

ASPECTS REGARDING THE DESIGN OF THE GRIPPERS IN ROBOTIC HANDLING OPERATIONS USED OF AUTO BODYWORK SUBASSEMBLIES

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Abstract

The paperwork is based on a scientific research, made by the author, with the goal of optimisation from the designing phase, to grow the technical and economical performances. The author of the paperwork has the goal to optimise a gripper model, designed with the aim of robotic handling of a sheet-metal subassembly, composing a auto bodywork. The robotised handling system functionality, where we use the gripper, is realised by a computer programme driving software, making handling operations, from point to point, after a programmed technological waypoint. The robotised handling of those subassemblies presents many advantages, consisting in time reduction for the handling operation of the subassembly, growth of the productivity of the whole system and of the production capacity.

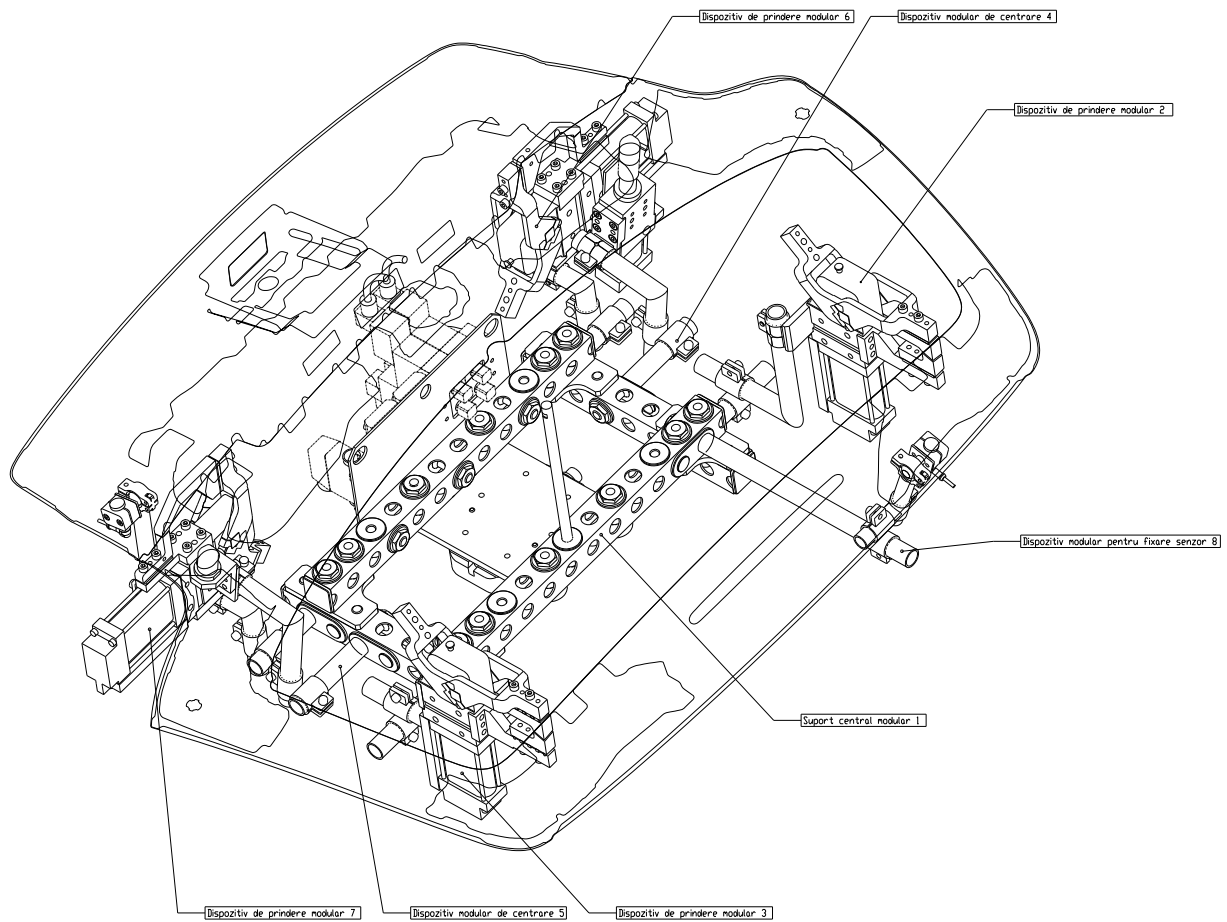
1. INTRODUCTION

To make a vehicle model, requires designing and manufacturing new tools belonging to the category of drawn mould, used for manufacturing a new design of bodywork, and it implies the design of some grabbing devices, used for robotised handling of sheet-metal elements and subassemblies, and components of the auto bodywork.

