

中北大学信息商务学院

外文翻译

精密虎钳设计及相关技术研究

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系 名： 机械工程

专 业： 机械设计制造及其自动化

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2016 年 6 月 2 号

附件： 1. 外文资料翻译译文； 2. 外文原文。

附件 1:

使用内部车载电源的汽车千斤顶发展

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摘要:汽车千斤顶通常用机械的优势，让一个人通过手动的力量来提升车辆。更强大的千斤顶使用液压动力提供更大的升力和更大距离。本文介绍了汽车千斤顶紧急情况下使用的开发与利用内部点烟器电源(12v)。自动千斤顶利用该电源以节省不必施加任何人的能量。以增加提升力，以确保有足够的电，使变速比被使用。汽车千斤顶的开发利用的SolidWorks®和分析，以检查安全系数和力作用。制造工作已经由铣削和研磨机完成。千斤顶将进行测试，预测有足够的力量来提升和保持汽车作为普通汽车千斤顶。

关键词: 自动汽车千斤顶，点烟器，Solidworks，传动比

引言

汽车千斤顶是用来提高设备所有或车辆进入的空气的一部分，以便于车辆的维护或故障修理。大多数人都熟悉的基本汽车千斤顶（手动操作），它包括作为最新汽车的标准设备。愿意更换轮胎的车主都是从前到后等等或者谁可能在春天冬天之前安装雪地轮胎，并卸下它们需要使用千斤顶执行工作[1]。卸下漏气的轮胎是不是一个非常愉快的经历。现今，各种汽车千斤顶已经开发了用于从地面抬起汽车。但是，可用千斤顶通常是手动操作的，因此需用户的大幅的体力。例如在特别的恶劣天气条件下，千斤顶对老人和残疾人的使用非常困难[2]。鉴于这种固有的缺点，商用汽车维修及服务站通常配备大型高科技汽车升降机，其中该升降机是通过电供电系统升高和降低[3]。然而，由于其规模和采购成本高，维护电力车升降机，这类升降机一般不提供给车主。这种电供便携式千斤顶不仅能代替通过手动操作千斤顶起重汽车的艰巨任务，而且进一步降低维修汽车所需的时间。当需要修复的道路的侧面或其它危险情况下的汽车[4]，这样的功能特别有利。

此外，还有报道关于汽车千斤顶而导致几次严重的事故。指定额定托起 1000 公斤，但是由消费者事务进行的测试显示，是失败起重 250 公斤后的工作和可能千斤顶损坏的时候接近其额定载荷的重量[3]。试验证明，该千斤顶有低于所承受的准备重量倾向，并且它不符合澳大利亚标准车辆千斤顶的最小性能的要求[5]。该项目的目的是开发一个容易

操作、安全、能够轻松提升和下降汽车并不涉及太多体力的汽车千斤顶。

发展

图 1 示出的自动汽车千斤顶设计：

1. 原来剪式千斤顶
2. 螺杆轴
3. 电动车窗电机
4. 小齿轮
5. 齿轮
6. 框架支架
7. 固定支架

此外，图 2 是自动汽车千斤顶的实际原型。按图形中全部要求，然后转换到真正的原型。它还包括一个开关按钮的系统，以提高和降低千斤顶总负载。图 1，显示从垃圾场收集到的剪式千斤顶，它仍然可以使用。在市场中，剪式千斤顶是在现有最佳的千斤顶。据法哈德，气动和液压千斤顶是不安全的，因为通常都需要维护和有泄露[6]。它是在剪式千斤顶基础上发展的。螺杆轴，可旋转并抬高头部装来上下。螺杆轴是非常重要的，因为在这种设计需要一个系统，该系统能够承受的负载，并锁定该千斤顶的凸起程度。螺杆将机制调整并保持高度的水平。

电机来自从垃圾场，它是从二手车电动马达卸下的。从制造商和计算值的扭矩，它提供 $5.877\text{N}\cdot\text{m}$ 扭矩是足够高的，适合项目[7]。也有小齿轮和大齿轮，这是在主传动装置系统，如图 3 所示。这是传动系统，增加了扭矩 $17.631\text{N}\cdot\text{m}$ [8]。此外，该帧是用于电动电机支架。最后，稳定架是支持电动机的重量，并以稳定的剪式千斤顶。这也是很好的平坦表面当顶起汽车的时候[9]。

