Fixing Trailer Hitch for Roof Rack of Cargos

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Abstract: **This article presents a new technical solution of fixing trailer hitch which serves as a connection between single track vehicle and cargo, mainly light trailer. They are manufactured from steel girder and nets which are constructed by point welding. They are designed to indicate the necessary solidity and the required load bearing capacity of the cargo. The application of roof racks is universal and these products are in great demand in the field of game management. There are a lot of trailer hitches which the manufacturers tailor to customers´ demands. The stated technical solution is subject of published industrial utility model at the Industrial property office of the Slovak republic**.

Key words : **Trailer hitch; roof rack of cargos; technical solution; industrial application.**

1. Introduction

Present-day device under the name NB (Table 1.) is a usable product which is designated for a transportation of burdens and is suitable for the transportation of much polluted things for the sake of construction of its. This device is product which is a welded construction of the profiled material and spot-welded mesh with a final surface finish done by galvanization. The application of roof racks is mainly in the field of game management for the transport of dead animals or for the transport of bags with feed material in the winter[4],[5],[7]. The overall system is constituted by basket from welded mesh and holder which is connected to the holder by screwed joints. The carrier is fixed to the car screwed joint via holder and provided tool serves for screw follow-through of holder[1],[2]. The assembly itself is simple. The holder is slid into joining sphere, it is centred and then the pressure bolt is tightened by the provided tool. The pressure bolt ensures the holed against the turning and spontaneous move. This holder has one disadvantage – limited application for concrete types of trailer hitches. The previous practical application of fixing trailer hitch it not universal and it is depended on a sharp of car hitch body. The big disadvantages is the design of the holder which is suitable only for special shape and it application is problematical and even unreal for other types of hitches. Incorrect application could have serious consequences from damage of the holder and the cargo to car damage or risks to road users. Excluding the major shortcomings of the clamping device, the customers have requirements to eliminate the other tools during the assembly and disassembly of the bracket itself and also simplify and speed up the process of clamping.[10],[12]

2. The point of technical solution

Presented disadvantages are removed by suggested technical solution. This solution relates to fixing device which is used for connection between single track vehicle and dragged device (cargo roof rack, light trailer, etc.). The fixing trailer hitch is constituted by load - bearing bracket to which the extended spacer bracket is connected to the bracket of the carrier pin and secured by cotter pin. At the same time the spacer bracket is connected with basic and hinged jig via load – bearing pin secured by rings. The hinged jig is connected to the spacer bracket via pin secured by rings. The rib shapes are designed so as to tightly grip round the ball joint of the dragged system. The hinged jig has tightly connected hinged ribs i.e. middle hinged rib, left hinged rib and right hinged rib. To the load-bearing bracket it is pushed the safety pin secured by cotter pins. The joint is pushed in the hinged jig and it is placed in section the basic jig, sliding. Table 1. presented the technical parameters of NB 800 and NB 1000 roof racks.[6],[10],[11]

DOI: 10.18421/TEM61-06
https://dx.doi.org/10.18421/TEM61-06

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Table 1. Technical parameters of roof racks

	NB 800
Sizes	800 x 500 x 120 mm 1000
Mesh size	50 x 50 x 5 m
Loading capacity of roof rack	100 kg

The difference between presented alternatives is only in total length of roof rack.

3. Figure summary from the technical drawing

The technical solution is explained by technical drawing. Figure 1. and figure 2. present the total arrangement of device´s functional parts. Figure 1. presents the side view and figure 2. presents the elevation of suggested mechanism. Figure 3. and figure 4. present the shape of ribs which are used in suggested mechanism. These ribs are suggested so that they tightly surround the ball joint of the dragged system. Figure 5. presents the final shape of trailer hitch. [3],[4],[10]