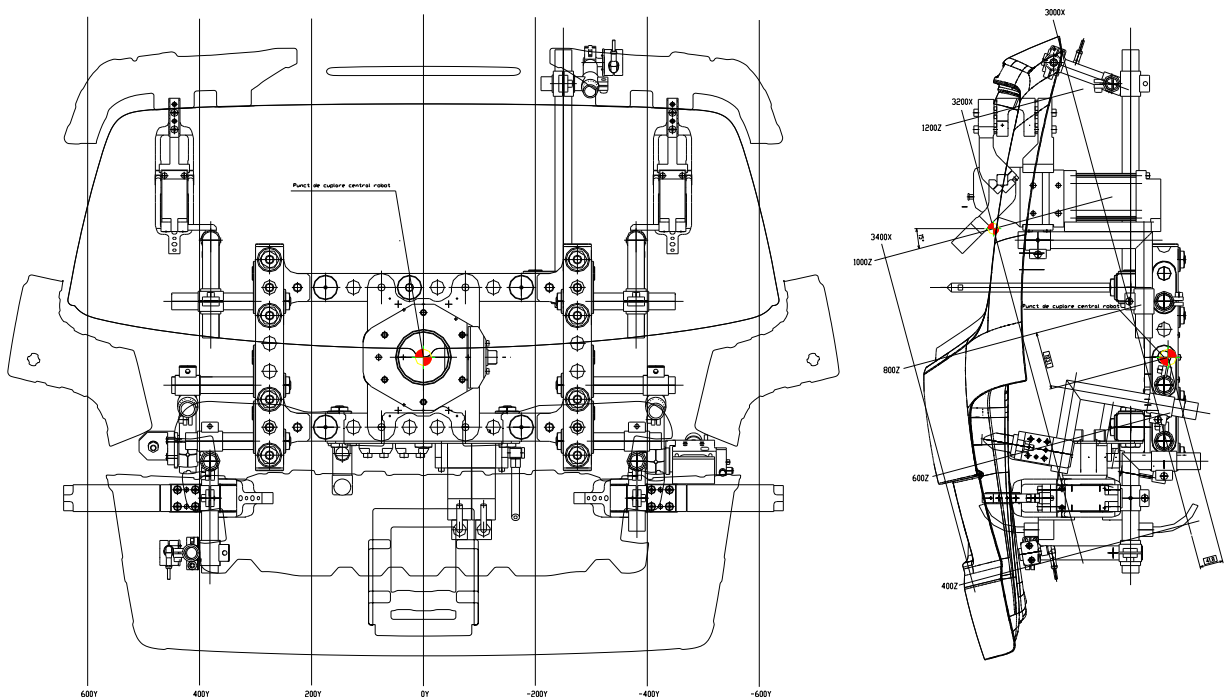
For designing a handling gripper, of a component or subassembly, for vehicle bodywork, there are some principles which must be taken in consideration.

First of all the gripper, still in the designing phase, must be made of sufficient component elements, with a modular type structure, to fulfil their main goal, which is to have the capacity to maintain fixed in safe conditions the bodywork element, without the danger that it could come off from the grabbing system while handling. When designing a gripper, from this category, the choice of the necessary components is made having as starting base the information's received from the designing compartment of the bodywork manufacturing company, having as starting base the 3D model, and offering in the same time, precise information's regarding the geometrical shape, the sheet-metal thickness, the weight and linear and angular measure of the sheet-metal element. In general to fix a auto bodywork mould, there are used four grabbing systems, with a modular structure, and the actuating of the fixing rods is realised pneumatically, because the benefits it represents. The name met in the field of study literature for the fixing system with the help of which the metal sheet is fixed, is called clamps.

In picture 1 and 2 are presented two points of view of the gripper assembly structure, designed and presented in this paperwork, its structure being modular, offering multiple advantages, consisting in a fast design and execution, which finally bring to low costs.



