

用于铅酸蓄电池中的极板及其制造方法

技术领域

本发明涉及用于铅酸蓄电池中的极板及其制造方法。

背景技术

在公开日为1991年5月8日的名称为“酸性板形正极板”的中国专利申请CN1051273A中公开了一种极板，该极板由二块结构相同的导电板叠合而成，二导电板的叠合面四周布置有主筋，每一块导电板上设有数量相等的进液孔，而且二导电板的叠合面上涂覆有铅粉。通过使进液孔在导电板叠合面一侧具有卷边或通过导电板叠合面上布置加强筋的措施，来加强铅粉涂层在极板上的结合牢度，从而提高极板的使用寿命。虽然该专利在一定程度上提高了极板的使用寿命，但从对蓄电池的综合性能上来看，极板过厚导致了比能量相对下降。

在公开日为1991年3月13日的另一份名称为“高比能长寿命铅酸蓄电池”的中国专利CN2073171U中，提出对蓄电池的极板进行减薄的技术方案，其作法是将正极板板栅减薄到4.0-7.5MM，同时将负极板的板栅也相应减薄，从而使得铅酸蓄电池同一槽体内的极板数量相对增加即表面积增加，充放电的极化电流减小。这样，在不影响使用寿命的前提下，提高了比能量。但是，通过减薄极板增大表面积来增加比能量，一般来说必然对极板的使用寿命和强度造成影响。而这种影响正是多年来铅酸蓄电池行业中一直难以解决的难题。

以上两项专利所公开的技术方案，都不能从根本上解决铅酸蓄电池的寿命与比能量之间相互矛盾的问题。而且，镉的回收利用率低、生产成本低。

有鉴于此，本发明的目的是提供一种用于铅酸蓄电池中的、具有高比能、高功率、长寿命、耐过放电并可以快速充电的极板及其制造方法。

发明简述

本发明提出这样一种用于铅酸蓄电池的极板，其特征在于，包括：

活性基体，所述活性基体包括均匀混合并交织在一起的铅纤维和含镉铅合金纤维，所述铅纤维占所述基体总重量的60 - 90 %，而且所述铅纤维的表面上镀有镉，所镀的镉占铅纤维重量的1 - 5 %；

板栅，与所述活性基体配合，用于集流导电；

极耳，用于极板间的电连接，所述极耳与所述板栅电连接地固定在所述板栅上。

本发明还提出一种用于制造极板的方法，包括下列步骤：

利用切削、熔压或熔喷的方法将铅和含镉的铅合金制成铅纤维和铅合金纤维；

将这些纤维切成小段；

把剪切成小段的铅纤维和铅合金纤维倒入粘性的溶剂中搅拌，使它们形成在三维方向彼此均匀混合、缠绕的混合物；

将所述溶剂从所述混合物中压出，从而形成坯块；

对该坯块进行压缩；

通过熔压，使该坯块上带有板栅；和

将一个极耳连接在所述板栅上。

以下结合附图，对本发明提出的用于铅酸蓄电池中的极板进行详细描述。

附图简述

图1 为本发明铅酸蓄电池极板的主视图；

图2 为图1 所示的铅酸蓄电池极板的侧视图；

图3 为本发明另一种铅酸蓄电池极板的剖视图；

图4 为图3 所示的铅酸蓄电池极板的主视图；

图5 为图1 中铅酸蓄电池极板所采用的一种极耳的主视图，这种极耳在活性基体与板栅结合在一起后，再装到板栅上。

图6 为图5 所示极耳的侧视图。

对本发明较佳实施例的详细描述

本发明所提出的用于铅酸蓄电池的极板包括活性基体3、301、302和用于集流导电的板栅2、7，以及用于增强活性基体的机械强度的片材4、5。当然板栅2、7同时也具有加强活性基体的机械强度的作用。

本发明中的活性基体由铅纤维和铅合金纤维混合而成，需要注意的是，本发明中所提及的“纤维”一词，是指很细的条状物，例如铅纤维是指很细的铅丝，而且本发明所提及的“纤维”，在下文中有时与“纤维段”一词具有同一个含义。

采用纤维的优点在于，纤维可增大活性物质的表面积，使活性物质的利用率得到提高，比能量增加。将两种纤维混合后采用类似无纺布抄纸（AGM方式）的方式，将其制成纤维毡或纤维布结构，可使纤维之间形成许多孔洞，这些孔洞，由于毛细现象，在蓄电池内进行成流反应时，能够保证充足的酸液流入，使反应顺利进行。

制成活性基体时，要保证各种纤维能够保持均匀的混合比例，即在相同的单位面积内，含有各种纤维的比例相同。当采用成束的多根纤维制做活性基体时，该纤维束既可以由同种纤维构成，也可以由具有一定混合比例的混合纤维构成，但一般情况下，如果需要的纤维数量较多时，最好是先将纤维按一定比例混合后成束，再在束之间进行混合，以制做活性基体。采用上述方法制出的活性基体具有类似毛毡或布的结构。另外，在制做活性基体时，为了使制成的铅酸蓄电池极板具有更好的强度和集流导电性能，还可以将由上述方式制成的基体块与一种完全由铅合金纤维制成的铅合金毡间隔放置，经过轻压后使它们结合在一起，形成具有更好强度和集流导电性能的活性基体。

本发明使用的混合纤维主要由具有一定重量比的铅纤维和铅合金纤维构成。为增加基体或者说极板的集流导电性能和强度，也可加入一些其它种类的纤维和浸渍剂。但是，铅纤维和铅合金纤维作为主体，在不加其它任何纤维的情况下，完全可以制成本发明所述的铅酸蓄电池极板。

在本发明的极板中，铅纤维占铅纤维和铅合金纤维总重量的60-90%，而且所有铅纤维的表面上镀有占其本身重量1-5%的镉。当活性基体形成后，并且做正极板时，其中铅纤维的表层会生成 β -PbO₂晶格；若是做负极板，铅纤维表层则仍为钝铅。用在铅酸蓄电池极板中的铅纤维，在经通电发生反应后，在表面镀的镉的催化作用，即可在正极板上

形成具有 β -PbO₂晶格,而且由表面向深层发展,最后形成芯部为纯铅,而表层具有 β -PbO₂的状态。当蓄电池放电时,极板表层的 β -PbO₂晶格会与酸反应形成电荷,而芯部纯铅部分作为输送电荷的通道。

铅合金纤维占铅纤维和铅合金纤维总重量的10-40%,而且表面可镀有占其总重量1-5%的镉。在使用时,在铅酸蓄电池中的正极板中的铅合金纤维的表层上,会形成 β -PbO₂晶格;而在负极板中的铅合金纤维的表层即形成纯铅。但是,无论在正极板中还是在负极板中,铅合金纤维的内部始终保持原有的合金状态。

本发明的核心内容即是以上述的两种纤维采用一定比例混合而制做用于铅酸蓄电池极板的活性基体。由于铅合金纤维本身强度高,且耐腐蚀性好,同时具有较好的导电性能,因此,在与铅纤维混合构成基体后,通过再在基体上熔压出集流导电板栅,即可满足极板使用中的强度要求和集流导电的性能要求,并可以防止极板的破损和电池内部的短路。在所形成的基体中,铅纤维主要起产生电荷的作用,而铅合金纤维主要起集流导电和支持整个极板的作用。还有,由于铅合金纤维中含有少量的镉,因此,可始终使两种纤维形成的正极板表面保持 β -PbO₂晶格,使极板始终保持高储电状态。

简单地说,在采用铅纤维和铅合金纤维制成用于铅酸蓄电池的极板后,由于这两种纤维表面镀有1-5%左右的镉,因此在通电反应时,联通直流电正极的一组铅酸蓄电池的极板的表面在镉的催化作用下形成 β -PbO₂晶格。而在以后的使用中,在不断的充放电过程中,则是由铅合金纤维中所含的镉的催化作用下,使铅纤维表层始终保持 β -PbO₂晶格。由于 β -PbO₂的微观表面积比 α -PbO₂的大近20倍,因此, β -PbO₂晶格的储电量远远大于 α -PbO₂晶格。同时在本发明中, β -PbO₂是在铅纤维表层和铅合金纤维表层直接通电产生反应后生成的,因此 β -PbO₂与纤维之间的联接十分紧密,不易脱落,而且该两种纤维内部保持纯铅或铅合金状态,因此能够经受大电流脉冲式充电时所产生的振动。另外,由于 β -PbO₂与硫酸不属同晶,因此放电后生成的硫酸铅不在这两种纤维表面结核成晶。铅纤维深层也可以生成 β -PbO₂并参加反应,因此在放电过程中,可长时间保持大电流输出。电镀镉的另一个作用是,本发明在活性基体成形后,利用电火花放电,使混合纤维中的各根纤维的搭接点微熔在一起,以在进行成流反应时,整个极板内部形成可靠的集流导电网络,同时进一步增强整个极板中各种纤维之间的

联接强度，提高极板的使用寿命。而采用电火花放电技术，需要纤维和铅合金纤维表面具有氧化层才能进行。而在镀镉后，镉即可代替氧化层，使电火花放电技术得到实现。

铅合金纤维中优选含有占其总重量0.5 - 5 %的镉，1 - 7 %的锑和88 - 98.5 %的铅。采用上述配方制成的铅合金纤维主要在普通蓄电池中使用，而且成本较低。

在本发明中铅合金纤维的另外一种铅合金的组份可以为例如按重量比为含有0.1 - 0.5 %的银、0.08 - 0.5 %的钙、0.5 - 5 %的镉和94 - 99.32 %的铅。采用这个配方制成的铅合金纤维具有较好的耐腐蚀性，也可提高蓄电池的使用寿命。但这种合金的制造成本比较高，而且由于加入银会降低氢和氧的过电位，所以使用时导致电解液的损耗比较大。

除上面所指的两种纤维外，本发明的活性基体中还可以包括其他微细纤维。这些微细纤维包括碳纤维和其它有机化学纤维。加入碳纤维的主要目的是用来弥补铅合金纤维集流导电性能的不足。尤其是在铅合金纤维占重量比较少的情况下，集流导电效果不好时，加入一定量的碳纤维既不明显增加重量，又可以起到很好的集流导电效果。碳纤维的加入量为铅纤维和铅合金纤维重量和的0.1 - 0.5 %。另外还可以加入其它的有机化学纤维，主要是晴纶纤维等具有耐酸腐蚀且具有良好的抗拉性的有机化学纤维。这些纤维的加入主要是为了增强整个极板的强度。所加入的有机化学纤维，可以产生类似绳子或网的捆扎作用，使各种纤维结实地形成整体。所加入的有机化学纤维量应占铅纤维和铅合金纤维总重量的0.1 - 0.5 %。

另外，本发明中所述的活性基体在成形后，可放入浸渍剂中。浸渍剂优选为聚四氟乙烯，整个活性基体在浸渍后，可防止纤维之间产生移动而使活性基体变松引起强度的降低。浸渍剂的加入量为基体重量的0.1 - 0.5 %，另外还可在活性基体中加入0.1 - 0.5 %的碳粉，例如，乙炔碳黑、可膨胀石墨粉、木碳粉、活性碳粉等。以上所述的碳纤维、有机化学纤维和碳粉都是在活性基体成形前各种纤维混合时加入的，而浸渍剂则是在活性基体成形后才加入的。

如图1、2所示，板栅2作为同时起到集流导电作用和加强活性基体

的机械性能的装置，一体地固接于活性基体3上。制作时，最好采用直接在活性基体3上熔压的方法在基体3上形成板栅2，因为熔压出来的板栅2是由基体3的本身材料形成的，因此与基体3之间具有很好的电联接，因而具有比普通极板更小的内阻。同时，减少了非活性物质，也就等于增加了活性物质所占的重量比例。

板栅2中具有栅条21，这些栅条21优选呈放射状并且会聚到所述板栅与下面将要提到的极耳的连接处，以利于集流导电。

也可采用两片预先制好的例如网格状的板栅2（未示），它们放在活性基体3两侧并与基体3熔压成一体。另外，板栅2也可采用以铅合金纤维制成的具有较大孔洞的多孔网状结构（未示），再浸渍现在通用的铅膏，以便制成比普通涂膏式极板综合性能更好的蓄电池极板。

