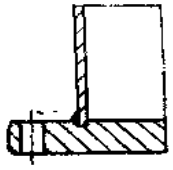
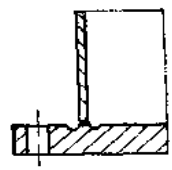


**24-1.9** 避免铅设备与混凝土或石棉直接接触

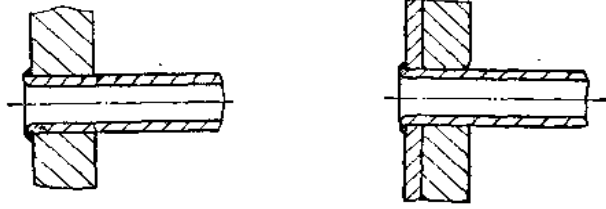


**24-1.10** 避免相焊接零件的表面物理状态差异悬殊, 将封头锥面加工移至外壁

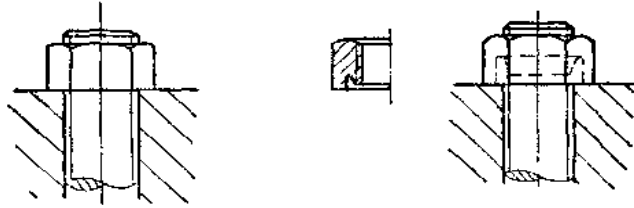


设计原则	不合理设计图例	合理设计图例
<p><b>24-1.11</b> 防止碳钢与不锈钢焊接，因碳钢对不锈钢的稀释和增碳作用会引起晶间腐蚀，需采用不锈钢垫板过渡</p>		
<p><b>24-1.12</b> 将不锈钢多道焊接的最后一道焊缝置于腐蚀介质一侧</p>		
<p><b>24-2</b> 防止缝隙腐蚀</p>		
<p><b>24-2.1</b> 采用焊接代替螺纹联接</p>		
<p><b>24-2.2</b> 采用对接焊接</p>		
<p><b>24-2.3</b> 避免采用螺纹联接</p>		
<p><b>24-3</b> 防止应力腐蚀</p>		
<p><b>24-3.1</b> 用焊接件代替煨弯件</p>		
<p><b>24-3.2</b> 避免高的热应力、过烧、晶粒粗大，合金成分烧蚀，使相焊接的不锈钢零件壁厚差不悬殊</p>		

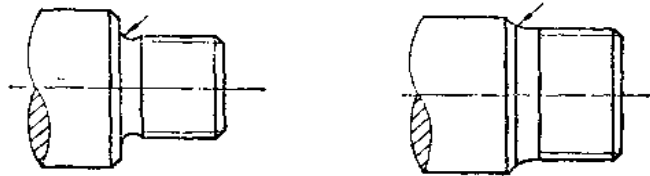
24-3.3 避免应力腐蚀，采用不锈钢管、复合钢板，并须降低胀接处的峰值应力。图中胀板右侧面为不锈钢（接触腐蚀介质），左侧面为碳钢（接触水）



24-3.4 将螺母内割，降低峰值应力



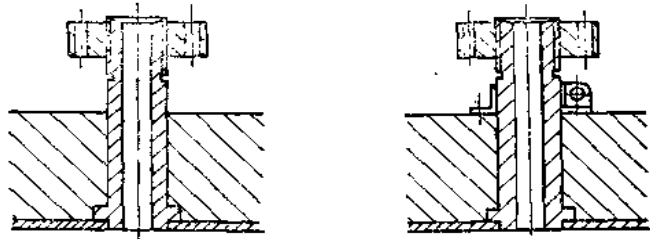
24-3.5 采用半径尽可能大的圆角，降低峰值应力



24-3.6 给出零件的最佳的几何形状，改点焊为铆接避免腐蚀疲劳

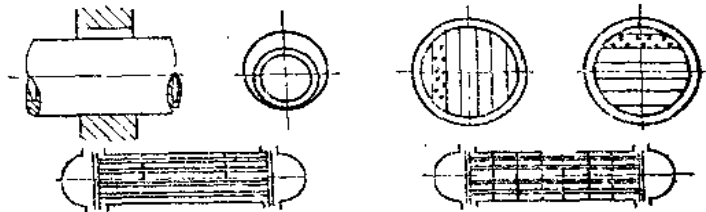


24-3.7 加强设备接管支撑，防止因该管振动引起衬里与接管焊缝的腐蚀疲劳

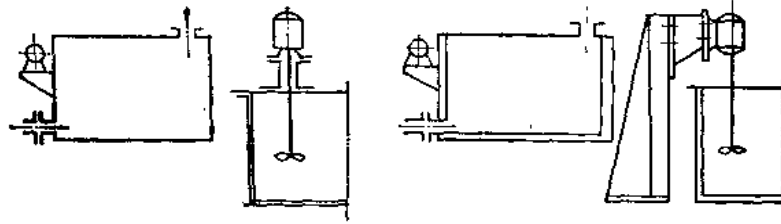


24-4 防止振动加剧腐蚀

24-4.1 适当增加折流板或采用折流棒(纵向或横向)

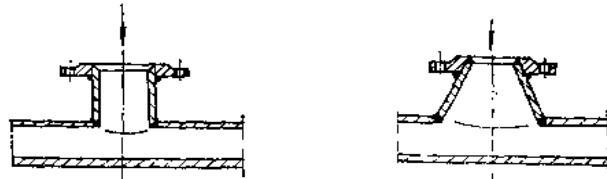


24-4.2 将振源隔离

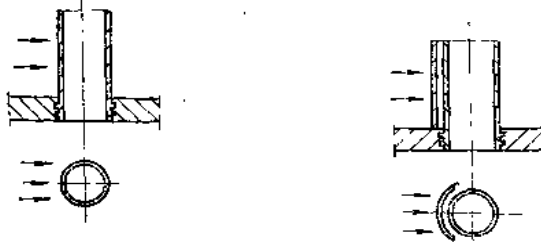


24-5 防止冲刷腐蚀

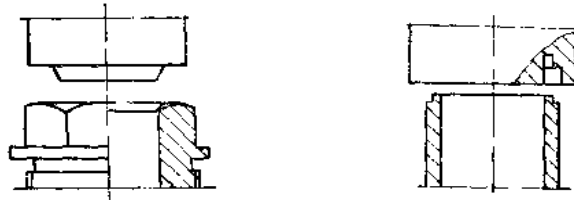
24-5.1 将进口接管做成扩大形



24-5.2 在流体冲刷方向上列管加半管保护

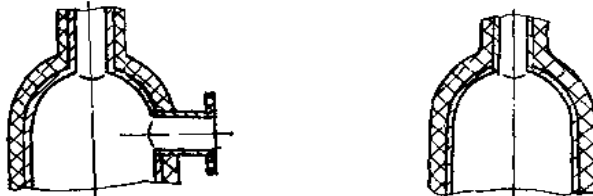


24-5.3 使密封面不直接受高速流体中夹带颗粒的冲刷

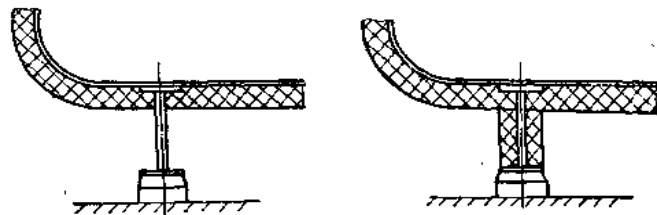


24-6 防止露点腐蚀

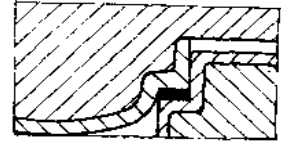
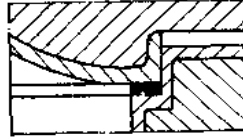
24-6.1 尽可能不在设备上开无保温的人孔等



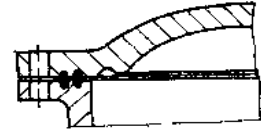
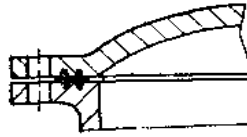
24-6.2 不使高温设备局部冷却, 如图中钢支柱也需有保温层



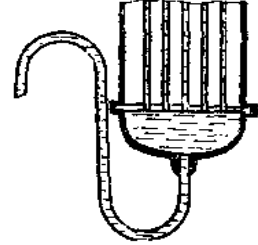
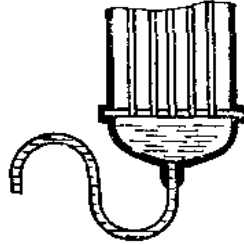
24-6.3 顶盖向下凸，避免冷凝液腐蚀密封垫圈和衬里



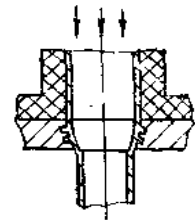
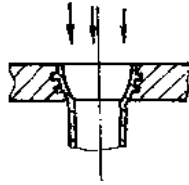
24-6.4 将铸铁顶盖边缘制成带滴液用的凸缘，以避免冷凝液腐蚀密封垫圈