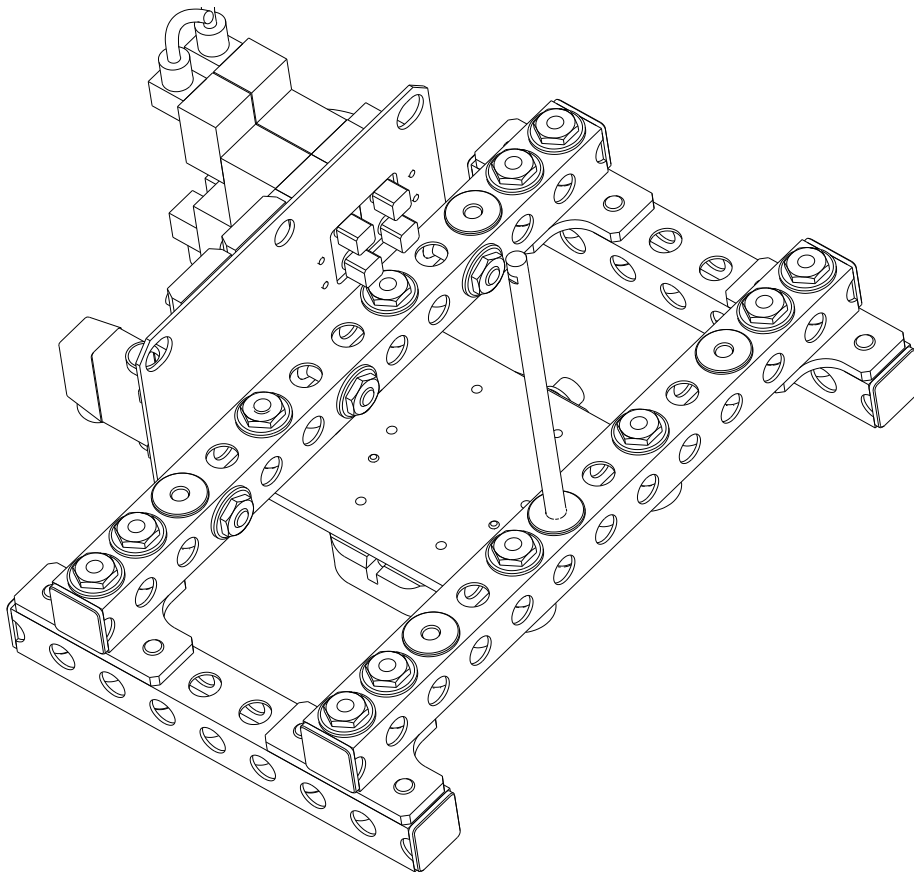
Picture 1. Assembly draw of the handling modular gripper, surprised in a bodywork handling position.



Picture 2. Upside view and lateral view of the modular gripper, indicating the position of the centred and fixed system for the handling element of the handled bodywork.

2. OPTIMISATION FOR THE GRIPPER DESIGN BY USING TYPICAL MODULAR CONSTRUCTIVE ELEMENTS

As a starting base for the gripper design presented in the paperwork, the designer must take account in choosing the material of the profile shape from the composition of the central support which has a molecular structure, the rectangular shape of the profiles being foreseen with multiple holes punctured for fixing the component elements, without affecting it's resistance, this representing the main framework and on its structure will be assembled the other component modular elements of the gripper. Their installation using the installation system with thread, is realised from adequate typical elements, in a as small as possible time range. In picture 3 is presented the 3D design of the central support of the gripper, its rectangular shape being realised from modular profiles, in the left side having installed an interface place, by which it is realised the interface with the robot, assuring the mechanical, energetically and informational interface.



Picture 3. The 3D Design of the central gripper support

The second very important aspect in the grippers design from this category is the fact that the designer must conceive the gripper so that it cancels all the mobility degrees of the handled bodywork element, meaning that it cancels the translations and rotations on the three axes X, Y and Z.