板栅2上联接有极耳1，用于极板之间的联接。极耳1可以当在基体3上熔压形成板栅2时，一齐压出。但为了节省两种纤维的用量，最好采取在活性基体3与板栅2结合后再加装另外的极耳1的方式，即极耳1是一个单独的部件例如铅块101（图5和6），并具有一个与活性基体3的厚度相应的槽10，通过熔压的方式，其可以固定在成形后的板栅2的边缘上。

上面提到的铅合金纤维毡，其组份可以与活性基体3中的铅合金纤维的组份相同，但因铅合金纤维毡的主要作用是增加极板强度和集流导电，因此其铅合金纤维的直径应粗一些，例如可以采用多根铅合金纤维构成的较粗的铅合金纤维束。

如图3、4所示为本发明的用于保证基体的机械强度的装置的另一实施方式，该装置由铅和具优良导电性金属构成的双金属片构成，采用这样的结构，金属片既用于承载活性基体301、302，又用于代替单格电池之间串联的零件，同时构成一个双极性极板。这样构成的极板的内阻很低，而且壳体材料用得少。

在双金属片结构两面联接的活性基体301、302的形状在本实施例中为圆形，为了保证活性基体301、302有较好的强度，在它们侧面形成有板栅7，在本实施例中，格栅7为在基体301、302上形成的多条径向压痕。在圆形的活性基体301、302上，沿半径方向开有

一长形缺口9。该缺口9的内端9 1为半圆形，且与各自的圆形活性基体同心。缺口9的宽度等于半圆的直径。采用这样的结构，是为给实现全密封氧循环蓄电池留下气室。另外也解决了铅酸蓄电池极板中洛伦兹力把电解液推向周边，使极板不能得到充足电解液供应的问题。在采用这种带有缺口的圆形结构后，可使周边电解液很好地向中心回流，及时供给中心部分电解液。

双金属片结构由表面镀有一层薄铅的金属片4和与金属片4紧密固接的铅片5构成，且双金属片结构的中心部分有一与活性基体3 0 1、3 0 2上长形缺口9的半圆形内端9 1形状相应的半圆形通孔8。金属片要由具有一定强度和优良导电性的金属制成，一般采用纯铜片比较好。而且金属片表面与铅片表面都应是粗糙表面，即具有小的凸起或凹坑，这样可使铜片4、铅片5及两活性基体3 0 1、3 0 2之间处于很好的联接状态。本发明采用的方法是将铜片4进行双面冲孔，再与一侧面铸出小刺6的铅片5固接后形成双金属片结构，铜片上用于联接铅片一面的小刺6的高度应略大于铅片的厚度。而用于联接活性基体3 0 2的一面的小刺的高度也要略大于活性基体3 0 2的厚度。而铅片5上的小刺6一样要求大于活性基体3 0 1的厚度，以保证能够达到钉扎固定的效果。当安装到蓄电池中时，要以双金属片上有铅片5的一面作正极，因为阳极有溶解作用，这样可防止铜片4因溶解作用而进入到电解液中影响蓄电池的性能。双金属片结构的外周边应具有翻起的边缘4 1、5 1，这些边缘用于装入密封垫圈，同时在使用过程中用于对密封垫圈起保护作用。

双金属片结构上的半圆形通孔8，当在两个金属片上安装好圆形活性基体3 0 1、3 0 2后，应注满纯铅，以形成极板连接点，也就是极耳，而且其厚度应稍大于整个极板的厚度。利用上述极板制成蓄电池时，极板应正极（即双金属片上有铅片的一面）向上水平放置，这样可以防止在电化学反应中，因电解液密度不同而发生的分层现象。另外可使正极上产生的氧气向上跑，在负极上与氢化合成水，从而实现全密封后的氧循环。

以下用几个具体例子再进一步说明极板的结构及制造方法。

例1

图1和图2示出本发明的例1。首先通过熔压或切削、熔喷等方法制取铅纤维和铅合金纤维，为保证铅合金纤维具有较好的导电性，制得的铅纤维的直径可以例如为8 μm ，铅合金纤维直径为15 μm 。然后在这两

种纤维表面分别镀上分别占铅纤维和铅合金纤维各自重量2 %的镉。

采用的铅合金纤维的组份按重量百分比为2 %的铋、2 %的镉和96 %的铅。

再将这些纤维切成小段。铅纤维切后每段的长度为1 mm。铅合金纤维切后的每段长度为2.5 mm。

将铅纤维段和铅合金纤维段按重量比9 : 1 混合后，倒入装有甘油的容器中，搅拌均匀后，再倒入一底部有很多孔的容器中，然后用接在容器下部的真空泵和与容器直径相配合的位于容器上部的橡胶活塞，使用上压下抽的方法抽出甘油，即可制得具有均匀孔隙的坯块。该坯块再经过压滤、抽吸后，即可将大部分甘油吸出。再经清洗，烘干。

本发明之所以采用甘油（同时还包括在下面的例子中提到的水玻璃和色拉油），就是利用溶剂本身的粘度，使位于其中的纤维段在受到搅拌时，能够在三维方向运动，以达到各种纤维段之间的均匀混合以及彼此之间的缠绕效果。

然后再对该坯块施加一个压力，而使其进一步成形。

接着将坯块放入一模具中，利用电火花放电，压上具有辐射状栅条的板栅2，

最后如图5、图6所示，熔压上具有与该板厚度相应的槽10的铅块101，即可制成用于铅酸蓄电池的极板。

板栅2 为铅纤维和铅合金纤维构成的呈辐射状或其他形状的框架，该框架的外形为方形，活性基体3 是由铅纤维和铅合金纤维相互交织构成的羊毛毡状多孔体，其外形呈板状，活性基体3 嵌于板栅框架中的空隙之间，极耳1 为具有与板栅2 厚度相应槽10的铅块，通过该槽，极耳可以固接在板栅边缘上。

例2

采用例1 的方法制得直径80 μm 、长2.5 mm 铅纤维段和直径250 μm 、长2.5 mm 的铅合金纤维段。铅合金纤维由0.5 %的镉，1 %

的铈和98.5%的铅组成。在铅纤维和铅合金纤维表面分别镀上各占其自身重量5%的镉，将上述铅纤维和铅合金纤维按重量比6:4混合，倒入装有水玻璃溶剂的容器中，并同时加入占上述二者总重量0.1%的晴纶纤维、0.1%的碳纤维和0.1%的碳粉搅拌均匀。

然后按实施例1的方式将水玻璃抽出使坯块烘干。

再将直径250 μm 、长度25 mm的铅合金纤维按上述方法也制成用于与坯块配合的铅合金纤维毡。该铅合金由7%的铈，5%的镉和88%的铅组成。将上述二块坯块夹上1块铅合金纤维毡叠放后，经加热加压，使该层状物结合在成一体，并熔压出网格状板栅，然后熔压上极耳1，即制成本发明的用于铅酸蓄电池的极板。

本例中的极板与例1中所述的结构基本相同，只是板栅2是在由两层活性基体材料夹一层铅合金纤维交织而成的多孔体压实后构成的层状体上形成的网格状方形框架。而且板栅和活性基体3内含有0.1%的晴纶纤维0.1%的碳纤维和0.1%的碳粉。

例3

如图3、4所示，采用如实施例1的方法制取两块圆形基体301和302，一长形缺口9从坯块的一个侧边一直延伸到坯块的中心。基体上的长形缺口9的内端91为半圆形，且与圆形基体同心。为增加该基体强度，可熔压出压痕7，熔压时的温度要低于铅的熔点。

该圆形基体301、302由直径2 μm 、长度1 mm，表面镀镉2%的铅纤维和直径5 μm ，长度2.0 mm，表面镀镉2%的铅合金纤维制得，且铅纤维和铅合金纤维按重量比9:1混合。使用的熔剂为甘油。

双金属片结构中的一片由0.5 mm厚的铜片4构成，该片4的双面冲出小刺，并在表面镀上0.2 mm的铅后，再与厚度为0.5 mm，且表面铸有小刺6的铅片5固接在一起。且该双金属片结构的中心具有一个与圆形坯块301、302上长形缺口9的半圆形内端91形状相应的通孔8。

将该双金属片两侧面分别用小刺钉扎上一块圆形基体，并且使两个基体301、302上的长形缺口9方向一致。然后将双金属片上的半圆通

孔8和半圆形端9 1内注满纯铅,并使所注满的纯铅的高度略大于整个极板的厚度,即可制作出另一种形式的铅酸蓄电池极板。

例4

采用如实施例1所述的方法制得直径60 μm ,长20 mm的铅纤维段和直径200 μm ,长度25 mm的铅合金纤维段。铅合金纤维由7%的锑、5%的镉和88%的铅组成。且铅纤维和铅合金纤维表面均镀有各占其自身重量4%的镉。

将铅纤维和铅合金纤维按重量比7:3混合,倒入色拉油溶剂中搅拌均匀,再倒入底部多孔的容器,经自然渗透,也可制得具有均匀孔隙的坯块。该坯块经压滤,抽吸后,再进行清洗和烘干,制出所需形状。

再按例2所示的方法制得铅合金纤维毡。该毡由直径220 μm ,含锑5%、镉3%和92%的铅构成的铅合金纤维制成。

再将三块铅合金纤维毡和两块坯块叠放后熔压在一起。最后再将两块铅合金构成的网格状的板栅把这样制成的一块层状物夹在中央,并熔压在一起。再熔压安装上极耳1后,即制得本发明的用于铅酸蓄电池的极板。

按上述方法制得的极板具有以下结构,板栅2为铅合金构成的网格状框架。而活性基体3是由三层铅合金纤维多孔体和两层混合纤维多孔体压制而成的。由此活性基体3和两层板栅2构成具有层状结构的极板,极耳1仍为具有相应槽的铅块,并以该槽固接在板栅2的边缘上。

例5

按例2所述类似方法制得坯块。该坯块由直径50 μm ,长度15 mm的铅纤维段和直径130 μm ,长度15 mm的铅合金纤维段组成。铅合金纤维和铅纤维按重量比2:8混合,铅合金纤维由4.5%的锑,5%的镉和90.5%的铅组成。

铅合金毡中的铅合金纤维包括3%的锑,4%的镉和93%的铅。

将该坯块剪切成与安装极耳1后的极板形状相同的形状,然后把2块坯块和1块网格状的板栅2间隔叠放后,采用电火花放电技术进行熔压即可制成本发明的用于铅酸蓄电池的极板。

例6

按上述例1 - 5 所述的方法, 制造用于铅酸蓄电池的极板。所使用的铅纤维段的直径为 $40\ \mu\text{m}$, 长度为 $20\ \text{mm}$ 。铅合金纤维段的直径为 $70\ \mu\text{m}$, 长度为 $10\ \text{mm}$ 。铅合金纤维由7 %的镉, 2.5 %的锑, 90.5 %的铅组成。两种纤维表面均镀上占其重量2 %的锑。

铅合金纤维毡使用的铅合金纤维的直径为 $60\ \mu\text{m}$, 且由7 %的镉, 5 %的锑和88 %的铅组成。

例7

按上述例1 - 5 所述方法制造用于铅酸蓄电池的极板, 所使用的铅纤维段的直径为 $15\ \mu\text{m}$, 长度为 $5\ \text{mm}$, 铅合金纤维的直径为 $8\ \mu\text{m}$, 长度为 $2\ \text{mm}$, 并由0.1 %的银, 0.08 %的钙, 0.5 %的锑和99.32 %的铅组成。且铅纤维和铅合金纤维表面分别镀上各占其自身重量5 %的锑。混合重量比为6.5 : 3.5。

