

APPLICATION OF ERGONOMIC PRINCIPLES FOR THE DESIGN OF SPECIFIC TOOLS FOR THE OPENING AND CLOSING VALVE WITH STEERING WHEEL

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Summary

The need to have specific and sure tool for concrete labors in the industrial plants it´s increasing given the multiple processes that in them develop.

In this study there are exposed the ergonomic principles that have been followed in the processes of design of two new tools destined for the labor of opening and closing valve that should have a steering wheel as form of operation and control. As result, there have been obtained sure tools and that optimize the muscular effort of the operator, avoiding injuries in the workers and damages in the facilities.

Introduction

Among the most habitual activities in the majority of the industrial areas emphasizes the manipulation of steering wheels of control, so much for adjustments of liquid and gaseous flows regulated for valves like mechanical processes of closing and opening hatch.

This activity is in the habit of being impeded by the state of maintenance of the gears on those who move the steering wheels (presence of oils, dampness, stain, etc.), environments of limited permanency (extreme temperatures, explosive or asphyxiating atmosphere, etc.) and forced positions that demand of the workman a physical important effort that can derive in serious injuries on muscles and bones.

DEVELOPMENT OF THE DESIGN FOR THE KEY ANTROPOMÉTRICA®

The procedure of design has followed the guidelines established in an ergonomic conventional model (Galer, 1987) and that, later, relate:

STAGE 1: IDENTIFICATION OF THE PROBLEM

Nowadays many operations with valves are done by pneumatic and electrical equipments that avoid the direct action of the workers, it´s also habitual the manual manipulation.

In view of the effort risk and the use of handmade tools with steel doubled and welded without constructive and structural control, implying an important risk of cuts and puncture in case of fracture of the handmade tool caused of fatigue of the material, makes necessary the design of a stable, robust tool that fits perfectly in the periphery of the steering wheel and allows a comfortable and sure grasp.

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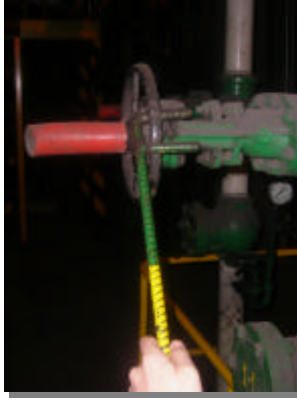


Photo 1: Tool employee in the opening and closing valve of steering wheel

Photo 2: Tool deformed by effect of the fatigue.

Photo 3: Tools broken.

STAGE 2: ANALYSIS OF THE NEEDS OF THE USER

Once identified the problem, there were analyzed by the workmen the basic characteristics that there should have a tool destined for the intention of driving the steering wheels, obtaining these results:

- The tool has to be stable in the union with the steering wheel.
- The tool has to have the dimensions adapted to be able to drive of sure form a wide range of sizes of steering wheel.
- The lever arm has to be the sufficiently long thing to optimize the effort.
- It does not have to have an excessive weight, but a mechanical resistance raised in view of the high effort of traction to which it is going to resist.
- The grasp has to be comfortable and the hilt must not slip.
- It has to be designed for a use for right and left handed.
- Should be easy to store, to clean and support.
- Should be visible and easy to find in the facilities.
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A search was realized on the market of manual tools that could offer an alternative, but positive results were not obtained.

STAGE 3: CONTRIBUTION OF DESIGN CRITERIA

- **Constructive material:**
There were valued different materials that were not compromising the resistance of the tool and the steel EN-GJS-500-7 was chosen caused its high resistance for the traction, break, twist and compression and by a specific density that was avoiding an excessive weight of the useful one.

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- **Process of design**

Several alternatives of design were analyzed and after elaborating the prototypes the definitive model concluded. The result is a tool of average size, of a weight of some 2 kg and formed by a compress of grasp, which consists of a cover and an extreme top that will anchor in the radiuses of the steering wheel.

Joined the compress by means of mechanical fixation, arranges a tubular handle of 80 cm with double plastic ergonomic hilt. It is considered a treatment necessary of galvanized superficially to increase the resistance to the corrosion.

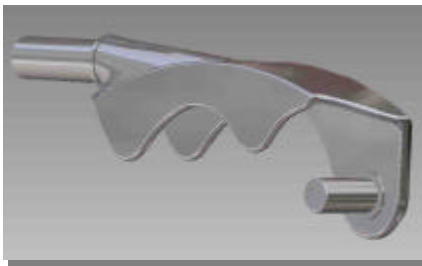


Photo 4: CAD of the design of the compress of grasp.