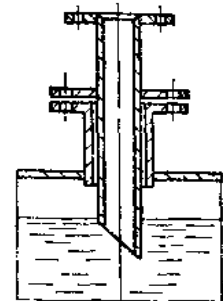
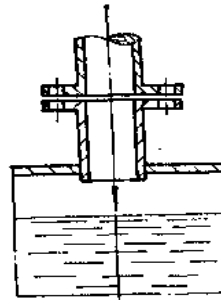
24-7 提高液封高度、防止冷凝器局部过热而腐蚀



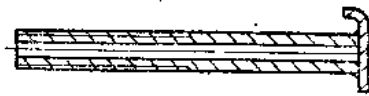
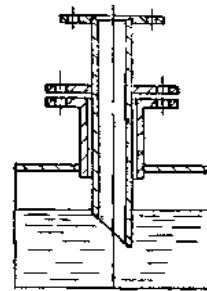
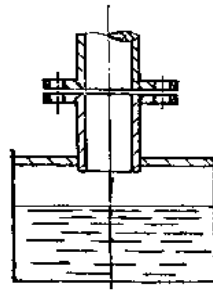
24-8 防止高温氧化，用耐火粘土及瓷管保护列管管头及管板



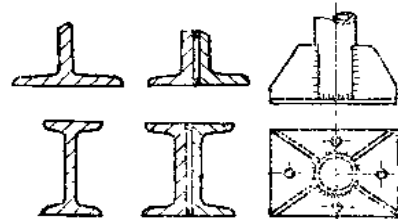
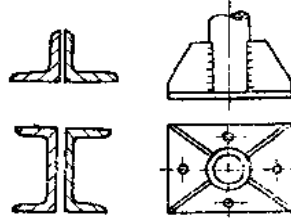
24-9 防止介质沿器盖和器壁流下引起局部腐蚀，进液管加装套管



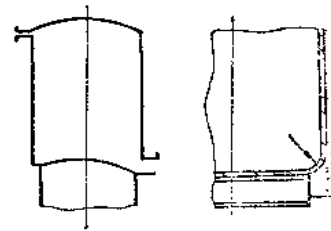
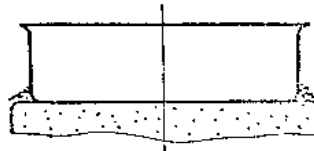
24-10 防止外面液体漏入设备内引起腐蚀，将盖子的下端包住设备的外壁，填料移入盖内



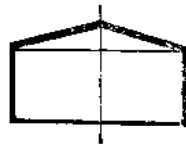
24-11 减少受腐蚀的面，将敞开的孔、缝封闭



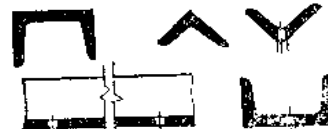
24-12 避免接触腐蚀介质，容器底部四周积垢，容器底部采用曲面结构或将支架截短，加滴水板



24-13 避免水沿器壁流下引起腐蚀，采用滴水管




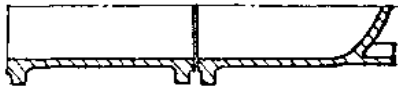
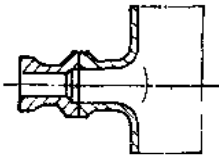
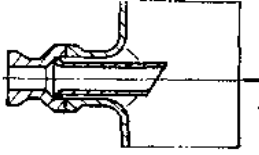

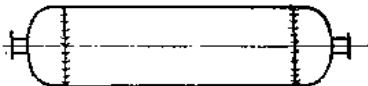
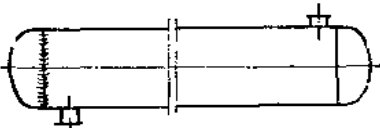
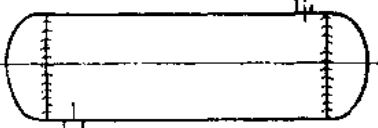
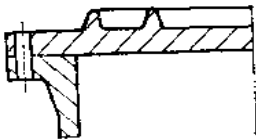
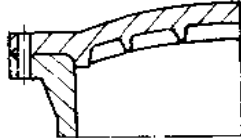
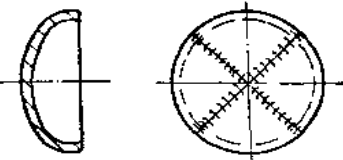
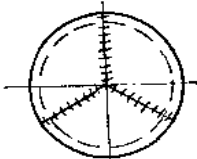
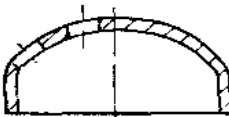
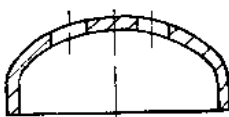
24-14 防止钢结构积水，使凹槽向下或在向上的凹槽上钻孔



设计原则	不合理设计图例	合理设计图例
<p>24-15 防止容器介质积滞加速腐蚀</p>		
<p>24-15.1 给出排液孔</p>		
<p>24-15.2 采用平管板并使管头与管板相平齐</p>		
<p>24-15.3 设备冷却套的底部向一侧倾斜</p>		
<p>24-15.4 底部出口管采用对接焊</p>		
<p>24-15.5 避免沉淀加剧腐蚀, 不可使容器壁与器底联接有死角</p>		



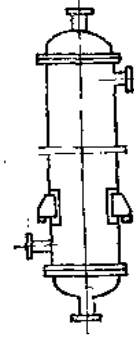
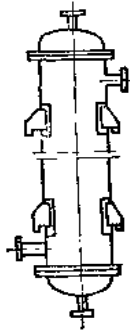
## 25. 静 设 备

设计原则	不合理设计图例	合理设计图例
<b>25-1 容器、盖、接管、支座</b>		
<b>25-1.1</b> 过大、过重的高硅铁铸造容器采用组合结构		
<b>25-1.2</b> 避免高硅铁铸件过热损坏, 用套管保护高硅铁铸件不直接受热液体、或蒸汽冲击		
<b>25-1.3</b> 使受压容器细长, 以减小壁厚		
<b>25-1.4</b> 尽可能避免各器外形尺寸超限		
<b>25-1.5</b> 尽可能避免受压容器使用平顶盖		
<b>25-1.6</b> 尽可能使拼焊的封头采用奇数焊缝, 以减小收缩应力		
<b>25-1.7</b> 不可在封头的边缘部分开孔		

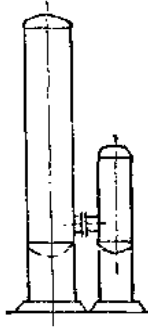
设计原则	不合理设计图例	合理设计图例
25-1.8 不可在高压容器筒身开孔		
25-1.9 尽可能避免在封头的厚缝上开孔		
25-1.10 不可使压力容器筒体上的非圆开孔的长轴平行于筒体的轴线		
25-1.11 不可在压力容器上开矩形的孔，以避免应力高度集中		
25-1.12 使焊缝远离应力集中部位		
25-1.13 避免产生裂纹，使角焊缝远离边缘		
25-1.14 用角钢等加强受压贮罐锥形顶(底)与柱形侧壁联接，顶(底)的焊缝必须接近顶(底)部		

设计原则	不合理设计图例	合理设计图例
<b>25-1.15</b> 使设备接管有足够的长度		
<b>25-1.16</b> 使气体在设备内均匀分布，气体进口管作成斜口等形式伸入设备		
<b>25-1.17</b> 防止液体流出设备时形成涡流，采用防涡流挡板		
<b>25-1.18</b> 防止分离出的液滴被气流带出分离器，挡板下端须弯卷，并加液封		
<b>25-1.19</b> 使容器相邻的纵焊缝距离不小于200mm		
<b>25-1.20</b> 卧式设备筒体纵焊缝可应置于筒体下部140°的包角范围内		
<b>25-1.21</b> 不可使卧式设备的封头与筒体的焊缝紧靠着支座，以防止焊缝应力集中和筒体轴向应力不均匀		

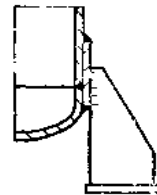
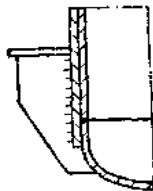
**25-1.22** 防止立式设备支承受力不均而引起的破坏，将设备支承在一个横截面上，不可支承在过多的横截面上



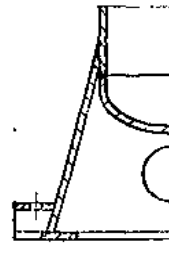
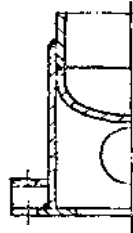
**25-1.23** 使设备布置紧凑，尽可能利用大设备支承悬挂小设备