采用的铅合金纤维毡中的铅合金纤维的直径为 $7\ \mu\text{m}$, 长度为 $15\ \text{mm}$, 并由0.2 %的银, 0.3 %的钙, 2 %的锑和97.5 %的铅组成。若按例2 所述方法, 添加的晴纶纤维为0.05 %, 碳纤维为0.05 %, 碳粉为0.05 %, 而且按例1 - 5 所述方法所制得的铅酸蓄电池极板, 可再浸渍0.1 - 0.5 %的聚四氟乙烯。

例8

按例1 - 5 所述方法制造酸蓄电池极板, 所采用的铅纤维段的直径为 $5\ \mu\text{m}$, 长度为 $3\ \text{mm}$, 表面镀占其重量5 %的锑。铅合金纤维的直径为 $20\ \mu\text{m}$, 长度为 $5\ \text{mm}$, 表面不镀锑。铅合金纤维由0.5 %的银, 0.5 %的钙, 5 %的锑和94 %的铅组成。

制作铅合金纤维毡的铅合金纤维的直径为 $7\ \mu\text{m}$, 并由0.1 %的银, 0.08 %的钙, 0.5 %的锑和99.32 %的铅组成。在制作例1 - 5 所述的铅酸蓄电池极板后, 可再采用化学浸渍的方法浸渍铅粉。

例9

按例1 - 5 所述的方法制造用于铅酸蓄电池的极板, 所采用的铅纤维的直径为 $2\ \mu\text{m}$, 长度为 $0.7\ \text{mm}$, 表面镀锑占其重量的1 %, 铅合金

纤维的直径为 $2\text{ }\mu\text{m}$ ，长度为 0.7 mm ，表面镀镉占其重量的 1.5% ，且由 0.3% 的银， 0.2% 的钙， 2% 的镉和 97.5% 的铅组成。铅合金纤维毡中的铅合金纤维直径为 $2\text{ }\mu\text{m}$ ，并由 0.5% 的银， 0.5% 的钙， 5% 的镉和 94% 的铅组成。按例3所述的方法制造时，双金属片中的一片为银片。按例1-5所述的方法制得铅酸蓄电池极板后，再直接浸渍铅粉。

工业实用性

1、由于利用纤维毡中的纯铅纤维作活性储电物质，而纯铅纤维的表面积比颗粒、铅粉膏、铅箔者大，所以活性物质利用率提高，比能量提高。

2、由于铅纤维表层在充电状态下始终保持转变为 β 型晶格的具有高储电能力的二氧化铅晶体状态，因此从根本上更进一步提高了活性物质的表面积和利用率及比能量。

3、通过在铅金属纤维毡上直接熔压出板栅、板耳，从而降低了板栅所占的重量，使活性储电物质相对含量增加，也提高了比能量。

4、由于采用铅合金纤维和铅纤维均匀混合制成活性基体，纤维之间是搭接在一起的，并且各搭接点经熔压微熔在一起，再加上直接熔压出板栅、边框、极耳，所以整个纤维毡形成一个完整的导电通路网络，同时形成一个有机的机械强度高的多孔整体极板，因而不易掉粉、掉渣、极板寿命长，内阻低，具有可大电流快速放电、比功率高及可快速充电和耐放电的性能。

5、通过用两片活性基体和一双金属片结构组合成一块铅酸蓄电池极板，双金属片既代替了电池单格之间的绝缘隔板，又起到了单格之间极板串联用的电联接零件的作用，而且双金属片用高导电金属片制作，其与基体接触面积大，还很薄，所以可使电池的内阻进一步降低，从而使壳体重量、铅联接件重量进一步降低，从而更进一步提高了蓄电池的比功率和比能量。

使用本发明的极板的铅酸蓄电池，经实际测试能达到以下主要指标（牵引重载荷放电）。

- A、比能量最低可达5.2 瓦时/ 公斤
- B、比功率最低可达1.5 瓦/ 公斤
- C、寿命最低可达800 个循环次数

权利要求

- 1、一种用于铅酸蓄电池中的极板，其特征在于，包括：
活性基体，所述活性基体包括均匀混合并交织在一起的铅纤维和含镉铅合金纤维，所述铅纤维占所述基体总重量的60 - 90%，而且所述铅纤维的表面上镀有镉，所镀的镉占铅纤维重量的1 - 5%；
板栅，与所述活性基体配合，用于集流导电；
极耳，用于极板间的电连接，所述极耳与所述板栅电连接地固定在所述板栅上。
- 2、如权利要求1所述的极板，其特征在于，所述铅合金纤维中的组份按重量百分比为：铅88 - 98.5%，镉1 - 7%，镉0.5 - 5%。
- 3、如权利要求1所述的极板，其特征在于，所述铅合金纤维中的组份按重量百分比为：铅94 - 99.32%，镉0.5 - 5%，钙0.08 - 0.5%，银0.1 - 0.5%。
- 4、如权利要求1所述的极板，其特征在于，所述铅合金纤维表面上也镀有镉，所述镉占铅合金纤维总重量的1 - 5%。
- 5、如权利要求1所述的极板，其特征在于，所述基体中还包括碳纤维、有机化学纤维、碳粉中的一种或几种。
- 6、如权利要求1所述的极板，其特征在于，所述基体含有聚四氟乙烯，聚四氟乙烯的量占所述基体总重量的0.1 - 0.5%。
- 7、如权利要求1 - 6所述的极板，其特征在于，所述板栅为框架状并且内部具有栅条。
- 8、如权利要求7所述的极板，其特征在于，所述栅条呈放射状并且会聚到所述板栅与所述极耳的连接处。
- 9、如权利要求8所述的极板，其特征在于，所述板栅是通过熔压而一体形成在所述基体上的。



10、如权利要求8所述的极板，其特征在于，所述板栅为由铅合金纤维构成的单独构件。

11、如权利要求8所述的极板，其特征在于，所述极耳的底部具有一个槽，该槽的宽度与所述板栅的厚度相同，以使所述极耳能夹在并从而固定在所述板栅上。

12、如权利要求8中任何一个所述的极板，其特征在于，所述极板还包括一个用于支持所述基体的双金属片结构，在该结构中，一片为铅片，另一片为表面镀有一层铅的铜片或银片，两片金属片面对面固定在一起，双金属片结构的两侧用于分别固定一个所述基体。

13、如权利要求12所述的极板，其特征在于，所述双金属片结构的中心具有一个孔，位于双金属片结构两侧的所述基体分别具有一个从其一个侧边通向其中心的长形缺口，所述长形缺口靠近基体中心一端为半圆形，所述长形缺口彼此对齐并且其半圆形一端均与所述孔对齐，从而构成一个通孔，在该通孔中充满金属铅，构成极耳，该极耳的厚度大于由双金属片结构和基体所构成的极板的厚度。

14、如权利要求8所述的极板，其特征在于，所述基体为层状结构，其中的一层为由均匀混合并交织在一起的铅纤维和含镉铅合金纤维构成的坯块，另一层为由另一种含镉的铅合金纤维相互交织构成的铅合金纤维毡，该坯块与铅合金纤维毡交互叠置，构成所述的层状结构。

15、如权利要求8所述的极板，其特征在于，
所述铅纤维表面上和铅合金纤维表面上所镀的镉占它们各自重量的2%，
所述铅合金纤维中的组份按重量百分比为：铅96%，镉2%，锡2%；
所述铅纤维与铅合金纤维的重量比为9：1。

16、如权利要求14所述的极板，其特征在于，
所述基体为三层结构，第一层和第三层为所述的坯块，其中：
所述铅纤维表面上和铅合金纤维表面上所镀的镉占它们各自重量的2%，



所述铅合金纤维中的组份按重量百分比为：铅98.5%，铋1%，
镉0.5%，

所述铅纤维与铅合金纤维的重量比为6：4，

并且还包括0.1%的晴纶纤维，0.1%的碳纤维和0.1%的碳粉；

所述第二层为铅合金纤维毡，该铅合金纤维中的组份按重量百分比为：铅88%，铋7%和镉5%。

17、如权利要求13所述的极板，其特征在于，

所述铅纤维表面上所镀的镉占铅纤维总重量的2%；

所述铅纤维与铅合金纤维的重量比为9：1。

18、如权利要求14所述的极板，其特征在于，

所述基体为五层结构，第二层和第四层为所述的坯块，其中：

所述铅纤维表面上和铅合金纤维表面上所镀的镉分别占它们各自重量的4%；

所述铅合金纤维中的组份按重量百分比为：铅88%，铋7%，镉5%；

所述铅纤维与铅合金纤维的重量比为7：3；

所述第一、三、五层为所述铅合金纤维毡，该铅合金纤维中的组份按重量百分比为：铅92%，铋5%和镉3%；

所述板栅为由铅合金纤维构成的单独部件，并且在所述基体的两侧面上与所述基体熔压在一起。

19、如权利要求14所述的极板，其特征在于，

所述基体为三层结构，其中在第一层和第三层中：

所述铅纤维表面上和铅合金纤维表面上所镀的镉占它们各自重量的2%，

所述铅合金纤维中的组份按重量百分比为：铅90.5%，铋4.5%，镉5%，

所述铅纤维与铅合金纤维的重量比为8：2；

第二层为所述铅合金纤维毡，该铅合金纤维中的组份按重量百分比为：铅93%，铋3%和镉4%；

所述板栅由铅合金纤维构成的单独部件，并且二个所述板栅与二块所述基体间隔叠置并熔压在一起。

20、如权利要求14所述的极板，其特征在于，



在所述坯块中:

所述铅纤维表面上和铅合金纤维表面上所镀的镉分别占它们各自重量的2 %,

所述铅合金纤维中的组份按重量百分比为: 铅90.5 %, 锑7 %, 镉2.5 %;

在所述铅合金纤维毡中:

组份按重量百分比为: 铅88 %, 锑7 %和镉5 %。

21、如权利要求14所述的极板, 其特征在于,

在所述坯块中:

所述铅纤维表面上和铅合金纤维表面上所镀的镉占它们总重量的5 %, 所述铅合金纤维中的组份按重量百分比为: 铅99.32 %, 镉0.5 %, 钙0.08 %和银0.1 %, 所述铅纤维与铅合金纤维的重量比为6.5 : 3.5, 并且还包含0.05 %的晴纶纤维, 0.05 %的碳纤维和0.05 %的碳粉;

在所述铅合金纤维毡中:

组份按重量百分比为: 铅97.5 %, 镉2 %, 钙0.3 %和银0.2 %。

22、如权利要求14所述的极板, 其特征在于,

在所述坯块中:

所述铅纤维表面上所镀的镉占铅纤维总重量的5 %, 所述铅合金纤维中的组份按重量百分比为: 铅94 %, 镉5 %, 0.5 %钙和0.5 %银, 所述铅纤维与铅合金纤维的重量比为6.5 : 3.5;

在所述铅合金纤维毡中:

组份按重量百分比为: 铅99.32 %, 镉0.5 %, 钙0.08 %和银0.1 %。

23、如权利要求13所述的极板, 其特征在于,

在所述坯块中:

所述铅纤维表面上和铅合金纤维表面上所镀的镉占它们各自重量的1 %和1.5 %, 所述铅合金纤维中的组份按重量百分比为: 铅97.5 %, 镉2 %, 0.2 %钙和0.3 %银;



在所述铅合金纤维毡中:

组份按重量百分比为: 铅94%, 镉5%, 钙0.5%和银0.5%。

24、一种用于制造如权利要求1-23中的任意一种极板的方法, 其特征在于, 包括下列步骤:

利用切削、熔压或熔喷的方法将铅和含镉的铅合金制成铅纤维和铅合金纤维;

将这些纤维切成小段;

把剪切成小段的铅纤维和铅合金纤维倒入粘性的溶剂中搅拌, 使它们形成在三维方向彼此均匀混合、缠绕的混合物;

将所述溶剂从所述混合物中压出, 从而形成坯块;

对该坯块进行压缩;