4. Realized technical solution of suggested trailer hitch

Figure 1. and figure 2. presented the example of technical solution realization. It presents the total arrangement of functional parts of mechanism. The trailer hitch is constituted by load-bearing bracket 4 and main pin 8 which is secured by cotter pin 10. At the same time, the spacer bracket 3 is connected with basic jig 1 and hinged jig 2 via load-bearing pin 6 secured by rings 9. The hinged jig 2 is connected with the spacer bracket 3 via pin 7 secured by rings 9. Figure 3. and figure 4. present the shape of ribs which are used in suggested mechanism. These ribs are suggested so that they tightly surround the ball joint of dragged system. The hinged jig 2 has connected hinged ribs 12, 16 and 17 i.e. middle hinged rib 14, left hinged rib 13 and right hinged rib 16. To the load-bearing bracket 4 is pushed the safety pin 5 secured by cotter pins 10. The joint 11 is pushed in the hinged jig 2 and it is placed in the section of basic jig 1. [8], [9],[10]

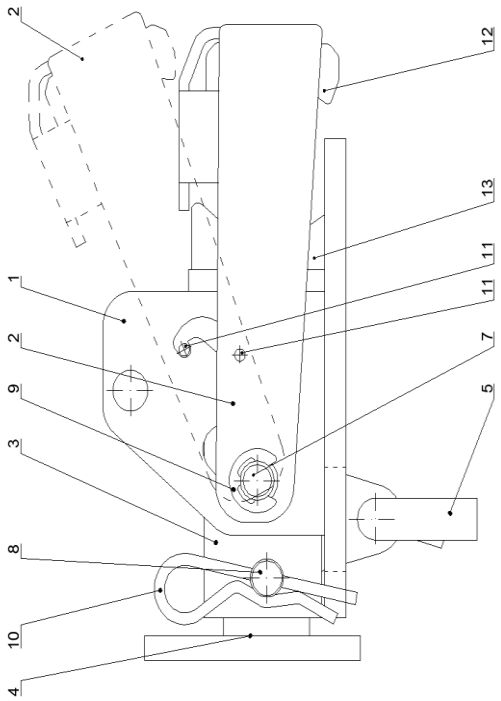

Figure 1. Suggested and realized technical solution [10]

Legend to Figure 1:

1 - basic jig
2 – hinged jig
3 – spacer bracket
4 – load – bearing bracket
5 – safety pin
6, 7 – pin
8 – central pin
9 – securing ring
10 - cotter pin
11 - pin
12, 16, 17 – hinged ribs
13, 14, 15 – attached ribs

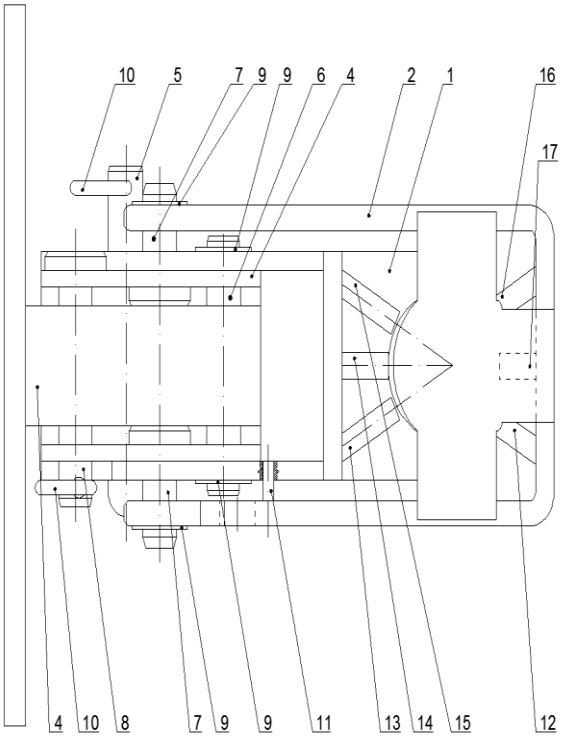

Figure 2. Realized technical solution [10]