**25-1.24** 适合设备布置需要，提高设备支座

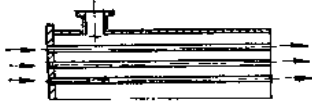
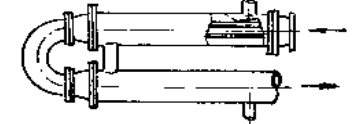
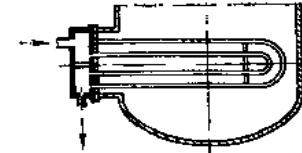
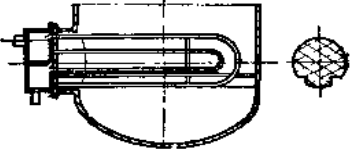
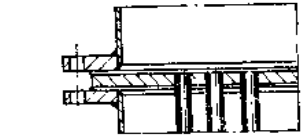
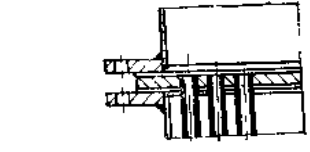
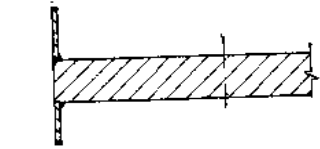
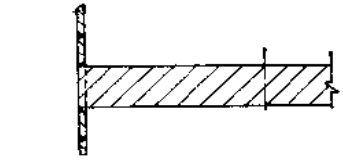
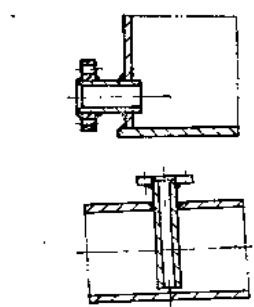
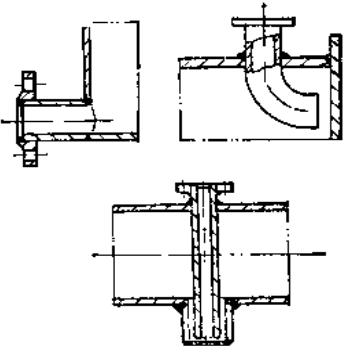
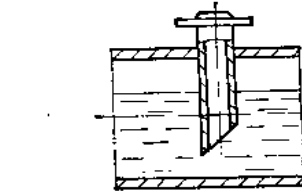
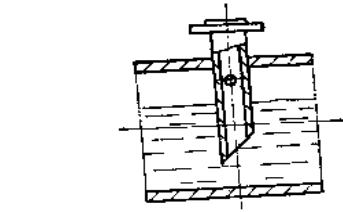


**25-1.25** 使支承面上的应力均匀连续，采用圆锥支座

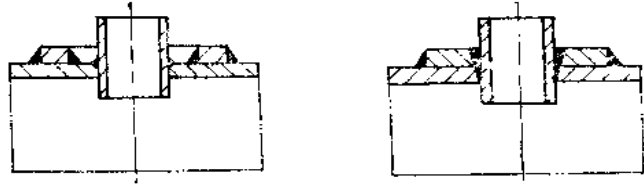


**25-1.26** 避免刚性破坏、采用梳状断开的裙座



设计原则	不合理设计图例	合理设计图例
<p>25-1.27 避免管板与列管焊接处振动腐蚀而渗漏，改氮泵压缩机列管冷却器为U形冷却器</p>		
<p>25-1.28 支承好伸入设备内的U形管束和管束的罩壳</p>		
<p>25-1.29 避免在筒体与管束之间的管板上形成高的弯曲应力而开裂</p>		
<p>25-1.30 避免特厚板块(厚300~500 mm)与薄壁壳体焊接困难，采用过渡联接件先与管板焊接，焊前充分预热，焊后热处理</p>		
<p>25-1.31 使料液能放光，将出口管设在设备最低位置</p>		
<p>25-1.32 防止伸入料液中的加料管倒虹吸，在管上开孔</p>		

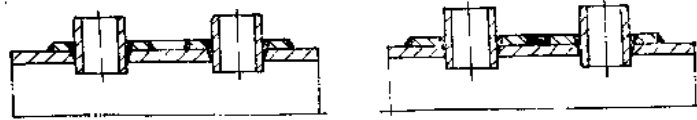
25-1.33 不可在补强板与孔口接管之间留有空隙



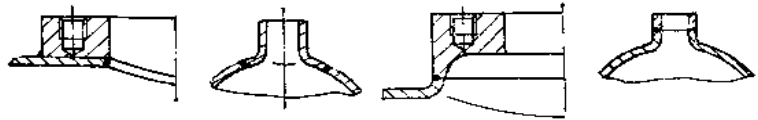
25-1.34 避免刚性破坏,降低重要厚壁容器开孔的刚度,孔口附近开槽



25-1.35 多个相邻的孔,采用联合补强

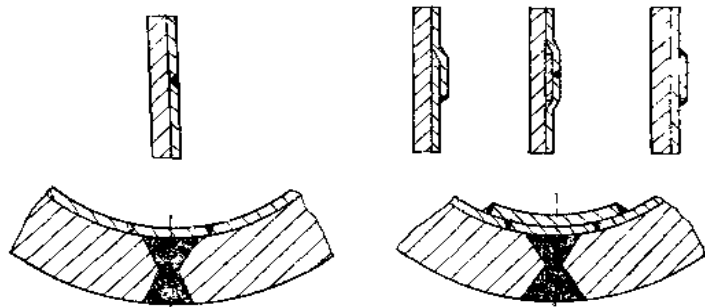


25-1.36 尽可能利用孔口凸起的卷边的挠性补强孔口

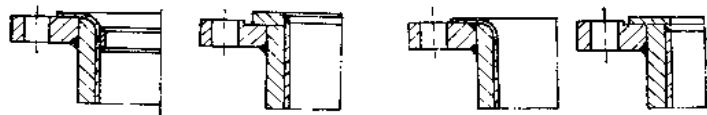


25-2 衬钛设备

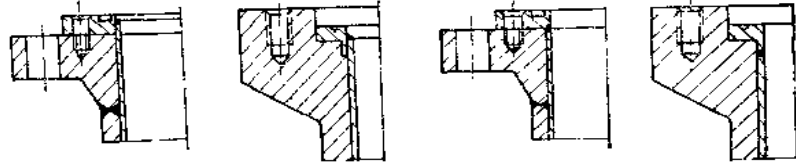
25-2.1 防止基层铁对钛焊缝污染、钛衬里采用搭接接头或对接接头,加钛盖板



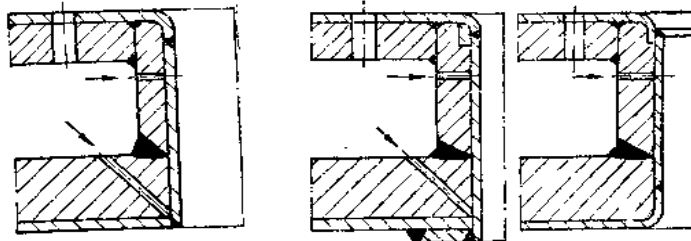
低压设备法兰



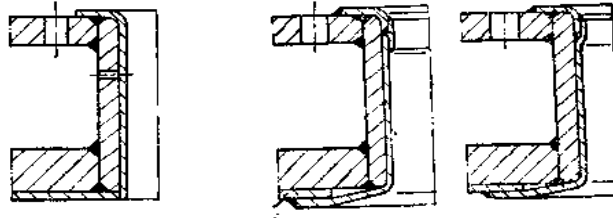
中高压容器法兰



设备接管



复合板容器钛管与钛板的焊接, 须将钛板钛复合层端边切去, 在留下的孔隙 (图中三角形范围) 用银焊填满



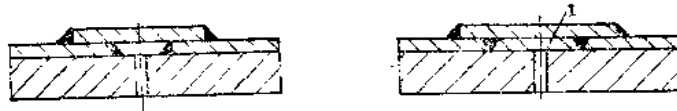
25-2.2 防止衬里焊缝污染, 在衬里焊缝背侧钻孔通入惰性气体。图中 1—银钎焊缝, 2—钛条或银条, 3—钛螺钉



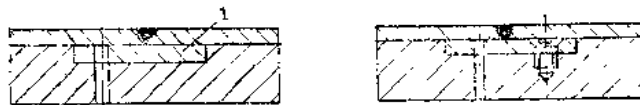
25-2.3 使钛衬里焊缝不与钢筒体接触, 将在焊缝下的钢筒体开深小于 3mm 的槽 (图中 1)


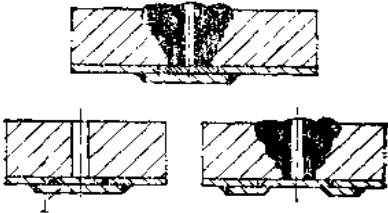
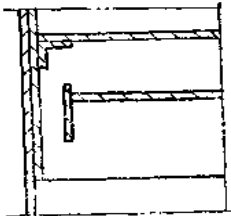
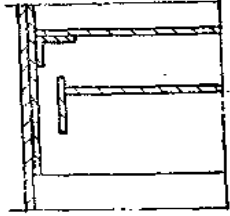
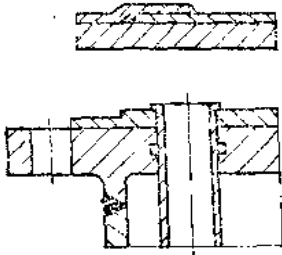
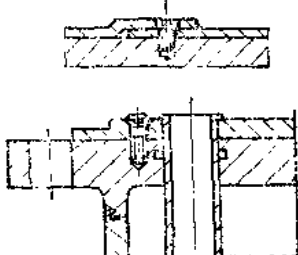
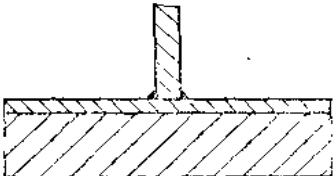
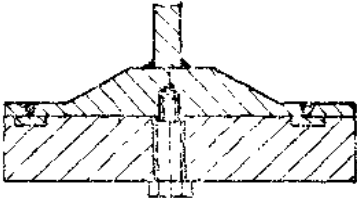
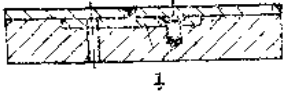
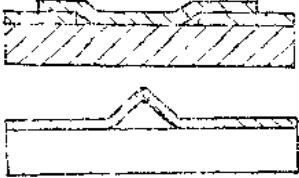
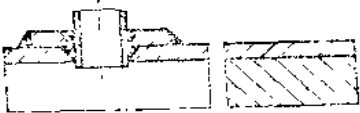
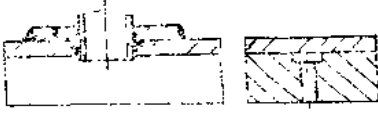