通过熔压, 使该坯块上带有板栅; 和

将一个极耳连接在所述板栅上。

25、如权利要求24所述的方法, 其特征在于, 所采用的粘性溶剂为甘油、水玻璃或其它具有与甘油和水玻璃类似粘度的溶剂。

26、如权利要求24所述的方法, 其特征在于, 将剪切成小段的铅纤维和铅合金纤维倒入粘性的溶剂中的步骤中还包括将碳粉、有机化学纤维和碳纤维中的一种或几种加入所述溶剂中的步骤。

27、如权利要求26所述的方法, 其特征在于, 所述有机化学纤维为晴纶。

28、如权利要求24所述的方法, 其特征在于, 将所述溶剂从所述混合物中压出的步骤是通过将所述混合物放入一个底部具有很多孔的容器中, 利用安装在该容器上部的活塞和容器下部的真空泵将所述溶剂抽出, 使所述纤维沉淀在该容器的底部实现的。

29、如权利要求24所述的方法, 其特征在于, 通过熔压, 对所述坯块进行压缩。

30、如权利要求24所述的方法, 其特征在于, 在对所述坯块进行压缩的同时, 通过电火花放电对所述坯块进行加热。

31、如权利要求24所述的方法, 其特征在于, 在所述坯块上形成



板栅之前, 所述方法还包括将所述活性基体进行浸渍的步骤。

3 2 、如权利要求3 1 所述的方法, 其特征在于, 所述浸渍剂为聚四氟乙烯或铅膏。

3 3 、如权利要求2 4 所述的方法, 其特征在于, 所述极耳为单独部件, 并通过熔压, 固结到板栅上。



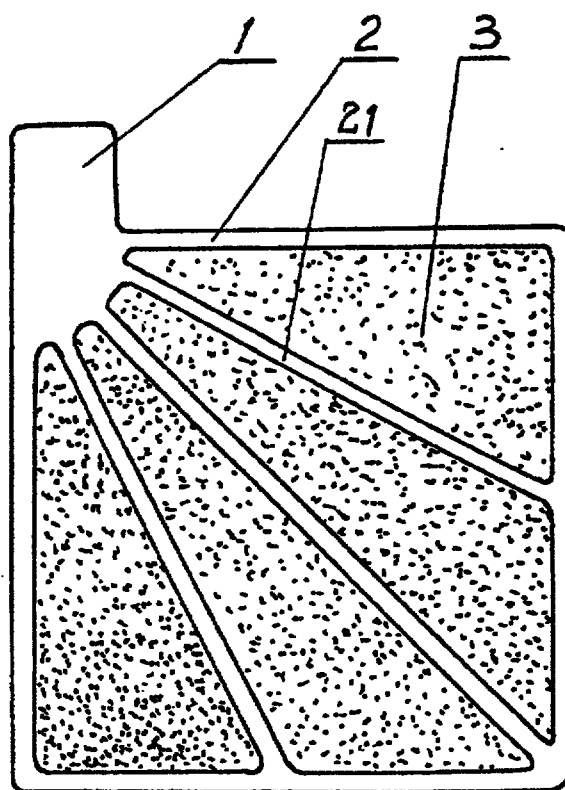
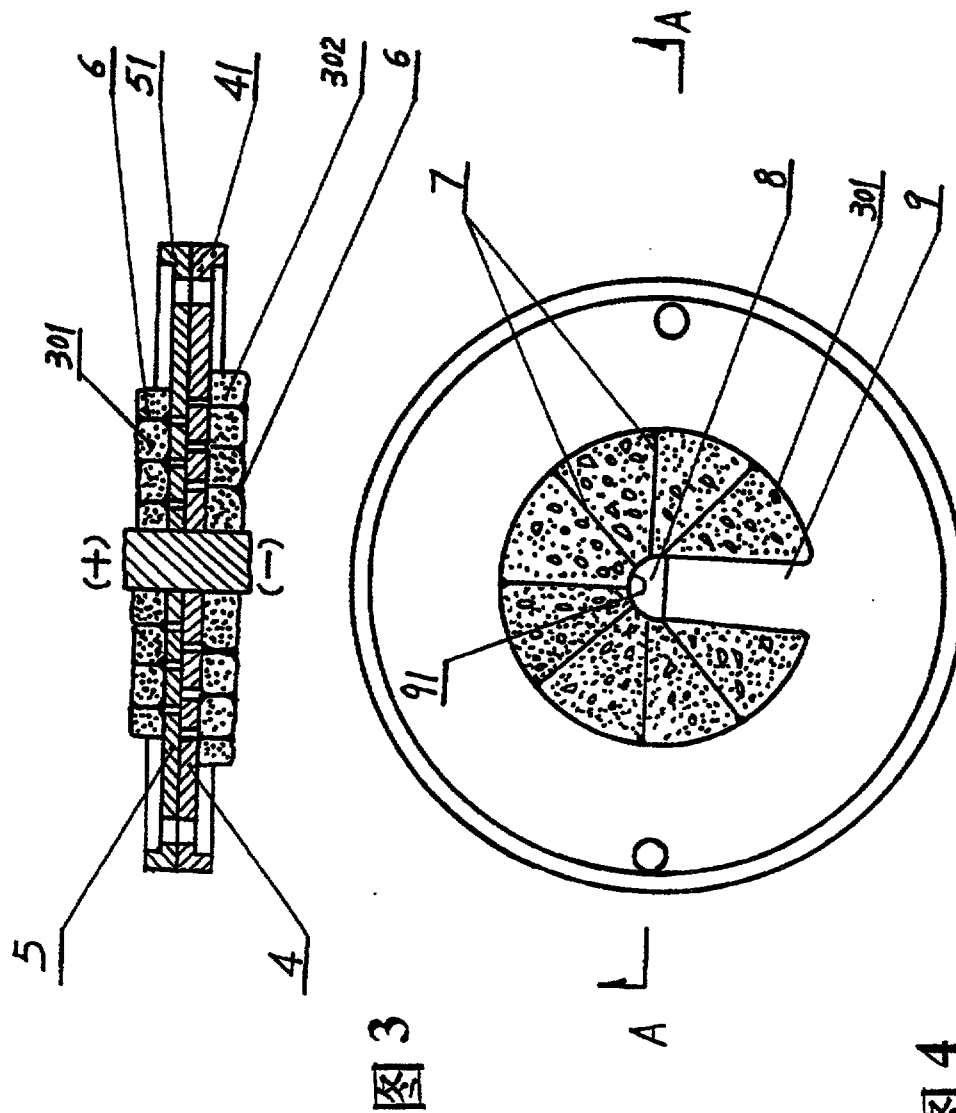


图 1



图 2



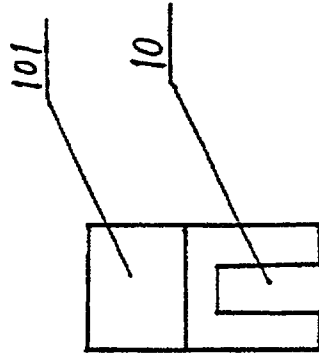


图 6

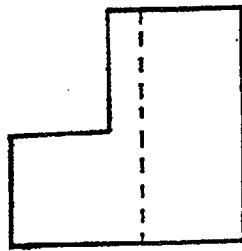


图 5

ELECTRODE PLATE FOR A LEAD ACID ACCUMULATOR AND ITS PRODUCING METHOD

5

Field of the Invention

The invention relates to an electrode plate for a lead acid accumulator and its producing method.

10 **Background of the Invention**

In Chinese Patent Application CN 1051273A, entitled "plate shaped acid positive electrode", issued on May 8, 1991, an electrode plate is disclosed, which consists of two overlain electrically conducting plates with the same structure. The peripheries of the adjacent faces of two electrically conducting plates are provided
15 with a main rib and each of electrically conducting plates is provided with substantially equal quantity of liquid incoming apertures. Meanwhile, the adjacent faces of two electrically conducting plates are coated with lead powder. In order to prolong the lifetime of electrode plate, the binding strength of the lead powder coating to the electrode plate is enhanced by providing crimping edge around
20 peripheries of the adjacent faces, or arranging reinforce ribs on the adjacent faces of electrically conducting plates. This patent has raised the lifetime of the electrode plate at certain level. However, from the point of view of overall behavior of the accumulator, the over thickness of the electrode plate leads to the reduction of specific energy.

Another Chinese patent application CN 2073171U, entitled "lead acid accumulator having high specific energy and long lifetime", issued on March 13, 1991, proposes a technical solution to reduce the thickness of an electrode plate in an accumulator, the way of which is to thin the plate grid of positive electrode plate to 4.0-7.5 mm. At the same time, the plate grid of a negative electrode plate is also to be thinned correspondingly, so that in a same container of the lead acid accumulator the number of electrode plates is increased relatively (i.e. the surface area is increased), and the polarization current for charging and discharging is reduced. Therefore, the specific energy is increased under the precondition that the lifetime is not damaged. However, the increase of specific energy by means of increasment of the surface area by thinning the electrode plate, generally speaking, will undoubtedly damage the lifetime and the strength of the electrode plates. Such disadvantage is just a problem difficult to be solved for several years in the accumulator field.

The technical solutions disclosed in the above mentioned two patents can not radically overcome the contradiction between the lifetime and the specific energy of an accumulator. Meanwhile, the recycling rate of cadmium is low, and the production cost is high.

Accordingly, the object of the present invention is to provide an electrode plate having high specific energy, high power, long lifetime, resistance to overdischarge and rapid charging, as well as its producing method.

Summary of the Invention

The invention provides an electrode plate for lead acid accumulator comprising:

an activated base, including lead fibre and cadmium-containing lead alloy fibre

5 which are mixed and interwoven homogeneously; said lead fibre accounting for 60-90 wt% of said base, and the surface of said lead fibre being plated with cadmium accounting for 1-5 wt% of the total weight of said lead fibre;

a plate grid for collecting current and conducting electricity in combination with said activated base; and

10 a lug, used in the electrical connection between the electrode plates and electrically fixed on said plate grid.

The invention also provides a method for producing the electrode plate, comprising following steps:

by means of cutting, melting pressing or melting blowing process, the lead fibre

15 and lead alloy fibre are produced from lead and cadmium-containing lead alloy; these fibers are cut into sections;

these sections of lead fibre and lead alloy fibre are put into a sticky solution; by means of stirring, a mixture which is mixed and interwoven homogeneously in three dimension is formed;

20 said solution is pressed out of said mixture to form a blank block;

the blank block is compressed;

a plate grid is formed on the blank block by means of melting pressing process; and

a lug is connected to said plate grid.

The electrode plate for a lead acid accumulator according to the invention will be described in detail with reference to the appended drawings.

5 **Brief Description of the Drawings**

Fig. 1 is a front view of an electrode plate for a lead acid accumulator according to the present invention;

Fig. 2 is a side view of the electrode plate for the lead acid accumulator shown in

10 Fig. 1;

Fig. 3 is a sectional view of another electrode plate for a lead acid accumulator according to the present invention;

Fig. 4 is a front view of the electrode plate for the lead acid accumulator shown in Fig.3;

15 Fig. 5 is a front view of a lug used on the electrode plate shown in Fig. 1; the lug is fitted to the plate grid after the activated base is combined with the plate grid; and

Fig. 6 is a side view of the lug shown in Fig. 5.

Detailed Description of the Preferred Embodiments

20 The electrode plate for a lead acid accumulator according to the present invention comprises activated bases 3, 301, 302, and plate grids 2, 7 for collecting electrical current and conducting electricity, as well as plates 4, 5 for enhancing the mechanical strength of the activated base. It is understood that the plate grids 2, 7 also have the function for enhancing the mechanical strength of the activated base.

The activated base according to the present invention is formed by mixing lead fibre and lead alloy fibre. It should be noted that the term "fibre" mentioned in the present invention means a very thin wire. Moreover, the term "fibre" mentioned in
5 the present invention and the term "one or more fibre sections" below have the same meaning sometimes.

The advantage to use fibre lies in that the fibre can enlarge the surface area of activated material to raise the utilization factor of activated material and increase
10 specific energy. After mixing two fibres, fibre felt or fibre cloth can be produced in the manner similar to the method of nonwoven cloth papermaking (AGM manner) with a lot of pores among fibres. When the reaction for forming current is going in the accumulator due to capillarity, these pores can allow enough acid liquid to flow into. Therefore the reaction can be carried out smoothly.