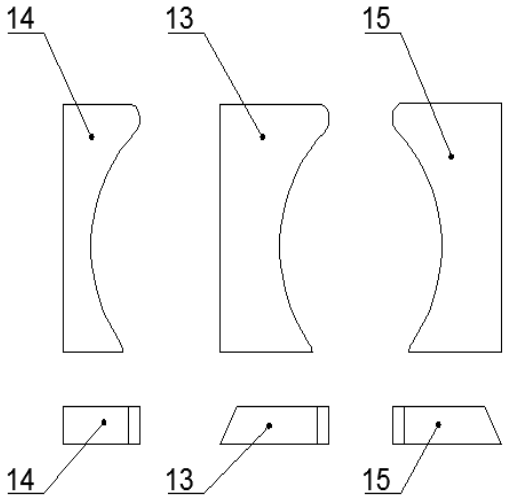

Figure 3. Shape of rib [10]

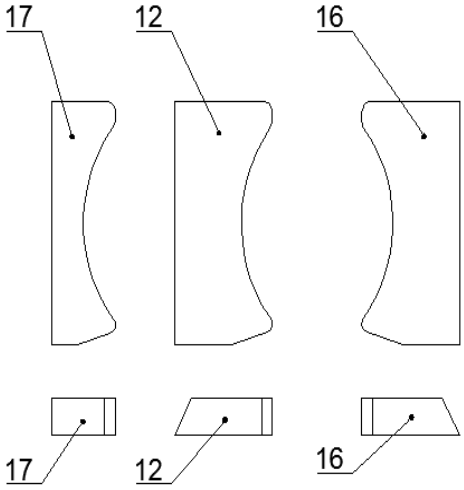

Figure 4. Shape of rib [10]

5. Transmission characteristics of the mechanism according to suggested technical solution

Figure 4. presents the final shape of the trailer hitch. It presents the total arrangement of the functional parts of the mechanism. The fixing trailer hitch is attached to the ball joint of a vehicle and via the second end part to the basket which includes the adequate load. It comes about the curve Ω of mechanism axis in relation to horizontal surface in consequence of load pressure in vertical direction. Its size depend on the load size, the material characteristics of mechanism, the free play between components of mechanism, etc. This mechanical system has the curve Ω_0 without load and the curve Ω with load [9]. The described set represents the mechanical system which is created by oscillations during the car motion as a result of roadway unevenness. The oscillations are possible to be considered the form of harmonic oscillations. Their frequency depend on the ruggedness of the roadway (load weight).

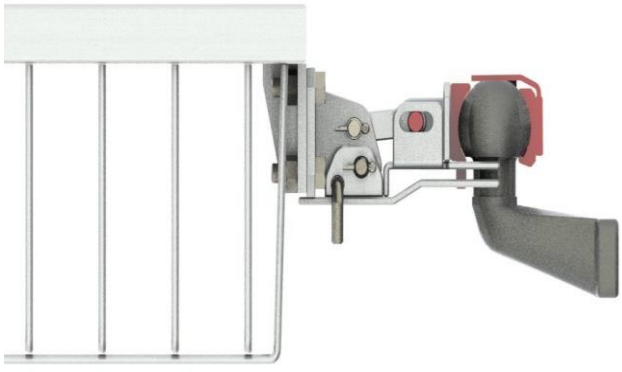

Figure 5. Final shape of fixing trailer hitch in working position

If we accept the premise that the system is linear the mathematical model of this system is linear differential equations with constant coefficients and derives from the image transfer will transfer proportional-derivative oscillating member with reducing (1):

$$F_w(s)=\frac{\Omega\ (s)}{\Omega_0(s)}=\frac{\frac{P}{I}s+1}{\frac{T_0}{K_0 I}s^2+\frac{1+K_0P}{K_0 I}s+1}=\frac{K_t s+1}{T_t^2 s^2+2aT_t s+1}\ (1)$$

Where, the "P" is the proportional part of set transmission, the "I" is integration part of set transmission, the "T_0" is time constant of set transmission and the "K_0"is intensification of set transmission.[12],[13]