25-2.4 将钛衬里焊缝下的钛板或银板 (图中 1) 用银钎焊或螺钉固定在钢筒体上



25-2.5 在钛衬里盖板下镶嵌钛板或银板, 图中 1—银板



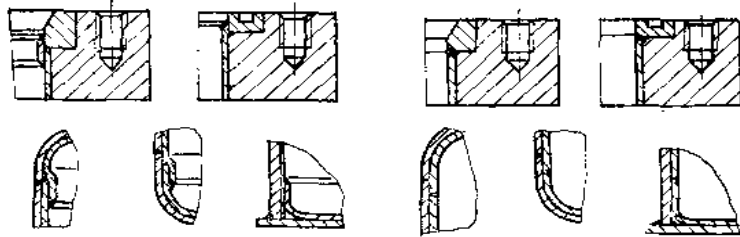
设计原则	不合理设计图例	合理设计图例
<p><b>25-2.6</b> 不可使复合板基层钢板焊缝下的复合层磨光处与钛衬里盖板间空着</p>		
<p><b>25-2.7</b> 保证衬里端部密封，采用银钎焊等</p>		
<p><b>25-2.8</b> 用螺钉加固钎焊部分</p>		
<p><b>25-2.9</b> 加厚支承内件处的衬里层，并用螺钉将其紧固于壳体上</p>		
<p><b>25-2.10</b> 衬里不锈钢件与钛件组合结构的热膨胀</p>		
<p><b>25-3</b> 衬里衬砌设备</p>		
<p><b>25-3.1</b> 复衬结构的板必须进行检测漏孔（复衬结构应包括衬里和补强板等）</p>		



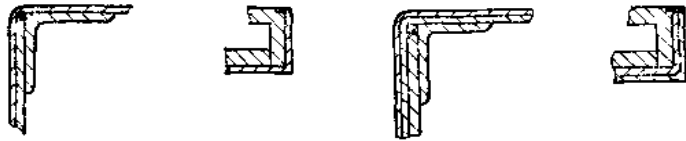
25-3.2 衬里厚度应按衬里不同部位的腐蚀速率确定



25-3.3 尽可能使衬里采用对接, 避免搭接



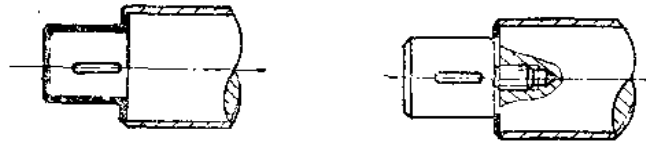
25-3.4 加强衬里层, 采用双层衬里



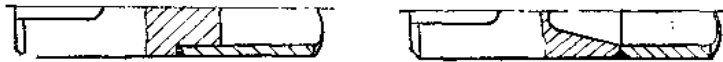
25-3.5 不可将衬里连到结构中承受载荷, 以避免衬里受到应力腐蚀和损伤



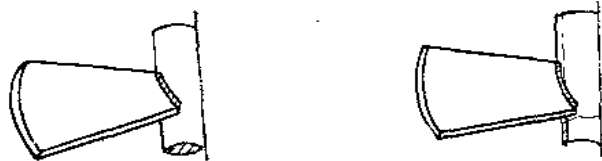
25-3.6 搅拌器轴头不采用堆焊结构, 避免溢槽等部位腐蚀



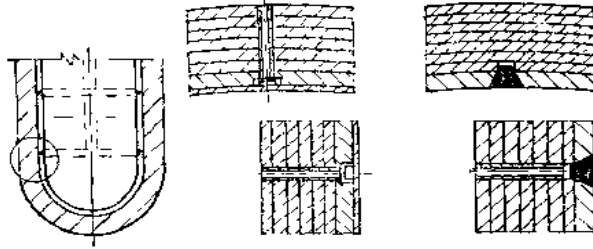
25-3.7 不锈钢搅拌轴采用焊接部位等厚度焊接



25-3.8 不锈钢搅拌器叶片与空心轴焊接



**25-3.9** 大型不锈钢衬里设备尽量不要进行机械加工。反应器检漏蒸汽槽可采用层板纵向、环向点焊联接形成



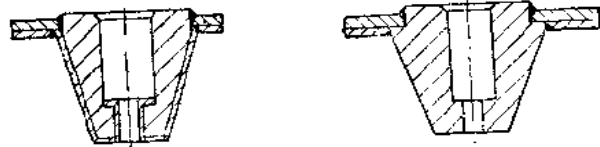
**25-3.10** 使塞焊、点焊衬里的焊点受力均匀，焊点布置采用等边三角形



**25-3.11** 塞焊孔径须合适( $\phi 12 \sim \phi 25$ , 深3mm以上), 以避免未焊透和产生气孔



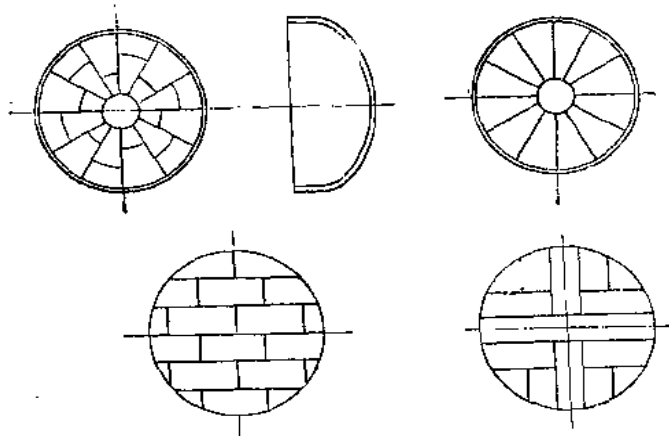
**25-3.12** 小的零件不宜采用不锈钢衬里



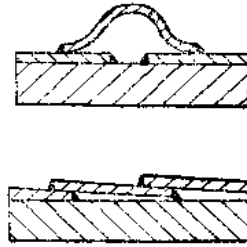
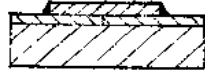
**25-3.13** 尽可能减少环向焊缝, 避免焊缝收缩时影响衬里与基体的贴紧



**25-3.14** 尽可能减少T形焊缝

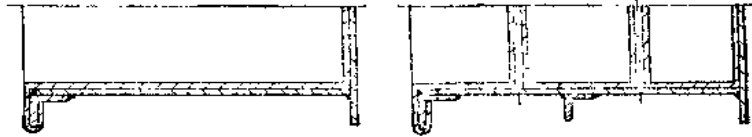


25-3.15 保证高温下工作的衬里能自由膨胀

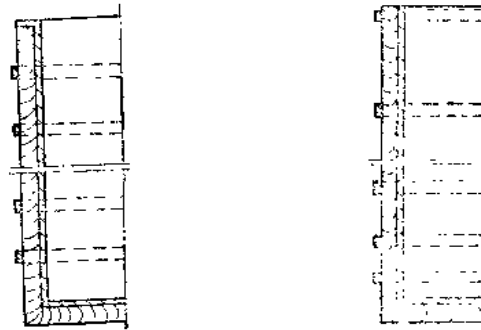


25-4 衬铅设备

25-4.1 保证衬铅容器的刚性，内用拉筋拉紧，外用角钢支撑



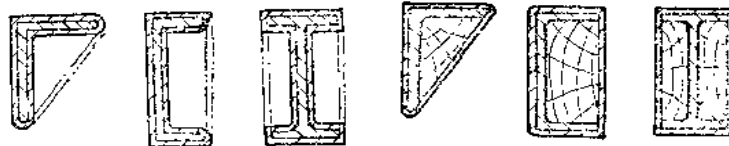
25-4.2 受静压强的高大衬铅容器的箍条布置上疏下密




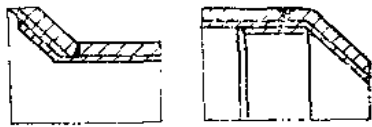
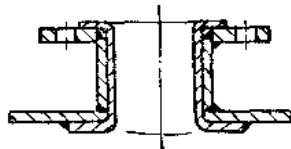
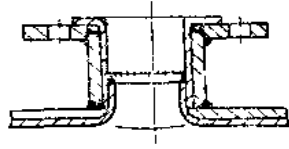