15

During preparation of the activated base, the mixing ratio among various fibres must be kept homogeneous, i.e. the ratio of various fibres per equal unit area must be similar. When the activated base is produced from bunched fibres, the fibre bunches can be made from the same fibres, or from various fibres under given
20 mixing ratio. Generally speaking, if the number of fibres is quite great, it is better to bunch various fibres under given mixing ratio at first, and then the bunches of fibres are mixed to produce the activated base. The activated base produced according to the above mentioned method possesses the structure similar to felt or cloth. In addition, during preparation of the activated base, in order to obtain an

electrode plate having better strength and current collecting and electricity conducting properties, the base block which is produced according to the above mentioned method can be arranged alternately with lead alloy felt which is fully made from lead alloy fibre. Then they are combined together by pressing, forming
5 an activated base with better strength and current collecting and electricity conducting properties.

The mixed fibre used in the present invention consists mainly of lead fibre and lead alloy fibre in a given weight ratio. In order to increase strength and current
10 collecting and electricity conducting properties of the base or the electrode plate, some other fibres and impregnants can be also added thereinto. However, in the case when no any other fibre is added, the electrode plate for a lead acid accumulator according to the present invention can be also produced from lead fibre and lead alloy fibre.

15

In the electrode plate according to the present invention, lead fibre accounts for 60 - 90 wt% of total weight of lead fibre and lead alloy fibre. Meanwhile, the surfaces of all lead fibre are plated with cadmium which accounts for 1-5 wt%. When an activated base according to the present invention is used in a positive electrode
20 plate, on the surface of lead fibre grows a layer of β -PbO₂ crystal lattice; When it is used in a negative electrode plate, the surface of lead fibre remains unchanged. After reaction, the lead fibre of the electrode plate can form β -PbO₂ crystal lattice on the positive electrode plate under the catalysis of cadmium plated on the surface; meanwhile the β -PbO₂ crystal lattice develops from surface to deeper portions, and

finally a state where the core is pure lead and the surface layer is of β -PbO₂ crystal lattice is formed. During discharge of an accumulator, β -PbO₂ crystal lattice on the surface layer of the electrode plate reacts with acid to form electric charge and the pure lead core is used as a channel for transmitting electricity.

5

The lead alloy fibre accounts for 10-40 wt% of the total weight of lead fibre and lead alloy fibre. Meanwhile the surface thereof can be plated with cadmium which accounts for 1-5 wt%. During utilization, β -PbO₂ crystal lattice is formed on the surface layer of lead alloy fibre in the positive electrode plate, while a pure lead layer is formed on the surface of lead alloy fibre in the negative electrode plate. However, whatever for the positive electrode plate or for the negative one, the initial alloy state always remains in the core of the lead alloy fibre.

The key point of the present invention is to mix the above mentioned two fibres under given ratio for producing an activated base to be used in the electrode plate for a lead acid accumulator. Lead alloy fibre itself possesses high strength, satisfactory corrosion resistance and rather good electric conductivity. Therefore, in combination with the plate grid for collecting current and conducting electricity, the base which consists of mixture of lead fibre and lead alloy fibre can meet the demands on the strength and the current collecting and electricity conducting properties during utilization, and can prevent the electrode plate from a poor mechanical strength and the short circuit in the interior of the accumulator. In the prepared base, lead fibre plays the main role in producing electric charge, and lead alloy fibre in collecting current and conducting electricity as well as in supporting

the whole electrode plate. Furthermore, since the lead alloy fibre contains a small amount of cadmium, β -PbO₂ crystal lattice can always be maintained on the surface of the positive electrode plate formed by these two fibres so as to keep the plate in a full electricity storage state.

5

In short, in the lead acid accumulator using the electrode plate formed with lead fibre and lead alloy fibre, since the surface of these two fibres is plated with cadmium accounting for 1-5 wt%, during the reaction due to electrization, on the surfaces of a group of electrode plates which are connected with a DC positive
10 electrode, β -PbO₂ crystal lattice is formed under catalysis of cadmium. During succeeding utilization, in the continuous charge and discharge, β -PbO₂ crystal lattice is then maintained consistently on the surface layer of lead fibre due to catalysis of cadmium contained on the lead alloy fibre. Since the microsurface area of β -PbO₂ is about 20 times larger than that of α -PbO₂ crystal lattice, the ability in
15 storing electricity of the former is much greater than that of the latter. At the same time, in the present invention, β -PbO₂ is resulted directly from the reaction on the surface layers of the lead fibre and the lead alloy fibre, and therefore β -PbO₂ can attach firmly on the fibre and is not prone to fall off. Moreover, as the cores of these two kind of fibres remain in initial state, the oscillation caused by large
20 current and pulse charging can be sustained. In addition, since β -PbO₂ and lead sulphate do not belong to the same crystal, lead sulphate does not nucleate on the surfaces of these fibres. In deep layer of lead fibre, β -PbO₂ can also be formed and is involved in the reaction, and therefore large current output can be kept for a long time in the discharging process. After preparation of a base according to the

present invention, the nodes among various fibres in the mixed fibres are slightly melted together using electric spark discharge technology, so that in the core of whole electrode plate forms a reliable network for current collection and electricity conduction and that the connection strength among various fibres in the whole electrode plate is further enhanced. However, in order to use electric spark discharge technology, on the surface of lead fibre and lead alloy fibre, oxide must exist. Therefore the second role of cadmium plating is used to substitute the oxide layer so that the electric spark discharge technology can be realized.

10 In the lead alloy fibre, the respective weight percentages of compositions preferably are: 88-98.5 wt% for lead, 1-7 wt% for antimony and 0.5-5 wt% for cadmium. The lead alloy fibre prepared according to the above mentioned prescription is mainly used in a conventional accumulator and has rather low cost.

15 In the present invention, in another lead alloy fibre, the respective weight percentages of compositions can be for example : 94-99.32 wt% for lead, 0.5-5 wt% for cadmium, 0.08-0.5 wt% for calcium and 0.1-0.5 wt% for silver. The lead alloy fibre produced according to this prescription possesses rather good corrosion resistance and can raise the lifetime of an accumulator. However, the cost for
20 producing such kind of lead alloy fibre is rather high, and the loss of electrolyte is quite large, since the over potential of hydrogen and oxygen is reduced due to the addition of silver.

Except above mentioned two fibres, the activated base according to the present

invention can further contain other tiny fibres. These tiny fibres comprise carbon fibre and other organic chemical fibres. The main object to add carbon fibre is to make up for insufficient current collecting and electricity conducting properties of lead alloy fibre. Especially when the weight percentage of lead alloy fiber is quite low and the current collecting and electricity conducting effect is unsatisfactory, the addition of carbon fibre in given amount does not increase the weight obviously, but can obtain good current collecting and electricity conducting effect. The added amount of carbon fibre accounts for 0.1-0.5 wt% of total weight of lead fibre and lead alloy fibre. Furthermore, other organic chemical fibres also can be added into, mainly such as acrylic fibres which possess acid corrosion resistance and good tensile strength. The addition of these fibres is mainly for enhancing the strength of whole electrode plate. The added organic chemical fibres can play a role similar to bundle effect of string or network to integrate various fibres firmly. The added amount of organic chemical fibres should account for 0.1-0.5 wt% of total weight of lead fibre and lead alloy fibre.

In addition, after preparation of the activated base according to the present invention, the base can be put into an impregnant. The preferred impregnant is polytetrafluoroethylene. The soakage of whole activated base can prevent the fibres from movement relative to each other to avoid the reduction of strength of the activated base. The added amount of the impregnant accounts for 0.1-0.5wt% of the weight of the base. Additionally, in the activated base, 0.1-0.5 wt% carbon powder can also be added, such as acetylene carbon, expandable graphite powder, charcoal powder or activated carbon powder. All the above mentioned carbon

fibres, organic chemical fibres and carbon powders are added at the time of mixing various fibres before the activated base is formed, but the impregnant is added after the activated base is formed.

- 5 As shown in Figs. 1 and 2, the plate grid 2 which plays a role of current collection and electricity conduction and enhances the mechanical strength of the activated base, is integratively fixed onto the activated base 3. During preparation, it is preferably to form the plate grid 2 directly on the activated base 3 by means of melting pressing the activated base 3. Since the plate grid 2 obtained by melting
10 pressing consists of same material as the activated base, the electrical connection between the plate grid 2 and the activated base 3 is good and the interior resistance is less than that in a conventional electrode plate. At the same time, non-activated material is reduced, i.e. the weight percentage of activated material is increased.
- 15 The plate grid 2 comprises grid strips 21, which are preferably radialized and converge to the connection point of the plate grid 2 with a lug to be mentioned below, making contribution to current collection and electricity conduction.

It is also possible to put two plated grids 2 (not shown), which have been
20 produced in advance such as in frame shape, on each side of the activated base 3, and then to integrate them with the activated base 3 by melting pressing. Alternatively, the plate grid 2 can be also made of lead alloy fibre in the form of a porous net (not shown) having larger pores, then is soaked with common lead paste to help the electrode plate with the overall properties better than that of the

conventional pasted electrode plate.

On the plate grid 2, a lug 1 is connected as a joint among the electrode plates. The lug 1 can be pressed out simultaneously with the formation of the plate grid 2 when the latter is being produced by melting pressing. However, in order to economize the consumption of two fibres, preferably an additional lug 1 is provided after the activated base 3 and the plate grid 2 have been integrated, i.e. the lug is a separate member such as a lead block (Figs. 5 and 6), which has a groove with a width corresponding to the thickness of the activated base 3 and can be fixed on the formed plate grid 2 by melting pressing.

The compositions of the above mentioned lead alloy fibre felt can be the same as that of the lead alloy fibre in the activated base 3. However, since the main role of the lead alloy fibre felt is to enhance the strength and the current collection and electricity conduction properties of the electrode plate, the diameter of its lead alloy fibre should be greater, for example, bunches of lead alloy fibre can be used.

An alternative embodiment of arrangement for assuring the mechanical strength of the base according to the present invention is shown in Figs. 3 and 4. The arrangement consists of a bimetallic plate made of lead and another metal with satisfactory electric conductivity. In such a structure, the bimetallic plate is used both for substituting the elements connected in series between single accumulator cells, as well as for forming a bipolar electrode plate. The interior resistance of the

electrode plate formed in such a manner is low.

In the embodiment, the activated bases 301, 302 which are attached on both sides of the bimetallic plate are of circular shape, on the side faces of which bases grids
5 7 are formed in order to assure the activated bases 301, 302 to have better strength.

In the present embodiment, the plate grid 7 comprises radial pressed dints integrally formed on the bases 301, 302. On the circular activated bases 301, 302, there is an elongated notch 9 along the radial direction. The inner end 91 of the notch 9 is a semicircle and is coaxial with the respective circular activated bases.
10 The width of the notch is equal to the diameter of the semicircle. Such a structure is used to leave a gas cavity for a fully sealed accumulator with oxygen circulation. At the same time, the problem about unsatisfied electrolyte supply to the electrode plate is solved, which is caused by Lorentz force in the lead acid accumulator, pushing the electrolyte to the periphery. Adopting such a circular structure with a
15 notch, the electrolyte at the periphery can flow back in time to the centre.