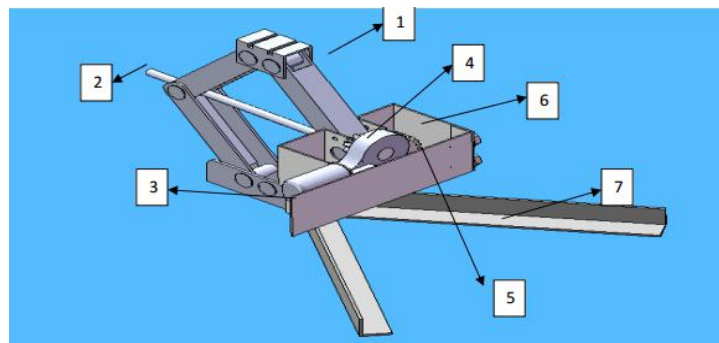


图 1. 来自 Solidwork 设计



图 2. 发展原型

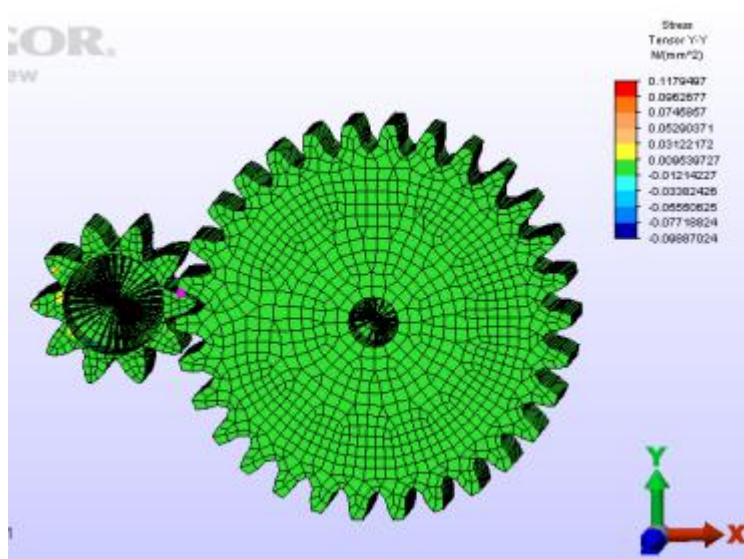


图 3. 齿轮系统

机械部件

该机构升降系统被应用在剪式千斤顶。剪式千斤顶的具体描述是，它可以承受 850 公斤的最大负荷的是然后切割块焊接在剪式千斤顶的端部和与其他部分焊接在一起，如图所示。

该焊机，涉及的是 MIG 机（金属惰性气体）。7 是该稳定基础，从 L 铁棒制成[8]。每个铁条的长度为 30cm，然后被旋入并焊接在剪式千斤顶的底座上。这是为了增加与表面积的稳定，剪式千斤顶将增加稳定性[5]。此外，折弯机也可用于弯曲齿轮系统的表面，弯曲锯机是用来切割原料的齿轮。如图 4 所示制造齿轮。

最好的，因此为这个项目最好的测试车是一个叫做 PERODUA 灵鹿®(682 千克)[10]。

该测试在报告中将加以详细的解释。3 号是原来的齿轮需要被丢弃，因为 4 号，小齿轮和 5 号，大齿轮采用金属丝电火花切割机制造。所有规格的齿轮，根据需要对所施加的转矩的规格系统[11]来提供。该齿轮系统是关键，因为它是由电机驱动的升降机构。来自电机的转矩将被供给到所述小齿轮，然后传送到大齿轮，它旋转时，螺杆轴顺时针或逆时针旋转。

通过使用 EDM 线切割机，操作者需要插入已经绘制的图形，然后再编程序到机器中，所以它会工作。然后 4 号小齿轮被制造，它被插入到电动电机的槽再焊接。6 号框架是组成设计的基础，以固定马达。它是使用 3 毫米低碳金属制成，然后根据维度[5]，用切割成小块。



图 4. 齿轮制造

根据图 5，开关为剪式千斤顶进行升降，是由 2 个 ON / OFF 开关按键控制的。该开关电路是为了使电机启动，而无需改变终端正和负、顺时针旋转和逆时针旋转。当使用该千斤顶时，每一次都需要改变终端，因此，通过使用这个开关，它更灵活，更容易为用户。该交换机还包含 2 个继电器将动作，当升降按钮按下，会驱动其中一个继电器，它会旋转电机到某个期望的水平。最重要的部分是，当按钮被释放，将直接停止。让我们说，如果按下红色按钮，然后它会启动继电器 1 线圈，然后它会切换开关，然后电源流入电机和第二个继电器，将直接进入到了负极，电机转动顺时针。反之亦然，如果按下黑色按钮[11]。

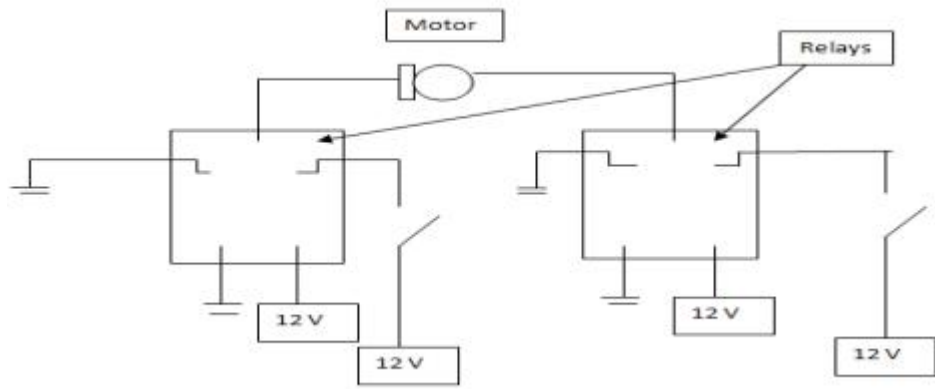


图 5：开关电路

结论

考虑到在市场上所有可用的千斤顶,这个原型可以通过在功能和设计上进行一些修改得到改善。目标是设计一个安全、可靠、并能升高和降低的水平、开发出由内部车载电源供电、自动化与按钮系统汽车千斤顶。虽然这款千斤顶只是基于 PERODUA 灵鹿基础上设计的,但通过使用更高的扭矩也能够举起更大的负载, Proton Wira®和 Proton Iswara®汽车。

致谢 由 University Malaysia Pahang (UMP)提供资金支持，同时非常感谢大四学生

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一种新型液压千斤顶的研究

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摘要：传统千斤顶的主要缺点是速度低夹紧力大或者是速度高夹紧力小。本文将介绍一种新型液压千斤顶。在这种千斤顶中，第一时间做出大小油缸和大小楔块。大小油缸可以同时工作并返回原点，所以可以根据载荷大小自动地改变速度，且容易操作。这种新型液压千斤顶的工作原理可以应用到其它方面，例如，台虎钳有几种不同的功能。