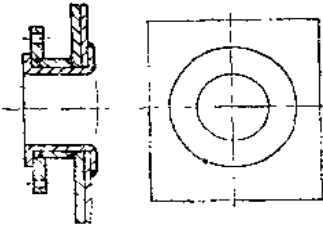
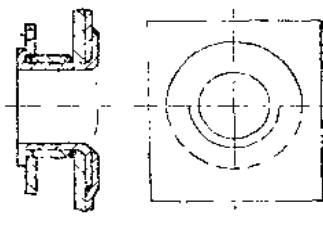
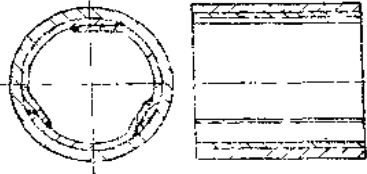
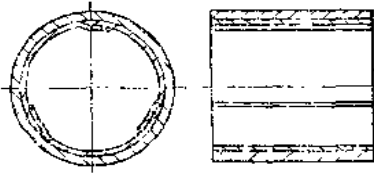

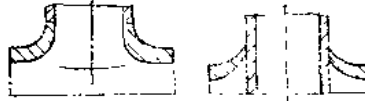


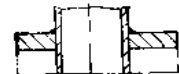
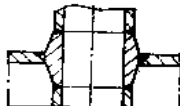
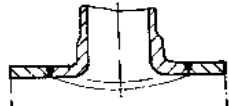
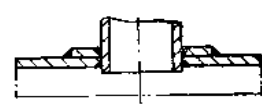
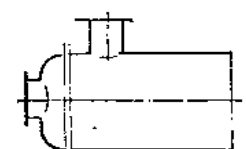
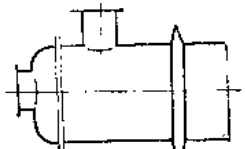
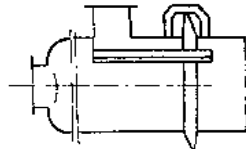
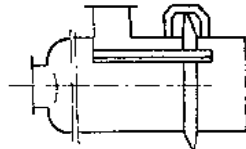
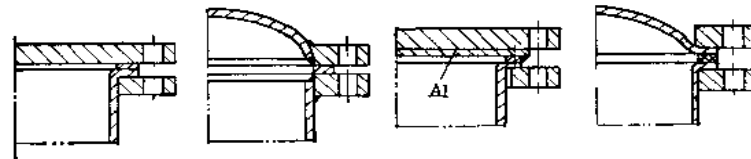
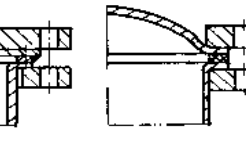
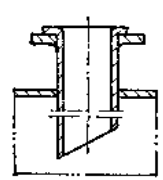
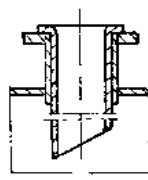
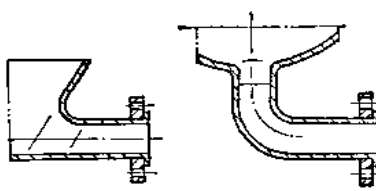
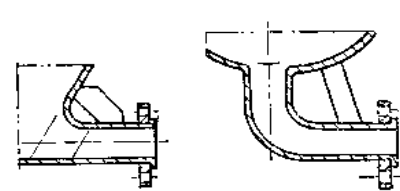
25-4.3 衬铅设备的拉筋伸出在器外的螺杆端用耐酸胶泥、沥青保护



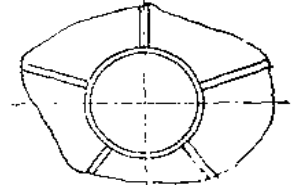
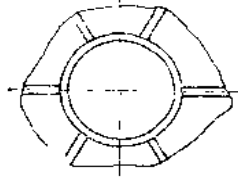
25-4.4 用木料填充衬铅型钢的内凹部分，以方便施工，保证使用



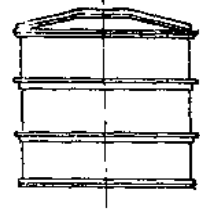
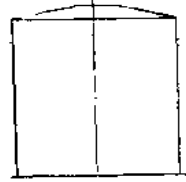
设计原则	不合理设计图例	合理设计图例
<p>25-4.5 尽可能采用易于焊接的组对形式，变横焊为平焊</p>		
<p>25-4.6 避免把焊缝设在拐角处</p>		
<p>25-4.7 避免向上开孔的衬里有仰焊缝</p>		
<p>25-4.8 避免向下开孔的衬里有仰焊缝</p>		
<p>25-4.9 避免横向开孔的衬里有仰焊缝</p>		
<p>25-4.10 使一端封闭的设备立焊搭接方向易于焊接</p>		
<p>25-5 铝设备</p>		
<p>25-5.1 利用铝的良好塑性，使角接的接管翻边对接</p>		

设计原则	不合理设计图例	合理设计图例
<p>25-5.2 管壁较薄的角接管采用厚壁短管过渡</p>		
<p>25-5.3 优先采用短管加强, 不采用易焊接变形的铸铝件</p>		
<p>25-5.4 充分考虑铝强度低、膨胀系数大的特点, 采用波形膨胀节使结构具有较大的挠性</p>		
<p>25-5.5 加焊固定板和支承板, 防止运输、吊装时膨胀节变形</p>		
<p>25-5.6 不可采用铝法兰和法兰盖</p>		
<p>25-5.7 避免在高速流体冲刷的部分直接使用铝材, 在换热器液体入口处须加挡板及保护套管</p>		
<p>25-5.8 防止变形, 用肋板加强接管</p>		

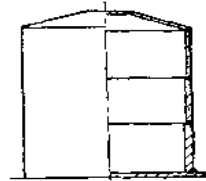
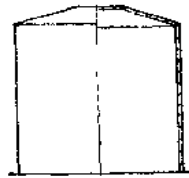
25-5.9 尽可能使加强肋板成奇数配置, 以减小收缩应力



25-5.10 直径  $\phi 4000\text{mm}$  以上的立式容器宜在器外利用角钢箍加强

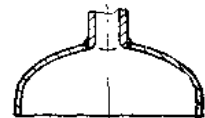
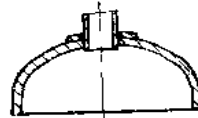


25-5.11 直径  $\phi 2500\text{mm}$  以上的立式贮槽应按液体静压强的变化, 分成几段采用不同的壁厚

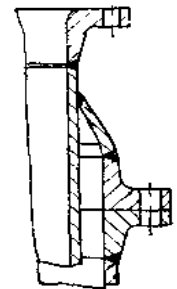
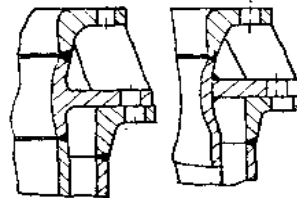


25-6 搪瓷设备

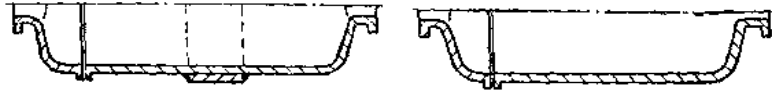
25.6.1 保证设备有足够的强度和刚度, 不采用局部加强, 采用整体加强



25-6.2 避免冷缩时受阻引起的局部应力, 不采用带肋板的结构



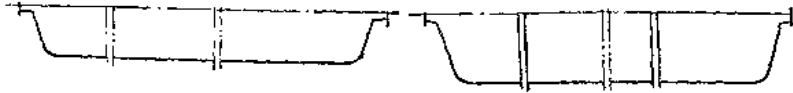
25-6.3 不可在设备外表面焊有接触面宽大的加强板



25-6.4 防止过烧或未烧透，保持设备各部分厚度相差不大



25-6.5 焊缝多的圆筒形搪瓷设备不宜过高过大，高径比以0.8~1.6（最佳为1.2）为宜，否则须采用组合结构



25-6.6 防止焊缝热应力影响搪瓷质量，保持相邻焊缝距离不小于50mm



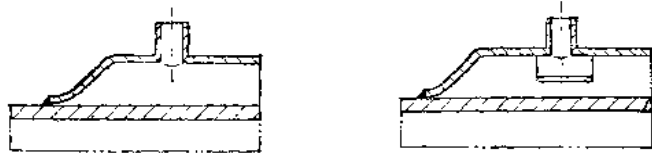
25-6.7 避免应力集中引起爆瓷，不可使焊缝在转角或板边等过渡区内，并避开一段距离



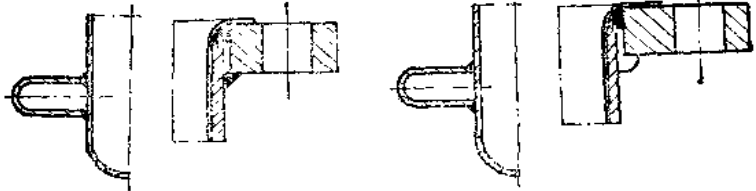
25-6.8 减少设备外表面与附件的焊缝，并使搪瓷前焊缝与搪瓷后焊缝避开一段距离