The bimetallic plate structure consists of a metallic plate 4 on which surface a thin lead layer is plated and a lead plate 5 closely fixed thereon. In the central part of the bimetallic plate, there is a semicircular through hole 8, which shape
20 corresponds to the semicircular interior end 91 of the elongated notch 9 of the activated bases 301, 302. The metallic plate should be made of metal having definite strength and satisfactory electric conductivity. In general, it is better of pure copper. Both the surfaces of the metallic and the lead plates should be rough, i. e. they are full of small projections and cavities in order to make the connection of

the copper plate 4 and the lead plate 5 with both activated bases 301, 302 firm. The method adopted in the present invention is to provide thorns 6 on both surfaces of the copper plate 4 and one surface of the plate 5 by bumping. The copper plate 4 is connected with one surface of lead plate 5 without the thorns 6 to form the bimetallic plate structure. The height of the thorns 6 on one face of the copper plate 4 for connection with the lead plate 5 must be slightly greater than the thickness of the lead plate 5, and the height of its thorns 6 on the other face for connection with the activated base 302 must be slightly greater than the thickness of the activated base 302. Similarly, it is required that the height of the thorns 6 on the lead plate 5 must be greater than the thickness of the activated base 301 in order to assure a firmly attachment. Since the consumption of anode, the lead plate 5 of the bimetallic plate shall function as a positive electrode, when it is arranged in the accumulator, in order to prevent copper of the copper plate 4 from entering into electrolyte so as to affect the properties of the accumulator. At the outer periphery of the bimetallic plate structure, the crimped edges 41, 51 are provided for accommodating sealing gaskets, also for protecting sealing gaskets in practice.

After the circular activated bases 301, 302 are attached on the bimetallic plate, the semicircular through hole 8 of the bimetallic plate must be fully filled with pure lead to form connecting point of the electrode plates, i.e. the lug. Meanwhile, the thickness of the lug must be greater than that of the whole electrode plate. When the accumulator has the above mentioned electrode plate, the positive electrode (i.e. the side where the lead plate of the bimetallic plate is located) must be horizontally arranged upward, so that the stratified phenomenon can be avoided,

which phenomenon occurs due to different densities of electrolyte at the time of electrochemical reaction. In addition, the oxygen which is created on the positive electrode can flow upward and combines with hydrogen on the negative electrode to form water, so that the oxygen circulation can be realized under the fully sealing
5 condition.

The structure of the electrode plate and its producing method will be described further in conjunction with the following examples.

10 Example 1

Figs. 1 and 2 show the example 1 according to the present invention. At first the lead fibre and the lead alloy fibre are produced by melting pressing, cutting or melting blowing etc. In order to assure that the lead fibre and the lead alloy fibre possesses rather satisfactory electric conductivity, the diameters of the produced
15 fibres are for example 8 micrometer and 15 micrometer respectively. Then on the surfaces of these two fibres, cadmium is plated correspondingly, which accounts for 2 wt% of respective weights of lead fibre and lead alloy fibre.

The compositions of the used lead alloy fibre are of 2 wt% antimony, 2 wt%
20 cadmium and 96 wt% lead.

Then these fibres are cut into short sections. The length of each lead fibre section is 1 mm and the length of each lead alloy fibre section is 2.5 mm.

Afterward, the sections of the lead fibre and the lead alloy fibre are mixed according to the weight ratio of 9 : 1. Then the mixture is put into a first container filled with glycerine and is stirred well. Then the contents in the first container are poured into the second container with a lot of pores on the bottom, and the
5 glycerine is extracted by means of a vacuum pump which is connected to the lower part of the second container and applies extraction from bottom. Moreover, a rubber piston is located immediately on the mixture in the second container and has a diameter matched with that of the container to apply pressure from top. Therefore, a blank block with homogeneous porosity can be produced by the
10 operation of the vacuum pump and the piston. After the blank block is pressed, filtrated and extracted, most of glycerine can be extracted. Then the blank block is cleaned and dried.

The reason to use glycerine (at the same time it also involves water glass and salad
15 oil mentioned in the following examples) is that by means of viscosity of the solution itself, the fibre sections therein can flow three-dimensionally during stirring to attain homogeneous mixing effect among various fibre sections and interweaving effect with each other.

20 Then the blank block is pressed again to be formed further.

Next the blank block is put into a mould and a plate grid 2 including radial dints is obtained by means of electric spark discharge.

Finally, as shown in Figs. 5 and 6, a lead block 101 which has a groove 10 with a width corresponding to the thickness of the blank block is arranged thereon by means of melting pressing, and an electrode plate for lead acid accumulator is produced.

5

The plate grid 2 is a frame having arms extending radially or in other direction and making of lead fibre and lead alloy fibre. The configuration of the frame is a square. The activated base 3 is a woolen felt- like porous plate consisting of lead fibre and lead alloy fibre interwoven with each other. The material of the activated
10 base 3 appears in the space between the arms of the frame of the plate grid. The lug 1 is a lead block having a groove 10 with the width corresponding to the thickness of the plate grid 2, and the lug can be fixed on the plate grid through the groove.

Example 2

15 Lead fibre sections with diameter of 80 micrometer and length of 25 mm and lead alloy fibre sections with diameter of 250 micrometer and length of 25 mm are produced according to the method mentioned in example 1. The lead alloy fibre consists of 0.5 wt% cadmium, 1 wt% antimony and 98.5 wt% lead. On the surfaces of the lead fibre and the lead alloy fibre, cadmium which accounts for 5 wt% of
20 their respective weights is plated respectively. The above mentioned lead and lead alloy fibres are mixed according to the weight ratio of 6 : 4. Then the mixture is poured into the first container filled with water glass solution. At the same time, acrylic fibres accounting for 0.1 wt% of total weight of above two fibres, carbon fibres accounting for 0.1 wt% and carbon powder accounting for 0.1 wt% are

added and stirred homogeneously.

Then water glass is extracted and the blank block is dried in the manner of example 1.

5

A lead alloy fibre felt used with the blank block is produced from lead alloy fibre with diameter of 250 micrometer and length of 25 mm according to the above mentioned method. The lead alloy consists of 7 wt% antimony, 5 wt% cadmium and 88 wt% lead. One lead alloy fibre felt is then sandwiched between above
10 mentioned two blank blocks. Afterward the sandwich is integrated by heating and pressing. Meanwhile a plate grid with a latticed shape is formed by melting pressing. Finally, after a lug is fixed by melting pressing, an electrode plate according to the present invention is thus produced.

15 The structure of the electrode plate in the present example is basically similar to that in example 1, and the only difference lies in that the plate grid 2 is a square frame with a latticed shape formed on the sandwich which is obtained after pressing two activated bases with one porous matter sandwiched therebetween wherein the latter is interwoven by lead alloy fibres. Meanwhile, the plate grid 2
20 and the activated base 3 contain 0.1 wt% acrylic fibres, 0.1 wt% carbon fibres and 0.1 wt% carbon powder.

Example 3

As shown in Figs. 3 and 4, two circular bases 301 and 302 are produced according

to the method described in example 1. An elongated notch 9 is formed and extends from the side edge to the centre of the blank block. The inner end 91 of the elongated notch 9 of the base is a semicircle which is coaxial with the circular base. In order to enhance the strength of the base, pressing dints 7 can be formed by
5 melting pressing. However the temperature of melting pressing has to be lower than the melting point of lead.

The circular bases 301, 302 consist of lead fibre which has diameter of 2 micrometer and length of 1 mm and which surface is plated with 2 wt% cadmium
10 and lead alloy fibre which has diameter of 5 micrometer and length of 2.0 mm and which surface is plated with 2 wt% cadmium. The mixing weight ratio between lead fibre and lead alloy fibre is 9 : 1. The solution to be used is glycerine.

One plate of the bimetallic plate structure is a copper plate 4 with thickness of 0.5
15 mm. Both faces of this plate 4 are bumped with thorns 6 and are plated with lead having thickness of 0.2 mm. Then it is fixedly connected to a lead plate 5 which has thickness of 0.5 mm. One of the surface of plate 5 is also bumped with thorns 6. In the centre of the plate struature, there is a through hole 8 which shape corresponds to the semicircular inner end 91 of the elongated notch 9 in the
20 circular blank blocks 301, 302.

On each side face of the bimetallic plate structure, a circular base is pricked by thorns 6 respectively. The elongated notches 9 of both bases 301, 302 are arranged in same direction. Then the semicircular through hole 8 on the metallic plate and

the semicircular inner ends 91 are filled with pure lead which height should be slightly greater than the thickness of whole electrode plate. Thus an electrode plate for a lead acid accumulator is produced.

5 Example 4

Lead fibre sections with diameter of 60 micrometer and length of 20 mm and lead alloy fibre sections with diameter of 200 micrometer and length of 25 mm are produced according to the method mentioned in example 1. The lead alloy fibre consists of 5 wt% cadmium, 7 wt% antimony and 88 wt% lead. On the surfaces
10 of the lead fibre and the lead alloy fibre, cadmium which accounts for 4 wt% of their respective weights is plated respectively.

The above mentioned lead and lead alloy fibres are mixed according to the weight ratio of 7 : 3. Then the mixture is poured into salad oil and stirred homogeneously,
15 afterward is poured into a container with a porous bottom. After pressing, filtering and extraction, the blank block is cleaned and dried to have a required form. As an alternative method, gravity-forced extraction may be used so as to clean and dried the blank block.

20 Then a lead alloy fibre felt is produced according to the method in example 2. The lead alloy fibre making from the felt has diameter of 220 micrometer and includes 5 wt% antimony, 3 wt% cadmium and 92 wt% lead.

Three lead alloy fibre felts and two blank blocks are piled up alternately, then are

pressed together by melting pressing. Finally, the above mentioned sandwich is sandwiched between two plate grids having a latticed shape and making of lead alloy. Then they are pressed together by melting pressing. After attachment of lug 1 by melting pressing, an electrode plate according to the present invention is produced.

The structure of the electrode plate produced according to the above mentioned method has a plate grid 2 which is a frame having a lattice shape and make of lead alloy. The activated base 3 is produced from three layers of porous matter of lead alloy fibre and two layers of porous matter of mixed fibre by pressing. Thus an electrode plate with a stratified structure is prepared. The lug 1 is still a lead block having corresponding groove which is used for fixing the lug on the plate grid 2.

Example 5

The blank block is produced according to the similar method described in example 2. The blank block consists of lead fibre sections with diameter of 50 micrometer and length of 15 mm and lead alloy fibre sections with diameter of 130 micrometer and length of 15 mm. The lead alloy fibre and lead fibre are mixed according to weight ratio of 2 : 8. The lead alloy fibre contains 4.5 wt% antimony, 5 wt% cadmium and 90.5 wt% lead.

The lead alloy fibre in the lead alloy felt contains 3wt% antimony, 4 wt% cadmium and 93 wt% lead.

The blank block is cut into the same shape as that of the electrode plate having an intergal lug 1. Then two blank blocks and one plate grid 2 with a latticed shape are alternately piled up so that the electrode plate can be formed by means of melting pressing using electric spark discharge technology.

5

Example 6

The electrode plate for a lead acid accumulator is produced according to the method mentioned in examples 1 - 5. The diameter of the lead fibre section is 40 micrometer and its length is 20 mm. The diameter of the lead alloy fibre section is 10 70 micrometer and its length is 10 mm. The lead alloy fibre consists of 7 wt% antimony, 2.5 wt% cadmium and 90.5 wt% lead. The surfaces of both fibres are plated with cadmium accounting for 2 wt% of their respective weights.

The diameter of lead alloy fibre used in lead alloy fibre felt is 60 micrometer and 15 the fibre consists of 7 wt% antimony, 5 wt% cadmium and 88 wt% lead.

Example 7

The electrode plate for a lead acid accumulator is produced according to the method mentioned in examples 1 - 5. The diameter of the lead fibre section is 15 20 micrometer and its length is 5 mm. The diameter of the lead alloy fibre section is 8 micrometer and its length is 2 mm. The lead alloy fibre consists of 0.1 wt% silver, 0.08 wt% calcium, 0.5 wt% cadmium and 99.32 wt% lead. The surfaces of both fibres are plated with cadmium accounting for 5 wt% of their respective weights. The mixing weight ratio is 6.5 : 3.5.

The diameter of lead alloy fibre used in lead alloy fibre felt is 7 micrometer and its length is 15 mm. The lead alloy fibre consists of 0.2 wt% silver, 0.3 wt% calcium, 2 wt% cadmium and 97.5 wt% lead. If it is produced according to the method mentioned in example 2, 0.05 wt% acrylic fibre, 0.05 wt% carbon fibre and 0.05 wt% carbon powder are added. Meanwhile when the electrode plate is produced according to the methods mentioned in examples 1-5, it can be impregnated with 0.1 - 0.5 wt% polytetrafluoroethylene.