关键词：液压千斤顶；力；速度

1. 引言

传统的液压千斤顶在工作行程和工作回程具有相同的速度。千斤顶承受的载荷越大速度越低，反之，速度越快其所承受的载荷越小。大多数千斤顶无法区分无载荷或者重载荷的情况，所以对于液压千斤顶，如果承受载荷大，其速度将变慢，反之，如果速度快，其所承受的载荷就小。于千斤顶从原始位置移动到工作位置需要相当长的时间，所以，传统液压千斤顶的工作效率相当低，浪费能源，浪费时间，而且工作范围狭隘。因此，传统千斤顶在速度与载荷之间存在冲突。

为了解决这种冲突，许多人做了很多关于新型千斤顶的研究，而且研制出了许多新型千斤顶。典型机械千斤顶具有快慢速螺旋传动装置的特点，其可以通过齿轮啮合或者分离螺母和螺栓来提供双倍速度。典型液压千斤顶特点是为一种千斤顶和多速千斤顶提供多速调整方法，通过在进油缸和出油缸之间提供几种液压油路来改变速度。该原理能够保证一个千斤顶具有几种速度，其可以根据负载的大小自动调节，并且具有相对高的工作效率。但是实际上使用并没有达到预期的效果，原因是存在太多的油泵，和极大增加阻力的油缸。

为了解决传统手动千斤顶在载荷和速度之间的冲突，我们发明了一种新型手动液压千斤顶，其专利为液压交换装置。

2. 设计新型液压千斤顶

2.1 新型液压千斤顶的设计理念

为了达到轻便、功能强大、多速和可靠的目的，我们既不使用传统千斤顶只有一个油缸和一个油泵的设计理念，也不参考在进油缸和出油缸之间有几级液压调速的设计理念。

经过调查，我们决定采用一个大油泵、一个小油泵、一个小油缸和一个大油缸的结构，这种结构在大小油泵系统和大小油缸系统有优势。下面为主要思路描述：增加一个受约束的大油泵和小油泵，即在油缸进油路连接一个轻载荷油路；增加一个受约束的小油泵和大油泵，顺序阀代替溢流阀。因此，我们可以通过调节手柄上的力和速度，使无级调速在一个小范围内，同时我们也可以通过切换控制阀和匹配大小油缸的方法在大范围内进行无级调速。

2.2 液压系统原理图设计

对于大量的研究和改进，我们制定了新型液压千斤顶的液压原理系统图，如同 1 所示。在新型千斤顶中，有控制手柄 1 和 9，小油泵 2，单向阀 3、7、10，小油缸 4，大油缸 5，顺序阀 6，大油泵 8 和进油管道和回油管线等。

图 1 还显示出，大油缸 8 的单向阀 7 也是小油缸进油输入路线，小油缸 2 的单向阀 3 也是缸体 4 进油线路，大油缸 5 也是邮箱。因此，我们通过连接所有管道制成双油泵双油缸系统。

大油泵吸油与油缸排油同步。当千斤顶需要回到原来的位置，油缸停止工作，同时工件的重力和活塞迫使油缸开始放油，排出的油通过双向阀返回到油泵中。这个过程称为油泵的吸排油。

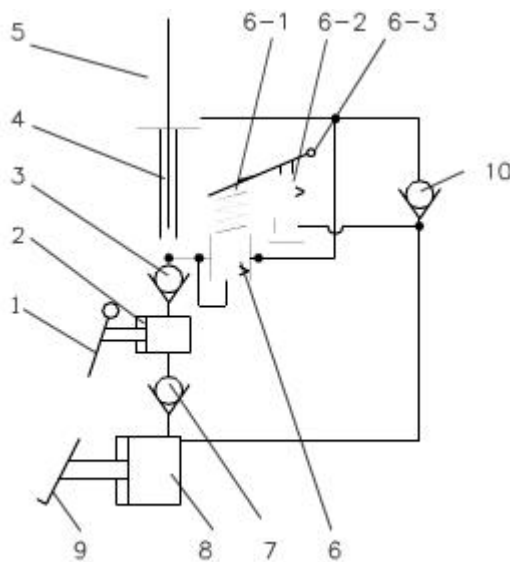


图 1 新型液压千斤顶液压系统原理图

通过移动手柄，在大油泵的油被排到油缸，向上推动，这个过程称为大油泵排油。

2.3 千斤顶速度分析

我们可以根据负载的大小分析这种新型千斤顶的速度。

在无负载情况下的速度：在这种情况下，顺序阀关闭，大油泵推动油液到小油缸，小

油缸推动大油缸的活塞，其以最高速度到达工件。

在小负载情况下的速度：在活塞接触工件后，顺序阀微微打开，小油泵推小油缸向上，同时大油泵推动油缸向上，因此千斤顶承受的载荷小。

在中等负载情况下的速度：在这个情况下，顺序阀部分打开，更多的油进入大油缸，推杆上的力也开始增大，千斤顶上的力强制使油泵停止工作，脱扣器推迟动作，因此手柄仅驱动小油泵，小油泵推高，压力油进入小油缸，迫使活塞以中等速度移动。