25-6.9 防止搪瓷面直接受液体、蒸汽的冲击和局部过热、过冷



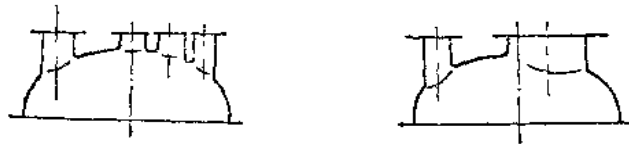
25-6.10 防止制件密封中空结构内的空气热胀爆瓷



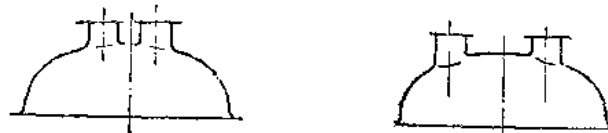
25-6.11 使设备上的接管平行于设备轴线



25-6.12 尽可能在设备上少开孔，用一个孔代替数个孔



25-6.13 不可使相邻的接管距离太近

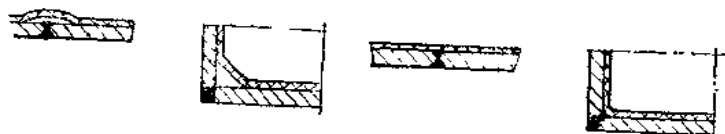


25-7 衬橡胶设备

25-7.1 防止橡胶衬里鼓泡、脱落，采用双面焊接，不用单面焊接和搭接



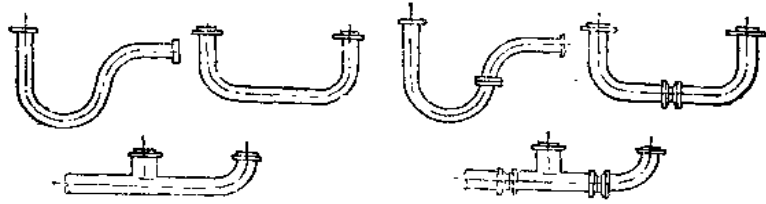
25-7.2 保证焊缝均匀、平整、无砂眼、凹陷等缺陷



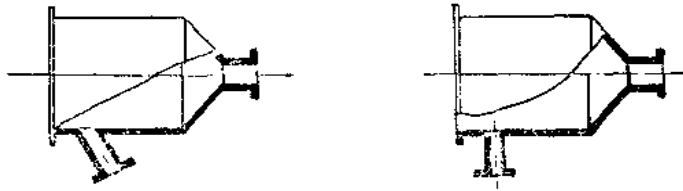


设计原则	不合理设计图例	合理设计图例
25-7.3 保证焊缝成圆角		
25-7.4 从两面焊接法兰、焊缝成斜坡、法兰不加工沟槽		
25-7.5 使设备转角处成圆角		
25-7.5 使设备转角处成圆角		
25-7.6 衬胶设备必须采用铆接时，应使用埋头铆钉		
25-7.7 不得采用螺纹、键、销联接，应用法兰联接		
25-7.7 不得采用螺纹、键、销联接，应用法兰联接		
25-7.8 保证全部焊接工作在衬胶前完成		

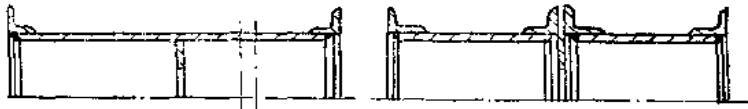
25-7.9 避免弯头、U形管, 并联管超长, 超长部分用法兰联接



25-7.10 使设备接管处焊缝圆滑、平整, 管口不得伸入设备内, 尽可能采用水平或垂直位置的接管



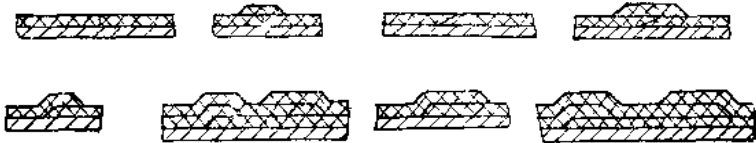
25-7.11 过于长大的设备采用组合结构



25-7.12 加大衬胶件的尺寸, 使衬胶后保持原来的工作尺寸



25-7.13 采用坡口对接, 不采用直边对接。若采用搭接, 则须保证搭接宽度



25-7.14 接缝的位置不可重叠, 必须错开一定距离



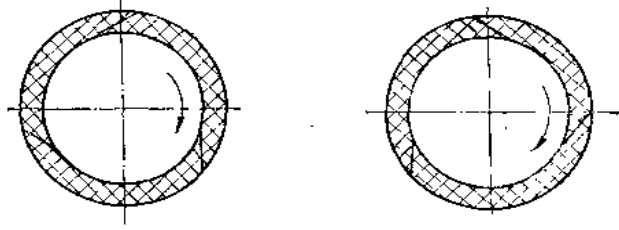
25-7.15 避免固结不紧或残存空气形成气泡, 不可采用不割散边的结构



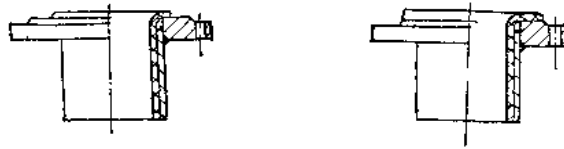
25-7.16 位物料进、出口的接缝顺着物料流动方向搭接, 避免冲击、磨损而脱胶