STAGE 4: FINAL EVALUATION OF THE PRODUCT

Several prototypes were tried by workmen in the facilities of Aboño's Thermal Head Plant (HC Energy), giving their conclusions the following results:

- An ideal stability is achieved in connect with the steering wheel and the effort is minimized on the part of the workman.
- The tool has a simple, but very effective use, to be based on the principle of the lever.
- Once positioned, the key neither moves nor tilts on the steering wheel, thanks to the lateral pieces, for what it does not spoil it and prevents from to be slipped.
- The length of the handle does that the power at the moment of realizing the work is maximum.
- The ergonomic hilt assures its firm grasp to it be able to be covered by the totality of the surface of the hand, which avoids the dangerous slippages. For the design of the zone of grasp, the measures have born palm groove in mind relating to the grasp, of the fingers and of the hands on the 95 percentile of the Spanish population published by the Department of Work and Social Matters of the Government of Spain, which allows its use with gloves of work. In addition, the presence of the hilt is incompatible with the use of extension pipes of the lever arm.

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Photo 5: Testing the key prototype



- Simple storage. The key has a perforation in the handle and allows the situation in hangers inside the environment of work.
- The metallized color and the color of the handle make it very visible in situations of scanty lighting or present of powder.
- Allows its use on steering wheels in horizontal and vertical position.
- Easy cleanliness given its rounded forms without corners.



Photo 6: Keys placed in the support



Photo 7 and photo 8: The key facilitates evidently the maneuver of the horizontal and vertical valves.

DEVELOPMENT OF THE DESIGN " KEY ANTROPOMÉTRICA FIX"

Continuing the guidelines that directed the design of the key previously analyzed, there was realized a new approach based on the possibility of arranging a lever in the same body of the steering wheel of the valve.

STAGE 1: IDENTIFICATION OF THE PROBLEM

In the occasions in which the space between steering wheels was scanty or was not arranging in the environment of work of a key Antropométrica, was making to itself the existence of one necessary connect in the steering wheel that increases the power of hardworking lever.

Connect this one it should have draft in the hilt to accompany to the movement of the steering wheel and like that to avoid excessive drafts to the operator.

This possibility also was interesting in those cases in which there were small the steering wheels that were demanding effort in its maneuver.

STAGE 2: ANALYSIS OF THE NEEDINGS OF THE USER

Once defined the problem, there were analyzed the needs that the new useful one should solve:

- It has to join in the perimeter of the steering wheel, to optimize the moment of the force.
- Is suitable that it presents the possibility of placing it in radial and axial position.
- The material of construction and the system of spikes of is too tight and it is necessary to be the sufficiently robust thing in order that it resists the push to applying.
- The hilt has to be gyratory in order that it accompanies to the movement of the driven steering wheel.
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STAGE 3: CONTRIBUTION OF DESIGN CRITERIA

- **Constructive material**
Given the mechanical requirements that are going to have to support new tools, was chosen for the sheet of steel of 2,5 mm of thickness fine mechanized.
It is covered with galvanized paint to avoid the possible corrosive process.
- **Process of design**
Carried out a design that allows its positioning in steering wheels of any diameter and one assures the stability and fixation thanks to its system of lace by means of mechanized pieces and use of spikes too tight.
The axis of push is endowed with an internal spring that, on having driven it, allows to place it of radial and axial form and the handle provided with ergonomic hilt, presents free movement.

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Photo 9 and 10: The key "Antropométrica fix" with the handle in axial position.



Photo 11 and 12: The key "Antropométrica fix" with the handle in radial(road) position.

STAGE 4: FINAL EVALUATION OF THE PRODUCT

The placement of several connect in steering wheels of different size and testing the conditions of normal use revealed that:

- It is perfectly adaptable to any diameter of steering wheel and remains joined of stable form thanks to its union by means of spikes.
- Prototypes have been tested with different intensities of traction and have remained immobile and inalterable.
- The maneuver is facilitated very much and there is avoided the muscular fatigue derived from the action on the steering wheel.

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CONCLUSIONS

The constant improvement of the conditions of work in the companies has to include a correct design of the working equipments and tools to avoid the muscular efforts that can produce painful injuries and labour long falls.

In occasions, the nonexistence of ideal tools does that the tasks were done with handmade tools whose represent an intolerable risk.

In this case, two tools have been achieved by new designs, expiring of sure form with the task and avoiding the muscular damage and wrong positions associated with the opening and closing of the valves of steering wheel.