The total time constant:

$$T_c=\sqrt{\frac{T_0}{K_0 I}}\ (2)$$

and attenuating:

$$a=\left[\frac{(1+K_0P)}{2K_0 I}\right]\frac{1}{T_t} \qquad (3)$$

The transitional characteristics of the system according to equation (1) are presented in figure 6. These courses characterize sound of system curve in the various material characteristics of mechanism structure. It is evident that this system can be in certain setting of characteristics and load the character of proportional differentiator oscillating part. It is necessary to take his attribute into the consideration and to optimize theirs by appropriate choice of partś shapes and materials. The action of load force to the basket bottom can be regarded as effect of defective element with breakdown transmission. [13], [14]

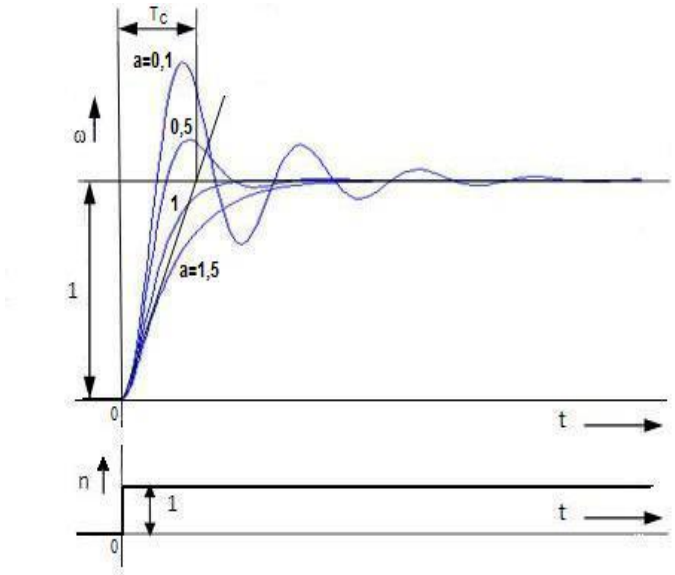

Figure 6. Characteristic of system according to equation (1) during the various values of attenuating; the K_c value is usually insignificant in relation to I parameter

$$F_{nz}(s)=\frac{\Omega(s)}{N_z(s)}=\frac{\frac{1}{I}s}{\frac{T_0}{K_0 I}s^2+\frac{1+K_0P}{K_0 I}s+1} \qquad (4)$$

Where :
F_{nz} –action of force size of load to the basket bottom

The system sound to the n_z is presented in figure 7.

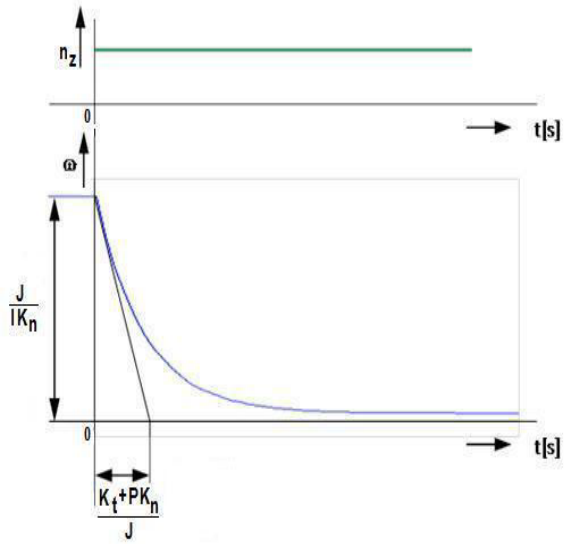

Figure 7. The sound of system to jumping change of breakdowns

The K_c value is usually insignificant in relation to I parameter. From the course (Figure 7.), it is evident that the examined configuration ensures the system invariance in relation to external breakdowns characterized by the impact of an angle line of mechanism axis to the horizontal surface. In reality, the situation is complicated because the load oscillates in the rhythm of non-harmonic oscillations which are proportional to the road surface. The transmission of mechanism breakdowns is very important and it should have a minimum value, ideally zero.