25-7.17 使胶缝的方向与设备转向一致,避免冲击、磨损胶缝

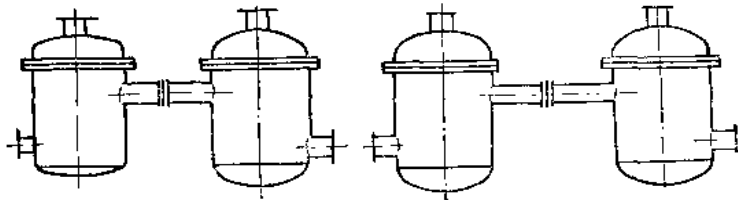


25-7.18 法兰衬胶翻边到沟槽,并保证法兰为平面

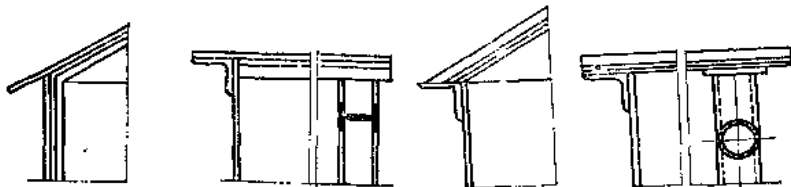


25-8 涂衬设备

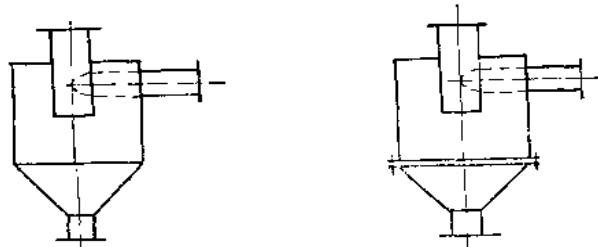
25-8.1 尽可能减少设备、零件规格



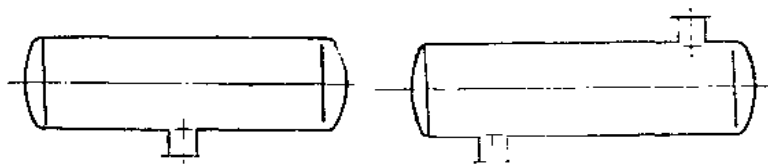
25-8.2 简化结构,方便涂衬,采用外部加强,改槽钢支杠为圆管支柱



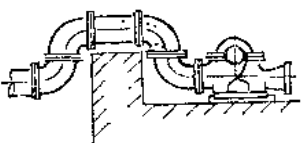
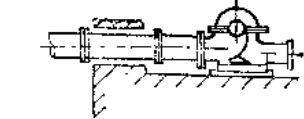
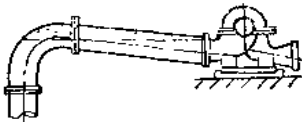
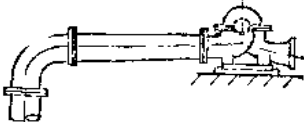
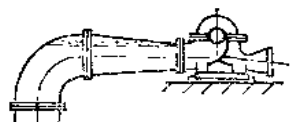
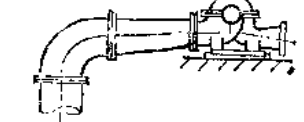
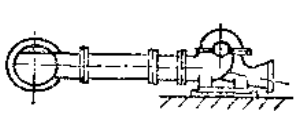
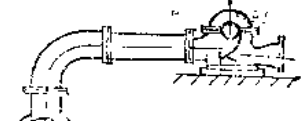
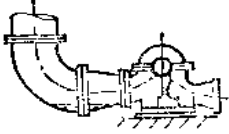
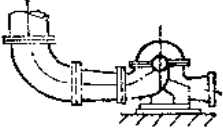
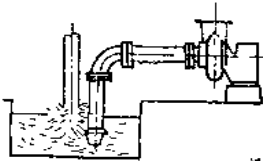
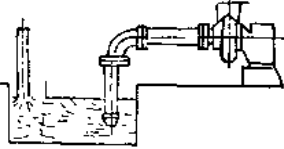
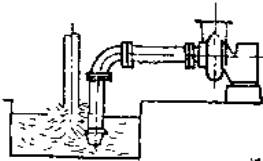
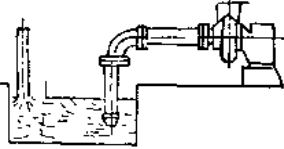
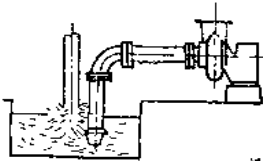
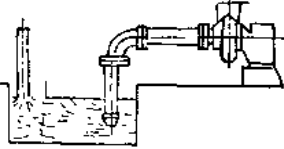
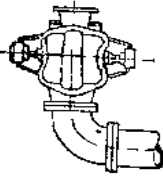
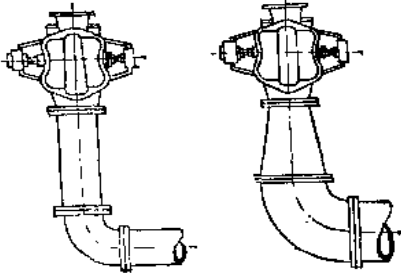
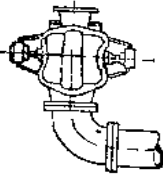
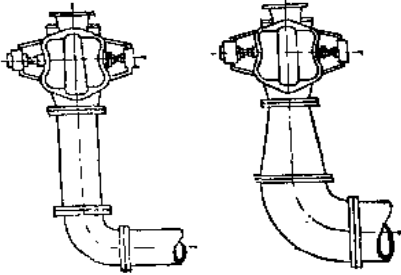
25-8.3 方便涂衬和检查,避免采用封闭结构



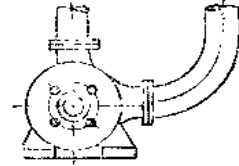
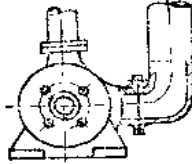
25-8.4 使涂衬作业能顺序或平行安全地进行,一端入孔在下,另一端入孔在上



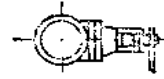
## 26. 配 管

设计原则	不合理设计图例	合理设计图例
<b>26-1 保证泵正常工作</b>		
<b>26-1.1 防止吸入管内空气积聚,吸入管向泵斜开(坡度5/1000),采用偏心大小头</b>		
		
		
		
<b>26-1.2 防止吸入管内液体滞留</b>		
		
<b>26-1.3 防止气泡被吸入泵内,将回液管与吸入管隔开一定距离</b>		
		
<b>26-1.4 防止双吸式泵进口液体偏流,不可将肘管直接与泵相连接</b>		
		

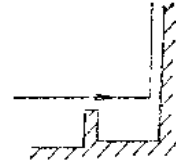
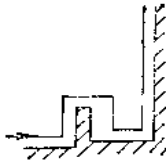
26-1.5 使泵出口肘管半径适中，保证泵以全功率工作



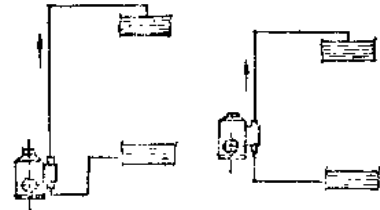
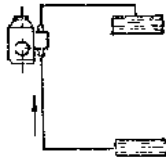
26-1.6 防止阀门处出现气泡，将阀门水平配置



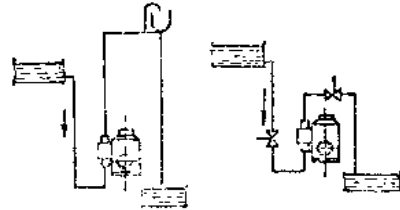
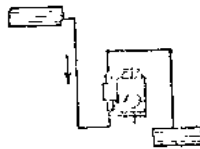
26-1.7 往复泵进口管不可成Ω形，管径不可小



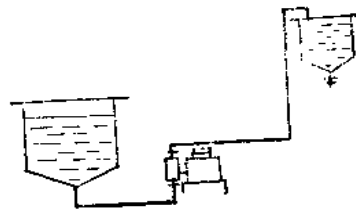
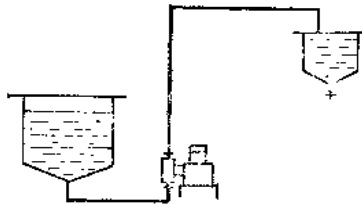
26-1.8 防止气蚀，计量泵吸入高度不可高



26-1.9 保证计量泵排出压力适当，采用高位槽或调节阀



26-1.10 防止往复泵排出管断流（和振动），泵的终端不可有很长的水平管线



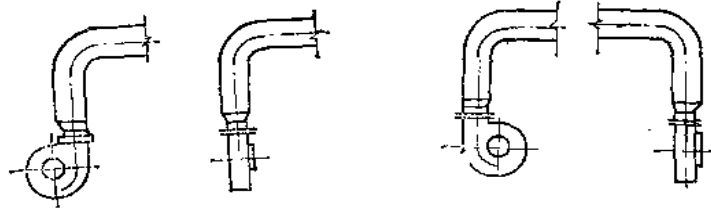
设计原则	不合理设计图例	合理设计图例
<b>26-2 保证风机正常工作</b>		
<b>26-2.1 防止气体偏流引起叶轮振动，进口阀须远离风机进口</b>		
<b>26-2.2 使气体顺着叶轮转向进入风机内</b>		
<b>26-2.3 使气体对称中心均衡地进入风机</b>		
<b>26-2.4 使风机出口短节与机壳相切或向内倾斜一小角度</b>		
<b>26-3 降低噪声</b>		
<b>26-3.1 降低噪声，增加出口叉管至出口管距离</b>		
<b>26-3.2 降低噪声，增加弯管至出口距离</b>		
<b>26-3.3 降低噪声，限制支管与扩散管间挠性管道的偏斜</b>		

26-4 减小压力损失

26-4.1 降低弯头处气体涡流损失，采用导向叶片

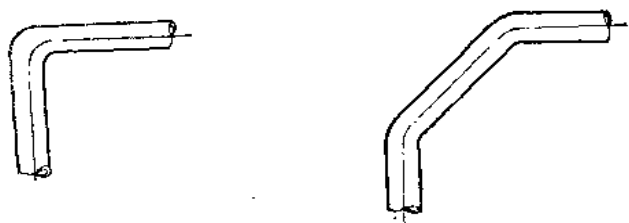


26-4.2 降低弯头处气体涡流损失，避免流体在惯性范围内扭曲

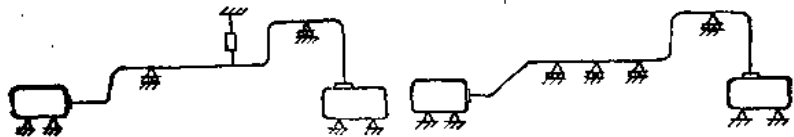


26-5 降低管道振动

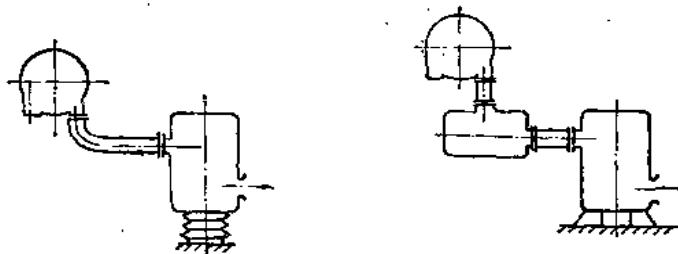
26-5.1 提高弯管刚度



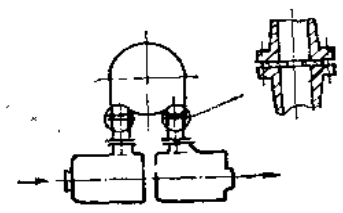
26-5.2 使排气管最大拐角不大于45°，增设滑动支承



26-5.3 使脉冲气流及时得到缓冲，紧靠气缸设置缓冲器



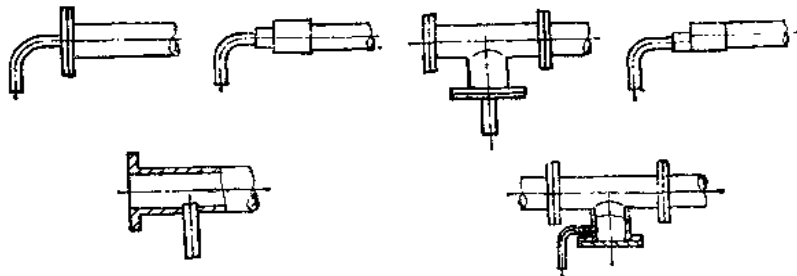
26-5.4 使压力脉动得到最大限度的衰减，在排气缓冲器的进口和吸气缓冲器的出口放置孔板