在重载情况下的速度：在这种情况下，顺序阀完全打开，小油泵泵入高压油，其直接进入大油缸和小油缸，活塞以最低速度中载荷移动。

3. 结构图例

这种新型千斤顶结构图例如图 2 所示，其外观如图 3 所示。图 2 显示，大油泵与基座 14 和邮箱的盖 8 复合，大油缸与缸体 15 和大活塞 5 复合，小油缸与被置于在基座中间和小活塞 4-1 之间的管道 4 复合，脚踏叉 9 附连到大油泵，控制手柄 1 安装到小油泵，基座 14 和顶梁 13 与导柱 11 连接，可移动臂 12 能通过导柱 11 在大小油缸间移动。

在无载荷情况下，可以踏动脚踏叉 9，大油泵将泵入液压油到泄油阀 10、3、7 中，然后油液进入大小油缸，以高速瞬间推动活塞到达工件处。在轻载荷情况下，可以踏动脚踏叉 9，大油泵将以更高的压力泵入油液，部分油液通过排油阀 10 进入大油泵，驱动大油缸，与此同时，其它油液通过排油阀 7 进入小油泵 2，所以小油泵中的油液比大油泵中油液的有更高的压力，这些油液通过推动梁快速起来的排油阀 3 驱动大小油缸。在重载情况下，大油泵中的油液压力升高，然后油液进入小油泵，油液的压力通过小油泵再次升高，然后油液进入大小油缸，大小油缸一起推动工件，其承载能力是大小油缸的总和。当油缸要返回时，可以转动顺序阀 6-3 的手柄来松开顺序阀 6-1 和回油阀 6-2，提高脚踏叉 9 来确保大油泵完全打开顺序阀的两个孔，工件和活塞的重力驱动大小油缸回到原来位置。



图 3 样品千斤顶外观

这种新型液压千斤顶已经解决了结构和操作的问题，其创新如下：(1) 内部产生液压联动：大油泵输油管线与大小油缸的回油管线直接连接，顺序阀不仅仅是大油缸和大油泵的进油阀，也是小油缸和大油缸的回油阀，卸油管道也是进油管道，大油泵的排油阀也是小油泵的进油阀，也就是说阀有多种功能。(2) 它使大小油泵和大小油缸的变速系统高度集成。(3) 封闭循环是相当的高效和可靠：油液进入油缸没有任何其它中间部分，所以这种千斤顶摩擦阻力小、很少的能量损失和灵活的运动。(4) 该结构简单：系统简洁、管线短、损耗小和零件数目少。

我们已将传统千斤顶与我们的样品千斤顶相比较。新型千斤顶和传统千斤顶都具有 12000 公斤的起重能力。假设千斤顶手柄在工作行程中的移动速度是 0.5m/s，传统千斤顶具有大约 5mm/s 的速度。但是这种新型样品千斤顶的速度能够在 1.05—4260mm/s 间改变。在回程过程中，仅仅需要转动顺序阀的手柄，该千斤顶能以高速返回到原来的位置，但是对于传统千斤顶，只有推动油缸的活塞才能回到原来的位置。

结束语

这种新型手动多速千斤顶最初使用封闭循环系统，其有一内部过程液压联动和使用大油泵作为油箱，它可以通过顺序阀导向自返回油液而自动改变速度。这种速度几乎没有压力损失、机械损失、机械损失、容积效率损失和能量损失。这种新型千斤顶巧妙的解决速度和力的问题，其设计理论也用于其它类型的手工工具，比如虎钳等。

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附件 2：外文原文

Malaysian Science and Technology Congress,

MSTC08, 16~17 Dec, KLCC, Malaysia, 2008.

Development of Auto Car Jack Using Internal Car Power

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Abstract Car jacks usually use mechanical advantage to allow a human to lift a vehicle by manual force. More powerful jacks are using hydraulic power to provide more lift over greater distances. This paper presents the development of the car jack for emergency use with using internal cigarette lighter power (12volts). The automatic easy car-jack utilizes this power source to save individuals having to exert any energy. To increase the lifting power in order to ensure the power is adequate, gear ratio was used. The car jacker was developed utilizing the Solidworks® and its analyses to check the safety factor and force acting. The fabrication work has been done with milling and grinding machine. The car jacker will be tested and it predicted to have enough power to lift and holding the car as normal car jacker.

Keywords: Automatic car jack, cigarette lighter, Solidworks, gear ratio

INTRODUCTION

An automotive jack is a device used to raise all or part of a vehicle into the air in order to facilitate vehicle maintenances or breakdown repairs. Most people are familiar with the basic car jack (manually operated) and it's included as standard equipment for most of the new cars. Vehicle owners who would like to rotate their tires themselves either front to back and so forth or who may install snow tires before the winter and remove them in the spring need to use a jack to perform the job [1]. Changing a flat tire is not a very pleasant experience. Nowadays, a variety of car jacks have been developed for lifting an automobile from a ground surface. Available car jacks, however, are typically manually operated and therefore require substantial laborious physical effort on the part of the user. Such jacks present

difficulties for the elderly and handicapped and are especially disadvantageous under bad weather conditions [2]. In light of such inherent disadvantages, commercial automobile repair and service stations are commonly equipped with large and hi-tech car lift, wherein such lifts are raised and lowered via electrically-powered systems [3]. However, due to their size and high costs of purchasing and maintaining electrically-powered car lifts, such lifts are not available to the average car owner. Such electrical-powered portable jacks not only remove the arduous task of lifting an automobile via manually-operated jacks, but further decrease the time needed to repair the automobile. Such a feature can be especially advantageous when it is necessary to repair an automobile on the side of a roadway or under other hazardous conditions [4]. There also reports on car jacks which lead to a serious number of accidents. A specified jack purposed to hold up to 1000 kilograms, but tests undertaken by Consumer Affairs has revealed that it fails to work after lifting 250 kilograms and may physically break when it has a weight close to its 1000 kilograms capacity [3]. Tests have proven that the jack has the propensity to buckle well under the weight it is promoted to withstand, and it doesn't meet the minimum or performance requirements of the Australian Standard for vehicle jacks [5]. The purpose of this project is to develop a car jack which is easy to be operated, safe and able lift and lowering the car without involving much physical effort.