6. Conclusion and industrial usability

This mechanism can be used wherever it is necessary to carry the lower the cargos. The mechanism serves as the connection between single track vehicle and cargo roof rack, light trailer, etc. These activities secure the needs of households, shops, manufacturing plants and the other companies including big manufacturing units. The manufacturing character of suggested mechanism provides possibilities of jobs in the fields without massive industrial base. This mechanism is suggested for simple and fast fixing with the guaranty of the safe use of roof rack in the trailer hitch.[1],[9],[10]

References:

[1] Kumar, S., Anil - Suren, N.: Production and Operations Management(With Skill Development, Caselets and Cases). 2nd ed. New Delhi: New Age International (P) Ltd., Publishers, 2008, 284 p. ISBN 978-81-224-2177-4

[2] Tomek, G. - Vávrová, V.: Řízení výroby a nákupu. Praha: Grada Publishing, a.s, 2007, 384 s. ISBN 978-80-247-1479-0

[3] Tomek, G. - Vávrová, V.: Řízení výroby. 2. roz. a dop. vyd. Praha : Grada, 2000. 408 s. ISBN 80-7169-955-1

[4] Svobodová, H., et al.: Produktový a provozní management. Praha: Oeconomica, 2003, 153 s. ISBN 80-245-0611-4

[5] KOVO spol. s r.o. [online], 2014, [cit.2014-03-06], Dostupné na internete:<http://www.kovosro.sk/sk/kovo-sro/titulka/>.

[6] Príslušenstvo pre nosiče [online], 2014, [cit.2014-03-06], Dostupné na internete: < http://www.gestal.sk/eshop/files/box2[1].jpg?t=1394203732548>.

[7] Typy ťažných zariadení [online], 2014, [cit.2014-03-06], Dostupné na internete:< http://taznezariadenia.sk/sk/content/6-typy-taznych-zariadeni>.

[8] SMERNICA EURÓPSKEHO PARLAMENTU A RADY 94/20/ES z 30. mája 1994 o mechanických spájacích zariadeniach motorových vozidiel a ich prípojných vozidiel a o ich pripevnení k takým vozidlám [online], 1994, [cit.2014-03-06], Dostupné na internete:<http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1994L0020:20040501:SK:HTML>.

[9] Matisková, D.,at all: Upevňovacie zariadenie pre nosiče nákladov SK 50030-2016 U1/ Darina Matisková ... [et al.] - Banská Bystrica : ÚPV SR - 2016. - 9 s..

[10] Szilagyi, E., Dupláková, D.: Aplikácia RDIF technológie pre zvýšenie efektivity a bezpečnosti v železničnej doprave / 2014. In: Management of manufacturing systems 2014 : zborník vybraných vedeckých prác : 1-3 Októbra 2014, Starý Smokovec. - Košice : TU, 2014 S. 107-110. - ISBN 978-80-553-1884-4

[11] Hricová, R. :Optimisation of labelling of tapered roller bearings / 2007. In: TSO - Technology Systems Operation '2007 : international scientific conference : Prešov, 21.-23.11.2007. - Prešov : FVT TU, 2007 S. 77-79. - ISBN 9788080739003.

[12] Flimel, M.:Dizajn a redizajn v pracovnom prostredí, 2015, Vydavateľ: Tribun EU, Cejl. 892/32, 60202 Brno, CZ. ISBN: 978-80-553-1930-8

[13] Jivkov, V., Zahariev E., : Dynamics of Flexible Wind Power Generator with Unbalanced Rotor: 2015, *TEM Jurnal Serbia, DOI: 10.18421/*TEM53-02ISSN2217-8309

[14] Kotus, M., Matisková, D., Mura, L. :

Impact of technological factors on dosing of metal at die-casting /2013.In: Advanced Materials Research. Vol. 801 (2013), p. 143-149. - ISSN 1022-6680