10 Example 8

The electrode plate for a lead acid accumulator is produced according to the method mentioned in examples 1 - 5. The diameter of the lead fibre section is 5 micrometer and its length is 3 mm. The surface thereof is plated with cadmium accounting for 5 wt% . The diameter of the lead alloy fibre section is 20 micrometer and its length is 5 mm. The surface thereof is not plated with cadmium. The lead alloy fibre consists of 0.5 wt% silver, 0.5 wt% calcium, 5 wt% cadmium and 94 wt% lead.

The diameter of lead alloy fibre used in lead alloy fibre felt is 7 micrometer and the fibre consists of 0.1 wt% silver, 0.08 wt% calcium, 0.5 wt% cadmium and 99.32 wt% lead. After the electrode plate is produced in examples 1 - 5, the electrode plate can be impregnated further with lead powder using chemical impregnating method.

Example 9

- The electrode plate for a lead acid accumulator is produced according to the method mentioned in examples 1 - 5. The diameter of the lead fibre section is 2 micrometer and its length is 0.7 mm. The surface thereof is plated with cadmium accounting for 1 wt% . The diameter of the lead alloy fibre section is 2 micrometer and its length is 0.7 mm. The surface thereof is plated with cadmium accounting for 1.5 wt%. The lead alloy fibre consists of 0.3 wt% silver, 0.2 wt% calcium, 2 wt% cadmium and 97.5 wt% lead.
- 10 The diameter of lead alloy fibre used in lead alloy fibre felt is 2 micrometer and the fibre consists of 0.5 wt% silver, 0.5 wt% calcium, 5 wt% cadmium and 94 wt% lead. When the electrode plate is produced, one plate of the bimetallic plate structure is a silver plate. After the electrode plate is produced according to the method described in examples 1 - 5, the electrode plate can be impregnated further
- 15 with lead powder directly.

Industry Realization

1. Since the pure lead fibre is used as activated material for storing electricity in the fibre felt, and the surface area thereof is larger than that of granula, lead powder and a lead foil, the utilization factor of activated material is raised and the specific energy is raised too.
2. Since the surface layer of lead fibre always remains in β -PbO₂ crystal lattice under charging condition, which has high electricity storage ability, the surface

area and the utilization factor of the activated material and the specific energy are radiacally raised further.

3. Since the plate grid and the lug can be directly formed on the lead fibre felt by
5 melting pressing, the relative weight of the plate grid is reduced and the relative content of the activated electricity storage material is increased, and therefore the specific energy is also raised.

4. Since the activated base is produced by homogeneously mixing lead alloy fibre
10 and lead fibre, the fibres are interwoven with each other and the nodes are slightly melted together. In addition, the plate grid, the frame and the lug are directly formed on the base by melting pressing so that the whole fibre felt forms a reliable and integrated network for current collection and electricity conduction and that an integrated porous electrode plate having high mechanical strength is formed.
15 Therefore for such an electrode plate, its lifetime is long and the interior resistance is low. Meanwhile, the electrode plate possesses the satisfactory properties such as capability for large current and rapid discharge, high specific power, capability for rapid charging and resistance to overdischarge.

20 5. The electrode plate is formed from a combination of two activated bases with one bimetallic plate structure. The bimetallic plate structure can not only substitute the insulating partition, but also can play a role for electrically connecting electrode plates between single cells in series. Meanwhile the bimetallic plate structure is composed of very thin metallic plates, which have high electrical

conductivity and large contact area with the base, so that the interior resistance of accumulator can be further reduced, and that the weights of housing and lead connecting members are further reduced. Thus the specific power and the specific energy of the accumulator are further raised.

5

The tested main specifications of the accumulator using the electrode plate according to the present invention are proved as follows (discharge under heavy load traction) :

10 A. the minimum specific energy can be of 52 watt-hour / kg

B. the minimum specific power can be of 150 watt / kg

C. the minimum lifetime can be of 800 cycles.



CLAIMS

- 5 1. An electrode plate for a lead acid accumulator characterized in comprising:
an activated base, including lead fibre and cadmium-containing lead alloy fibre
which are mixed and interwoven homogeneously; said lead fibre accounting for
60-90 wt% of said base, and the surface of said lead fibre being plated with
cadmium accounting for 1-5 wt% of the total weight of said lead fibre;
- 10 a plate grid for collecting current and conducting electricity in combination with
said activated base; and
a lug, used in the electrical connection between the electrode plates and
electrically fixed on said plate grid.
- 15 2. An electrode plate as claimed in claim 1 characterized in that the respective
weight percentages of compositions in said lead alloy fibre are: 88-98.5 wt% for
lead, 1-7 wt% for antimony and 0.5-5 wt% for cadmium.
3. An electrode plate as claimed in claim 1 characterized in that the respective
20 weight percentages of compositions in said lead alloy fibre are: 94-99.32 wt% for
lead, 0.5-5 wt% for cadmium, 0.08-0.5 wt% for calcium and 0.1-0.5 wt% for
silver.
4. An electrode plate as claimed in claim 1 characterized in that the surface of said



lead alloy fibre is also plated with cadmium and that said cadmium accounts for 1-5 wt% of said lead alloy fibre.

5 5. An electrode plate as claimed in claim 1 characterized in that one or more of carbon fibre, organic chemical fibre and carbon powder is contained in said base.

6. An electrode plate as claimed in claim 1 characterized in that said base further includes polytetrafluoroethylene which accounts for 0.1-0.5 wt% of said base.

10 7. An electrode plate as claimed in claims 1 - 6 characterized in that said plate grid is of frame shape and its interior has a plurality of strips.

8. An electrode plate as claimed in claim 7 characterized in that said strips extend radially and converge to the connection point of said plate grid with said lug.

15

9. An electrode plate as claimed in claim 8 characterized in that said plate grid is integrally formed on said base by melting pressing process.

10. An electrode plate as claimed in claim 8 characterized in that said plate grid is
20 a separate member making from lead alloy.

11. An electrode plate as claimed in claim 8 characterized in that on the bottom of said lug there is a groove, the width of which is equal to the thickness of said plate grid so that said plug can be fixed thereon.



12. An electrode plate as claimed in any one of claims 1 - 8 characterized in that said electrode plate includes further a bimetallic plate structure for supporting said base; said bimetallic plate structure including two plates in which one plate is a lead one and the other is a copper or silver one having a lead layer plated on its surface; these two plates are fixed together face to face and both the sides of the bimetallic plate structure are used for fixing one said base respectively.

13. An electrode plate as claimed in claim 12 characterized in that in the centre of said bimetallic plate structure there is a hole; said base located on each side of the bimetallic plate structure has a respective elongated notch extending from its side edge to its center; the end of said elongated notch near the centre of the base is a semicircle; said elongated notches are aligned with each other and their semicircular ends are aligned with said hole so as to form a through hole; lead is fully filled in said through hole to form a lug, the width of which is greater than the thickness of the electrode plate consisting of the bimetallic plate structure and the bases.

14. An electrode plate as claimed in claim 8 characterized in that said base is a stratified structure, wherein one layer is a blank block consisting of lead fibre and cadmium-containing lead alloy fibre, which are mixed homogeneously and interwoven together; the other layer is lead alloy fibre felt consisting of another cadmium-containing lead alloy fibre interwoven together; the blank blocks and the lead alloy fibre felts are piled up alternately to form said stratified structure.



15. An electrode plate as claimed in claim 8 characterized in that,
- on the surfaces of said lead fibre and said lead alloy fibre, cadmium is plated,
- 5 which accounts for 2 wt% of their respective weight;
- the compositions of said lead alloy fibre are of 96 wt% lead, 2 wt% antimony and 2 wt% cadmium;
- 10 the weight ratio between said lead fibre and said lead alloy fibre is 9 : 1.

- 16 An electrode plate as claimed in claim 14 characterized in that,
- said base is a three-layer structure; the first and the third layer are said blank blocks,
- wherein on the surfaces of said lead fibre and said lead alloy fibre cadmium is
- 15 plated, which accounts for 2 wt% of their respective weight;
- the compositions of said lead alloy fibre are of 98.5 wt% lead, 1 wt% antimony and 0.5 wt% cadmium;
- the weight ratio between said lead fibre and said lead alloy fibre is 6 : 4;
- 0.1 wt% acrylic fibres, 0.1 wt% carbon fibres and 0.1 wt% carbon powder are
- 20 further included; and
- said second layer is lead alloy fibre felt consisting of 88 wt% lead, 7 wt% antimony and 5 wt% cadmium.

17. An electrode plate as claimed in claim 13 characterized in that,



on the surfaces of said lead fibre, cadmium is plated, which accounts for 2 wt% of the total weight of lead fibre;

the weight ratio between said lead fibre and said lead alloy fibre is 9 : 1.

- 5 18. An electrode plate as claimed in claim 14 characterized in that,
said base is a five-layer structure; the second and the fourth layers are said blank blocks, wherein:

on the surfaces of said lead fibre and said lead alloy fibre, cadmium is plated, which accounts for 4 wt% of their respective total weight;

- 10 the compositions of said lead alloy fibre are of 88 wt% lead, 7 wt% antimony and 5 wt% cadmium;

the weight ratio between said lead fibre and said lead alloy fibre is 7 : 3;

said first, third and fifth layers are said lead alloy fibre felt, and the compositions of the lead alloy fibre are of 92 wt% lead, 5 wt% antimony and 3 wt% cadmium;

- 15 said plate grid is a separate member making from lead alloy fibre, and said plate grids located on both sides of said base are pressed together with said base by melting pressing.

- 20 19. An electrode plate as claimed in claim 14 characterized in that,
said base is a three-layer structure, wherein in the first and the third layer:

on the surfaces of said lead fibre and said lead alloy fibre, cadmium is plated, which accounts for 2 wt% of their respective weight;

the compositions of said lead alloy fibre are of 90.5 wt% lead, 4.5 wt% antimony



and 5 wt% cadmium;

the weight ratio between said lead fibre and said lead alloy fibre is 8 : 2;

said second layer is lead alloy fibre felt, and the compositions of the lead alloy fibre are of 93 wt% lead, 3 wt% antimony and 4 wt% cadmium; and

- 5 said plate grid is a separate member making from lead alloy fibre and two said plate grids and two said bases are piled up alternately and pressed together by melting pressing.

20. An electrode plate as claimed in claim 14 characterized in that,

- 10 in said blank block :

on the surfaces of said lead fibre and said lead alloy fibre, cadmium is plated, which accounts for 2 wt% of their respective weight,

the compositions of said lead alloy fibre are of 90.5 wt% lead, 7 wt% antimony and 2.5 wt% cadmium;

- 15 in said lead alloy fibre felt :

the compositions are of 88 wt% lead, 7 wt% antimony and 5 wt% cadmium.

21. An electrode plate as claimed in claim 14 characterized in that,

in said blank block :

- 20 on the surfaces of said lead fibre and said lead alloy fibre, cadmium is plated, which accounts for 5 wt% of their respective weight,

the compositions of said lead alloy fibre are of 99.32 wt% lead, 4.5 wt%, 0.5 wt% cadmium, 0.08 wt% calcium and 0.1 wt% silver,

the weight ratio between said lead fibre and said lead alloy fibre is 6.5 : 3.5,



0.05 wt% acrylic fibres, 0.05 wt% carbon fibres and 0.05 wt% carbon powder are further included;

in said lead alloy fibre felt :

its compositions are of 97.5 wt% lead; 2 wt% cadmium, 0.3 wt% calcium and 0.2
5 wt% silver.