THE DEVELOPMENT

Figure 1 shows the design of automatic car jacker where:

1. Original Scissor jack
2. Screw shaft
3. Power window motor
4. Pinion
5. Gear
6. Frame holder
7. Stabilizer base

Furthermore, Figure 2 is the actual prototype of the automatic car jack. The entire requirement from the drawing is then transform onto the real prototype. It also included a switch buttons system to raise and lowering the jack (Head load). Figure 1, shows the used scissor jack which has been collected from the junk yard and it still can be used. The scissor jack is the best jacks

available in the market. According to Farhad, the pneumatic and hydraulic jack is not safe because usually need maintenance and sometime leaked [6]. The development will be base on this scissor jack. The screw shaft which can be rotated and raise the head load up and down. The screw shaft is very important because in this design will need a system which can withstand the load and lock the raised level of the jack. The screw will be the mechanism to adjust and hold the height level. The motor is from the junk yard and it is from used car power window motor. From the manufacturer and calculated value for the torque, it supplied 5.877N.m torque which is high enough and suitable for the project [7]. There is also the pinion (small) and the gear (large) which is the main gearing system as shown in figure 3. This is the gearing system which increased the torque to 17.631N.m [8]. Furthermore, the frame is the holder for the power window motor. Lastly, the stabilizer base is to support the weight of the motor and to stabilize the scissor jack. It is also good for flat surface when jacking the car [9].

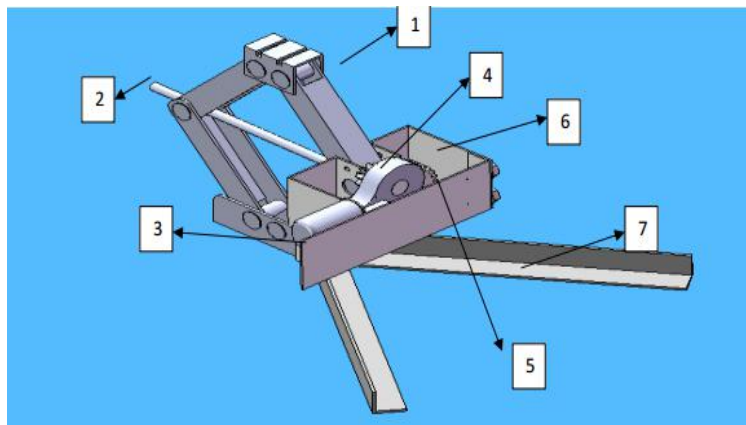


Figure 1. Design from Solidwork



Figure 2. Developed prototype

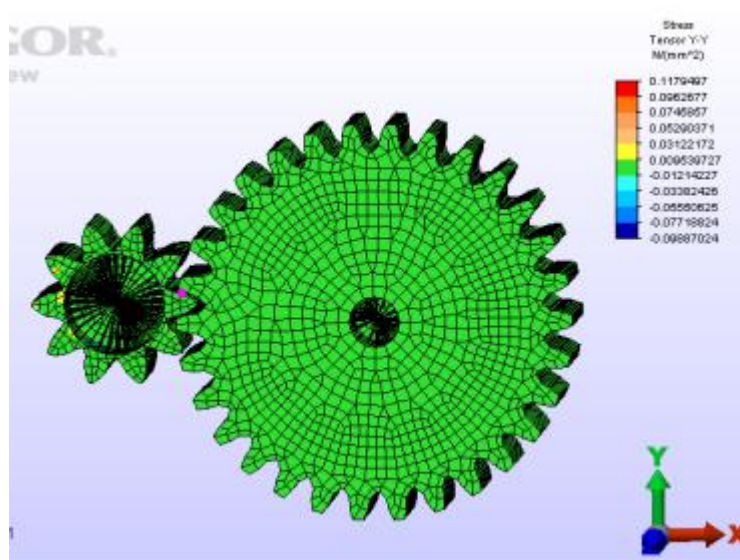


Figure 3. Gearing system

MECHANICAL PARTS

The mechanism lifting system was applied on the scissor jack. The scissor jack specific description is it can withstand the maximum load of 850kg which is the best because the test car for this project is a PERODUA Kancil® (682kg) [10]. The test will be detailed explained in the result. No. 3 is the motor which the original gear needed to be discarded because no. 4, pinion and no. 5, gear are manufactured using wire EDM cutting machine. All the specification of the gears according to the torque needed to be applied on the system [11]. The gearing system is the crucial thing as it is the lifting mechanism powered from the motor. The torque from the motor will be supplied to the pinion and then transmit to the gear and it rotated the screw shaft clockwise or counter- clockwise.

By using the wire EDM cutting machine, the operator needed to insert the drawing that has been made and then program the machine so it will work. After the no. 4 pinion is fabricated, it is inserted into the slot of the power window motor and welded. The no. 6 frame is fabricated base on the design to hold the motor. It is fabricated using 3mm low carbon metal and then cut using grinder into small pieces according the dimensions [5]. The cut pieces are then welded on the end of the scissor jack and welded together with other pieces as the picture shown.