设计原则	不合理设计图例	合理设计图例
26-6 方便操作		
26-6.1 使集管器有足够的流通截面, 保证支管与集器内的气体有相近的流速		
26-6.2 采用异径三通, 相对流动汇合总管作成弧形的并扩大管径		
26-6.3 采用斜三通, 避免正三通因施工偏差造成流体对冲		
26-6.4 采用斜四通, 避免流体正面对冲		
26-6.5 均匀布置吸入口、排出口, 使吸入、排出等量液体		
26-6.6 配置出口旁通管, 和止逆阀 (对往复泵尤为重要)		
26-6.7 将法兰螺栓孔跨中配置		

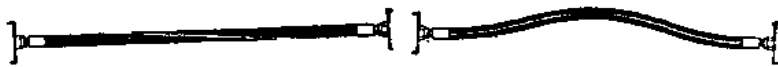


26-6.8 使残液排放干净，将排放管口放在最底下



26-7 软管连接

26-7.1 使直线安装的软管有一定程度的松弛



26-7.2 使软管接头方向与软管走向一致，避免软管过长



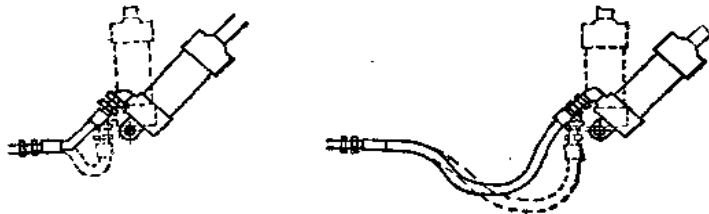
26-7.3 避免软管在接头附近弯曲



26-7.4 避免软管振动，使弯接软管的两边距离不小于最小弯曲半径的两倍



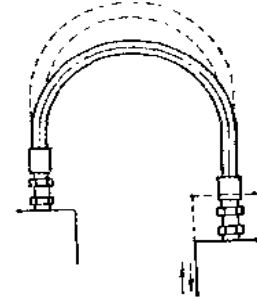
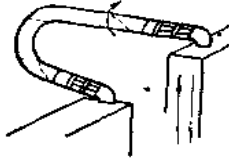
26-7.5 使反复弯曲工作的软管能充分伸展



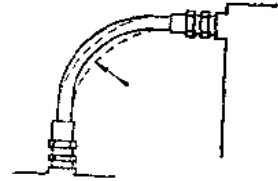
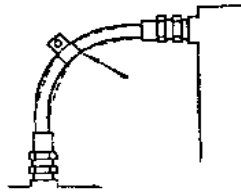
26-7.6 避免软管扭曲，使软管在同一平面内



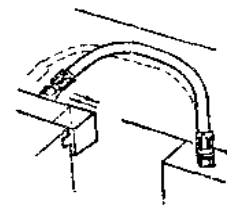
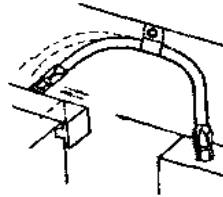
26-7.7 避免软管扭曲，使软管在运动平面内



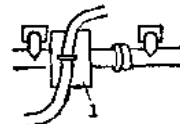
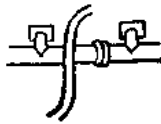
26-7.8 避免软管固定在弯曲部分



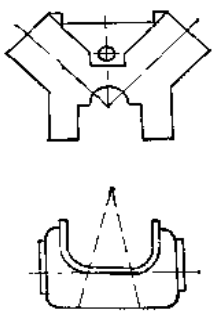
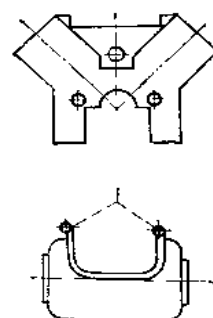
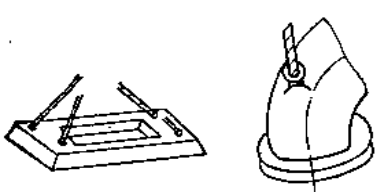
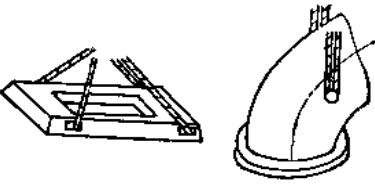
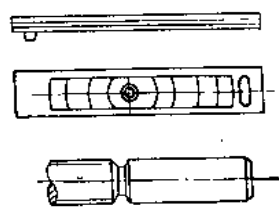
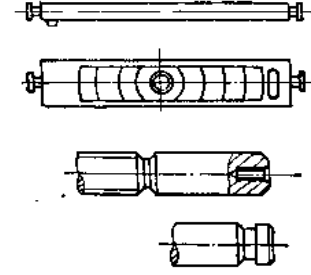
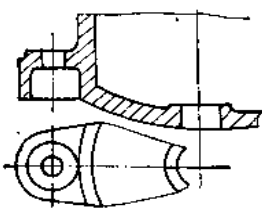
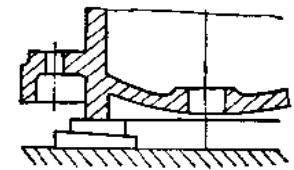
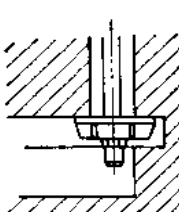
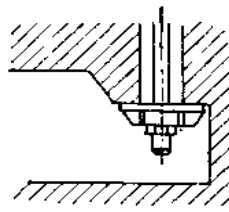
26-7.9 将两端接在不同平面的运动软管固定在适当的位置上，使各部分分别在各自的平面内运动

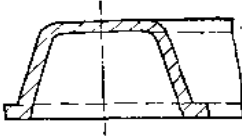
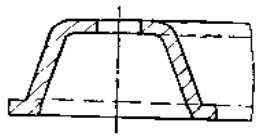
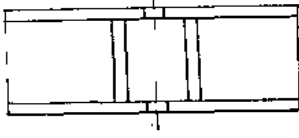
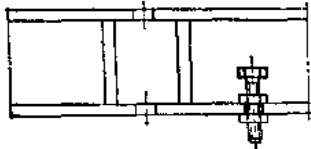
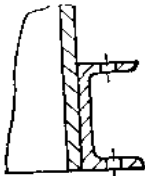
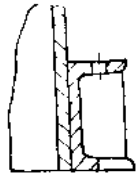
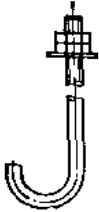
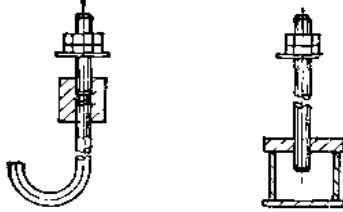
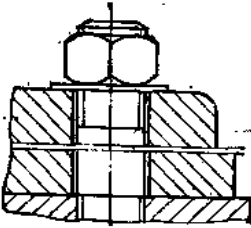
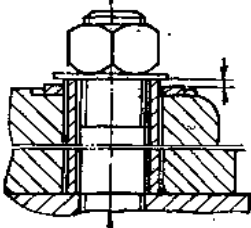
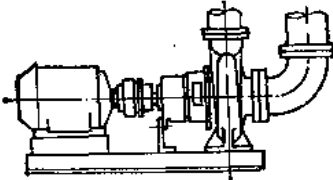
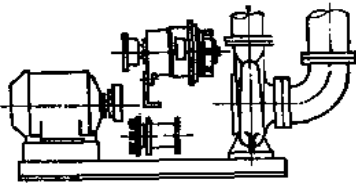


26-7.10 防止软管损坏，将软管与热源隔离，避免软管接触尖角，避免软管之间碰磨（图中1为隔热板）



## 27. 安 装

设计原则	不合理设计图例	合理设计图例
<p><b>27-1</b> 沉重的机器设备或机件应设置吊装孔、吊挂环</p>		
<p><b>27-2</b> 吊装很大的铸件, 使用铸孔或凸耳, 避免使用环首螺钉</p>		
<p><b>27-3</b> 长大的机件应设置凸耳、长轴一端设置吊装螺孔或吊挂环</p>		
<p><b>27-4</b> 使机座底部成平面</p>		
<p><b>27-5</b> 使机器设备基础有足够大的开口, 以便安装</p>		

设计原则	不合理设计图例	合理设计图例
<p>27-6 在需要灌注混凝土的底座及底板上必须设置一足够大的孔, 以便浇灌和空气泄出</p>		
<p>27-7 在底座上装调整螺钉, 以便调整底座的水平</p>		
<p>27-8 使地脚螺栓易于穿过底座, 底座下部做成U形凹槽</p>		
<p>27-9 使地脚螺栓长度可以调整, 以便机器就位固定</p>		
<p>27-10 地脚螺栓紧固时必须保证受热膨胀的底座能向一端自由滑动</p>		
<p>27-11 采用加长套筒的联轴器, 以方便泵拆装</p>		

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