22. An electrode plate as claimed in claim 14 characterized in that,

in said blank block :

on the surface of said lead fibre, cadmium is plated, which accounts for 5 wt% of

10 the total weight of said lead fibre,

the compositions of said lead alloy fibre are of 94 wt% lead, 5 wt% cadmium, 0.5 wt% calcium and 0.5 wt% silver,

the weight ratio between said lead fibre and said lead alloy fibre is 6.5 : 3.5;

in said lead alloy fibre felt :

15 its compositions are of 99.32 wt% lead, 0.5 wt% cadmium, 0.08 wt% calcium and 0.1 wt% silver.

23. An electrode plate as claimed in claim 13 characterized in that,

in said blank block :

20 on the surfaces of said lead fibre and said lead alloy fibre, cadmium is plated, which accounts for 1 wt% and 1.5 wt% of their respective total weight,

the compositions of said lead alloy fibre are of 97.5 wt% lead, 2 wt% cadmium, 0.2 wt% calcium and 0.3 wt% silver;

in said lead alloy fibre felt :



its compositions are of 94 wt% lead, 5 wt% cadmium, 0.5 wt% calcium and 0.5 wt% silver.

24. A method for producing one of electrode plates as claimed in claims 1 - 23
5 characterized in comprising following steps :
by means of cutting, melting pressing or melting blowing process, the lead fibre
and lead alloy fibre are produced from lead and cadmium-containing lead alloy;
these fibers are cut into sections;
these sections of lead fibre and lead alloy fibre are put into a sticky solution; by
10 means of stirring, a mixture which is mixed and interwoven homogeneously in
three dimension is formed;
said solution is pressed out of said mixture to form a blank block;
the blank block is compressed;
a plate grid is formed on the blank block by means of melting pressing process;
15 and
a lug is connected to said plate grid.

25. A method as claimed in claim 24 characterized in that the sticky solution
comprises glycerine, water glass or any other solution which has viscosity similar
20 to that of glycerine or water glass.

26. A method as claimed in claim 24 characterized in that the step wherein the
sections of lead fibre and lead alloy fibre are put into stick solution, further
includes a step in which one or more of carbon powder, organic chemical fibres



and carbon fibres are added into said solution.

27. A method as claimed in claim 24 characterized in that said organic chemical fibre is acrylic fibre.

5

28. A method as claimed in claim 24 characterized in that the step in which said solution is pressed out from said mixture is realized by means that said mixture is poured into a container with a lot of pores on its bottom and then that said solution is extracted using a piston arranged on the upper part of the container and a vacuum pump arranged on the lower part of the container to settle said fibres on the bottom of the container.

10

29. A method as claimed in claim 24 characterized in that said blank block is compressed by means of melting pressing process.

15

30. A method as claimed in claim 24 characterized in that at the time when said blank block is compressed, said blank block is heated by electric spark discharge process simultaneously.

20

31. A method as claimed in claim 24 characterized in that said method further includes a step for impregnating said activated base before the plate grid is formed.

32. A method as claimed in claim 31 characterized in that said impregnant comprises polytetrafluoroethylene or lead paste.



33. A method as claimed in claim 24 characterized in that said lug is a separate member and is fixed on the plate grid by melting pressing process.

ABSTRACT

5 An electrode plate for lead acid accumulator comprises an activated base including lead fibre accounting for 60-90 wt% of said activated base and cadmium containing lead alloy fibre, which are mixed homogeneously and interwoven; a plate grid for collecting current and conducting electricity in combination with said activated base; a lug for electrical connection between electrode plates, said lug is
10 electrically connected with said plate grid and is fixed thereon. Furthermore, a method for producing the electrode plate is provided, the method comprises steps, in which lead and lead alloy fibres cut into short sections are poured into sticky solution in order they are mixed with each other homogeneously in three dimensional direction by stirring.

15

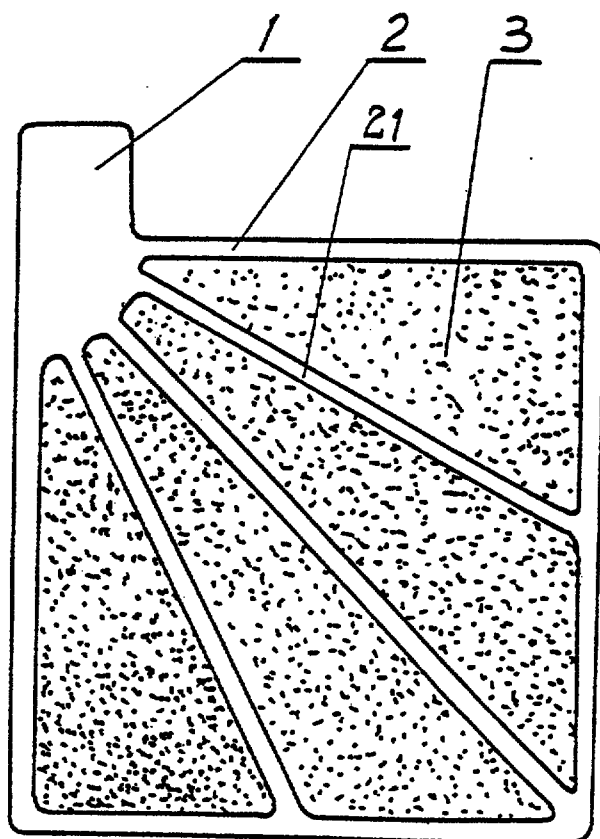


Fig. 1



Fig. 2

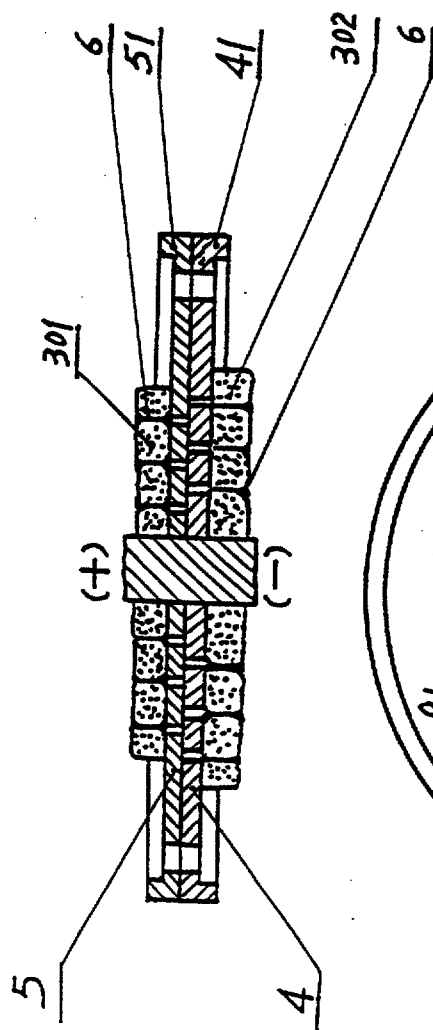


Fig. 3

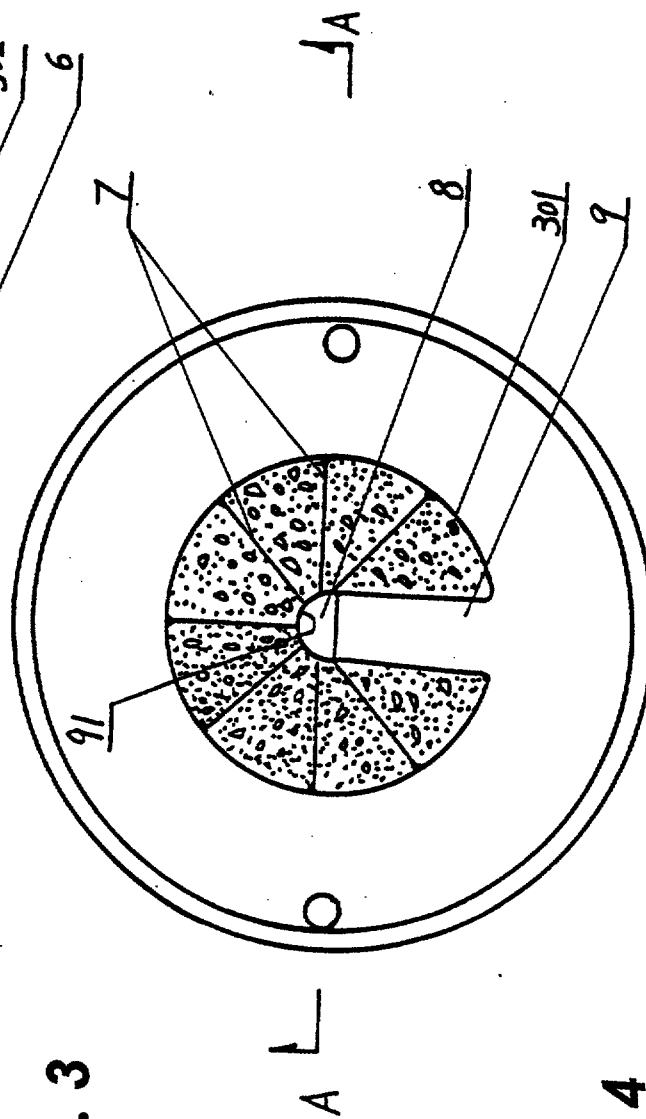


Fig. 4

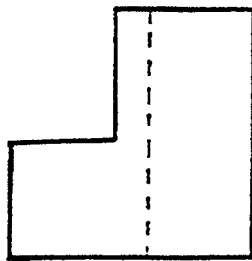


Fig. 5

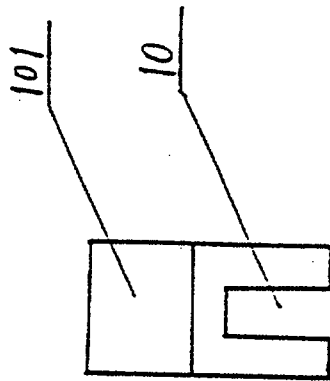


Fig. 6

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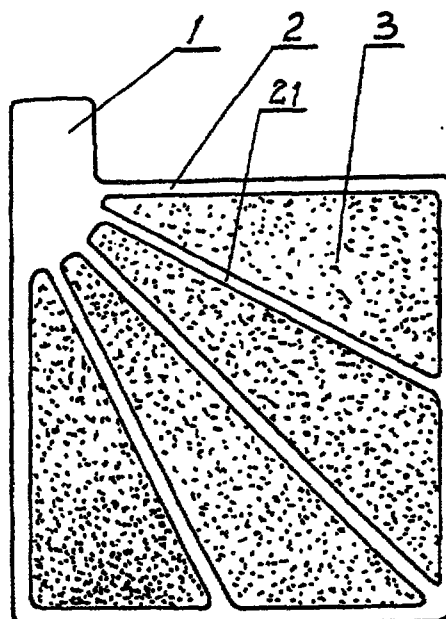
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(54) Title: AN ELECTRODE PLATE FOR LEAD-ACID ACCUMULATOR AND PRODUCING METHOD THEREOF

(54) 发明名称: 用于铅酸蓄电池中的极板及其制造方法

(57) Abstract

An electrode plate for lead-acid accumulator comprises an active substrate including lead fibre being 60-90wt% of the active substrate and cadmium-containing alloy fibre which are homogeneously mixed and interwoven; a plate grid for collecting current and electrically connecting in combination with the active substrate; and a lug for electrically connecting between the electrode plates which is connected and fixed onto the plate grid. Furthermore, there is provided a method for producing the electrode plate comprising step of applying lead fibre and lead alloy fibre cut into short sections and stirring, so as to form a mixture that is homogeneously mixed and interwoven in three dimension.



(57) 摘要

一种用于铅酸蓄电池的极板, 包括: 活性基体, 所述活性基体包括均匀混合并交织在一起的铅纤维和含镉铅合金纤维, 所述铅纤维占所述基体总重量的60-90%; 板栅, 与所述活性基体配合, 用于集流导电; 极耳, 用于极板间的电连接, 所述极耳与所述板栅电连接地固定在所述板栅上。还提出一种用于制造极板的方法, 包括把剪切成小段的铅纤维和铅合金纤维倒入粘性的溶剂中搅拌, 使它们形成在三维方向彼此均匀混合、缠绕的混合物的步骤。

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