The welding machine that involved is MIG machine (Metal Inert Gas). No 7 is the stabilizer base which is made from the L iron bar [8]. The length of each iron bar is 30cm and then is screwed and welded on the base of the scissor jack. This is to stabilize the scissor jack with increasing of the surface area will increase the stability [5]. Moreover, bending machine is also

used to bend the cover for the gearing system and bend saw machine is used to cut the raw material for the gear. Fabricated gear shown in Figure 4.



Figure 4. Fabricated gear

Base on Figure 5, switch for the scissor jack to be lifted and lowered are controlled by a 2 buttons switch with ON/OFF. This switch circuit is to make the motor enabled to rotate clockwise and counter-clockwise without changing the terminal positive and negative. It is time consumable to change the terminal every time when using this jack, so by using this switch, it is more flexible and easier for the user. The switch also contains 2 relays which will act when a lifting button is press it will actuate one of the relay and it will rotate the motor to the desire level. The most important part is that when the button is release it will stop directly. Let say if the red button is pressed, then it will actuated the coil in relay 1 and then it will change over the switch and supply will flow to the motor and to the second relay which will go directly to negative terminal and the motor will rotate clock-wise. Vice versa, if the black button is pressed [11]

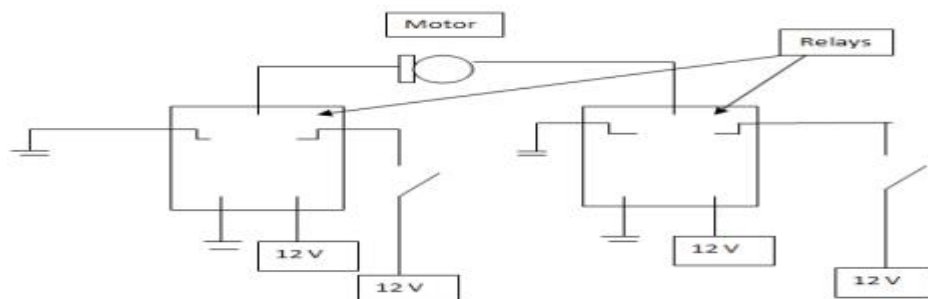


Figure 5: Switch circuit

CONSLUSIONS

Considering all available car jacks in the market, this prototype can be improved by a few modifications on the features and design. The objectives are to design a car jack that is safe, reliable and able to raise and lower the level, to develop a car jack that is powered by internal car power and automated with buttons system. Although this car jack was design only on PERODUA Kancil, by using higher torque it is able to lift more loads such as Proton Wira® and Proton Iswara® car.

Acknowledgments The financial support by University Malaysia Pahang (UMP) and final year student Amir Iskandar Bin Ariffin is grateful acknowledged.

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Research of A New Type of Hydraulic Jack

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Abstract: The main disadvantage of traditional manual hydraulic jack is that it has a slow speed with a big clamping force or a rapid speed with a small clamping force. A new type of hydraulic jack is introduced in this paper. In this type of jack, a big bump, a small bump, a big oil cylinder and a small oil cylinder are made together in a part in the first time. the big cylinder and small cylinder can work and returns to the original position synchronously, so it can change speed automatically according to the magnitude of load and be operated easily. The working principles of this new type of hydraulic jack can be applied to other instruments such as vices that have different functions.

Key words: Hydraulic Jack; Force; Speed

1 Introduction

Traditional hydraulic jack has the same speed both in working stroke and return stroke. The larger load which the jack bears, the slower speed it has, vice versa, the quicker speed it has. the small load it bears. Most jacks cannot distinguish the working condition without load or with heavy load, so for hydraulic jack, if it has a large carrying capacity it will has a slower speed, contrarily. if it has a faster speed it will has a small carrying capacity. It needs much time for a jack to move from the original position to the work piece than lifting work piece to the working position, so traditional hydraulic jack has a relatively low efficiency, wastes power and time, and has a narrow applied field. Therefore, traditional hydraulic jack has a confliction between speed and force it.

In order to eliminate this confliction, many people have done a lot of researches on inventing new types of jacks, many new type of jacks have been invented. The typical mechanical jack is the patent “a screw driving setup having a rapid speed and slow speed”, which can move at double speeds by gearing the joggling or separating the half-nuts and screw. The typical hydraulic jack is the patent “multi—speed adjustment methods for a type of jack and a multi—

speed jack”, it provides a method to adjusting speed by providing several hydraulic routes between oil—input cylinder and oil-output cylinder. This patent enables a jack have several speeds that can be automatically adjusted according with the magnitude of load, and has a relatively high efficiency. But it does not have the anticipative effect while it is practically using, the reason is that there were too many pumps and cylinders that increase the resistance greatly.

In order to resolve the confliction between force and speed of traditional manual jacks, we invent a new type of manual hydraulic jacks that is patented as “transaction device of hydraulic pressure”.

2 Design of new type hydraulic jack

2.1 Design idea for the new type hydraulic jack

In order to get the aims of handiness, powerful, multi-speed and reliable, we can use neither the design idea of traditional jack which has only a oil cylinder and a oil pump, nor the design idea of reference which has several hydraulic speed adjustment routes between oil-input cylinder and oil-output cylinder. After investigation, we decide to adopt the structure that has a big oil pump, a small oil pump, a big oil cylinder and a small oil cylinder, this structure have the advantages of both big-and-small oil pump system and big-and-small oil cylinder system. The main idea is described below: add a big oil pump which is bunched with the small oil pump, namely attach a light-load oil route on the oil. input route of the oil cylinder; add a small oil cylinder which is bunched with the big oil cylinder; the oil drain valve is instead with a sequence valve. So, we can regulate the speed steplessly in a small range by adjust the force and speed exert on the handle, also we can regular the speed steplessly in a large range by switch the control valves and the matching methods of big-and-small pumps and big-and-small cylinders.

2.2 Design of hydraulic system schematic diagram

For much research and improvement, we draw up the hydraulic system schematic diagram of our new type hydraulic jack as shown in Fig. 1. In the new jack, there are control handle 1 and 9, small oil pump 2, cone-way valve 3, 7, 10, small oil cylinder 4, big oil cylinder 5, sequence valve 6, big oil pump 8 and oil-enter pipeline and oil-return pipeline etc.

Fig.1 also illustrates that the oil drain valve 7 of the big pump 8 is also the oil-input of the small

pump 2, the oil drain valve 3 of the small pump 2 is also the oil-input of the small cylinder 4, the big oil pump 5 is also the oil tank. So we make a double-pump and double-cylinder system by connecting all the components with pipelines.

The oil sucking of the big pump is synchronous with the oil draining of the oil cylinder. When the jack needs to return to the original position, the oil cylinder stops working, meanwhile the gravity of the workpiece and the piston forces the oil tank begin to drain oil, the drained oil return to the big oil pump by a two-way valve. This process is called the oil sucking of the big pump.

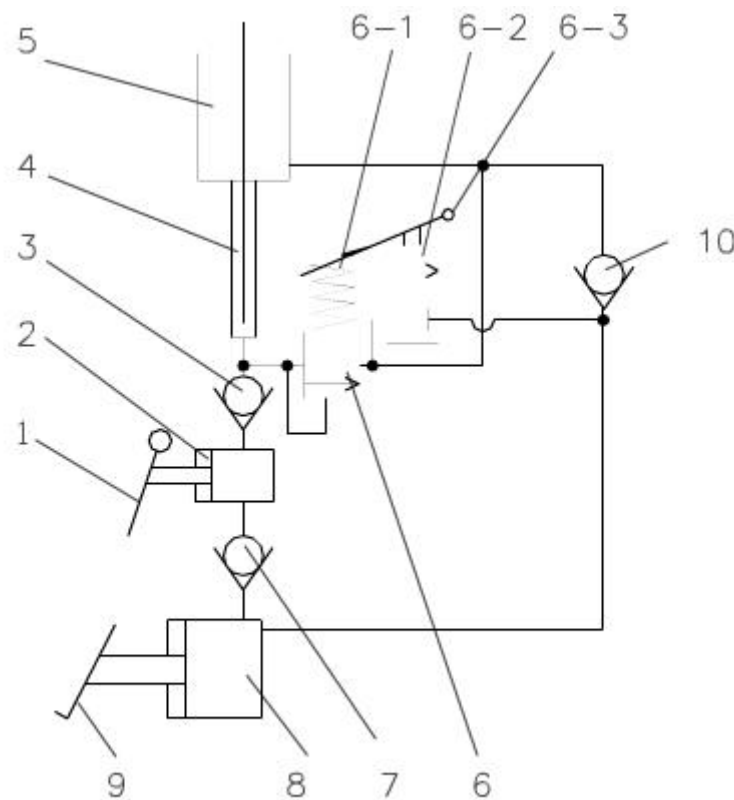


Figure 1 Hydraulic system schematic diagram of new type hydraulic jack

By moving the handle, the oil in the big pump is being drained to the oil cylinder and pushes the piston upward, this process is called the oil draining of the big pump.

2.3 Speed analysis of the jack

We can analyze the speed of this new type jack according the magnitude of load.

Speed in the situation without load: in this situation, the sequence valve is closed, the big oil pump pushes oil into the small oil cylinder. the small cylinder pushes the big cylinder's piston to access the workpiece at the highest speed until the piston touches the workpiece.

Speed in the situation of small load: after the piston touches the workpiece, the sequence valve is opened slightly, the small pump pushes the small cylinder upward while the big pump pushes the big cylinder upward, so the jack can afford a small load.

Speed in the situation of medium load: in this situation, the sequence valve is opened partially, more oil is pushed into the big cylinder, and the force of the jack is increased also, the load which the jack born enforces the big pump stop working, and the tripper is put off, so the handle only drives the small oil pump and the small oil pump pushes the high. pressure oil into the small cylinder, forces the piston move at a medium speed.

Speed in the situation of heavy load: in this situation, the sequence valve is opened fully, the small pump pumps high-pressure oil that enter the big cylinder and small cylinder directly, the piston moves at the lowest speed and born a heavy load.

3 Structure example

A structure example of this new type lack is shown in Fig.2, the appearance of sample jack is shown in Fig.3. Fig.2 shows that the big oil pump is composted with the big column space of the base 14 and the movable cover 8 of the oil tank, the big oil cylinder is composted with the base cylinder body 15 and the big piston 5, the small oil cylinder is composed with the pipe 4 which is set up in the middle of the base hermetically and a small piston 4-1, the treadons fork 9 is attached to the big oil pump, the control handle 1 is attached to the small oil pump, the base 14 and the top-beam 13 is united with the column 11. the movable beam 12 can be moved by the big cylinder and the small cylinder along the column 11.

In the situation without 1pad. one can pedal the treadons fork 9,the big pump will pump the oil into the drain valve 10, 3,and 7. then the oil enters into the big cylinder and small cylinder, pushes the piston move to accessing the workpiece at a high speed instantly. In the situation of light-load, one can pedal the treadons fork 9, the big pump pumps the oil at a higher pressure, some oil enters into the big oil pump through the drain valve 10,drives the big cylinder. meanwhile. the other oil enters into the small pump 2 through drain valve 7,so thee oil in the small pump has a higher pressure than the oil in the big cylinder, these oil drives both the

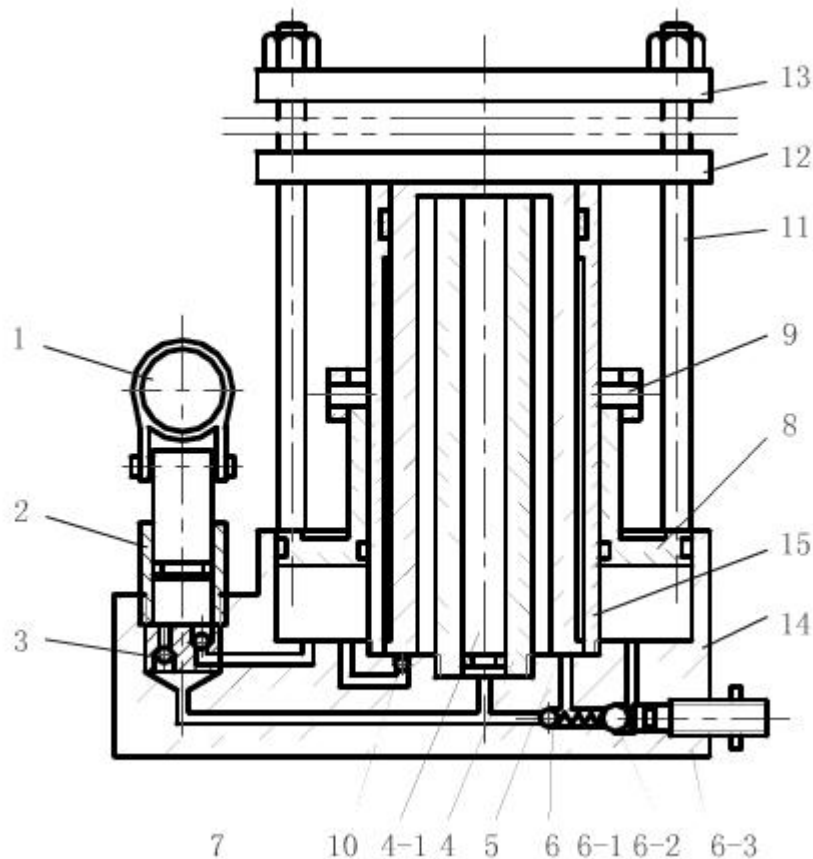


Figure 2 A structure example of new type hydraulic jack

small cylinder and the big cylinder through the drain valve 3 which push the movable beam 12 at a rapid speed together. In the situation of heavy-load, the oil pressure is elevated with the big pump, after the oil enters into the small pump, the oil pressure is elevated by the small pump once more, then the oil enters into both the big cylinder and small cylinder, both the big cylinder and the small cylinder move the workpiece together, the carrying capacity is the sum of the small cylinder and the big cylinder. When the cylinder needs to return, one can turn the handle of the sequence valve 6-3 to loosen both the spring of sequence valve 6-1 and the returning valve 6-2, raise the treadons fork 9 to enable the big pump fully opens the two orifices of the sequence valve, the gravity of the workpiece and the piston drives the big cylinder and small cylinder to return the original position.



Figure 3 Appearance of sample jack

This new type of hydraulic jack have solved both the structure problem and operation problem, the innovation is embodied below : (1) Internal procedure hydraulic pressure linkage: the oil-input pipeline of big pump is linked directly with the oil-return pipeline of both the big cylinder and the small cylinder, the sequence value is not only the oil-input valve of the big cylinder and big pump, also the returning valve of the small cylinder and the big cylinder, the oil-leave pipeline is also the oil-enter pipeline ,the oil-leave valve of the big pump is also the oil-enter valve of small pump, namely a valve has multipurpose. (2) It make the seed-change system highly integrates that the big pump and small pump plus big cylinder and small cylinder. (3) The closed cycle is highly effective and reliable: the oil enters the oil cylinder directly without any medial part, so the jack has a small friction drag and very few energy loses and a flexible movement. (4) The structure is simple: the system is concise, the pipeline is short, the kind of loses is reduced, the number of parts is small.

We have compared our sample jack with a traditional jack. The new jack and the traditional jack both have the same lifting capacity of 12,000kg. Supposing the moving speed of jack's handle is 0.5m/s in working stroke, the traditional jack has a constant speed of about 5mm/s, but this new the sample jack's speed can automatically change between 1.05--4260mm/s. In the return stroke, the sample jack can return to the original position automatically at a high speed(the only thing needed is turning the handle of the sequence valve), but for the traditional jack, only pushes the piston of the oil cylinder can it return to its original position.

4 Concluding remarks

This new type of manual multi-speed hydraulic jack originally use a closed-cycle system which has a internal procedure hydraulic pressure linkage and use the big pump as the oil tank, it can automatically change speed by self-returning oil flowing direction of the sequence valve. This kind of speed-change has no hydraulic loss, mechanic loss, volumetric efficiency loss and energy loss. This new type of jack ingeniously solved the condition between speed and force, the design theory can also be used for other kind of manual instrument such as vices, etc.

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