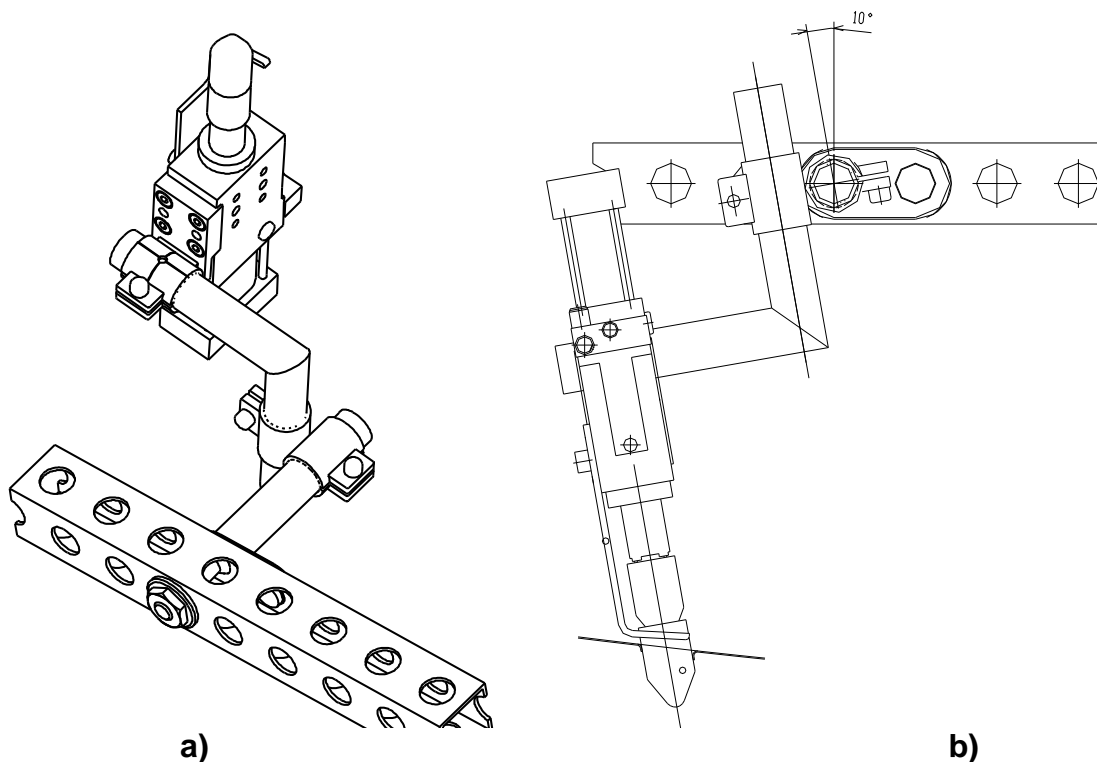
The first step in designing the gripper is to choose from the designing phase the two holes existent in the metal sheet structure from the blanking-moulding phase for the element, in which will be introduced two centring elements, named centring bolt or pin. The function for these pin, used for guiding-centring of the element and for reverse rotation

and reverse translation. The depth at which the centring pin enters in the hole is approximately 5-7 mm, but there are cases when enters in the hole only for 3 mm.

At the handling grippers the pin diameter is chosen with 1 mm smaller than the bodywork hole diameter. From a technological point of view the pin are made from materials of a superior quality, resistant to usage OSC 10 STAS 1700-80 and which will be chemically heat treated, and having finally hardness between 56-60 HRC.

When choosing the holes in which the centring pins enter we take in considerations different technical and functional aspects. Their position on the central support of the gripper, they must be on the same plan, with a maximum deviation of 2° . In case if the two holes are not in the same plan, there is the possibility that the diameter of the pin to be chosen so that it may allow the retreat of the gripper after the sheet metal has been detached.

In picture 4a) and 4b) are presented the 3D design of the mobile centre pin, and from the picture results the anchorage mode to the structure of the central support, using fixing bridle and tubular rods, and in picture 4 b) is presented a side view from which we can see its adjusting position.



Picture. 4a), b) 3D design of the central mobile bolt and the installation position.

The next step of the designer is the choosing and positioning, as efficient as it can be, of the clamps fixing systems, used at the gripper design construction. Ideal, these will be positioned at the highest distance one from another, if the construction of the sheet metal and of the devices which came in contact with the gripper allow this. For designing a gripper which can handle a component from car bodywork are frequently used equipments like Trunkers model V/V2 40 Vario.

The reason for usage of the Vario clamps is that the opening angle is adjustable and if necessary it can be modified very easy even after commanding the clamp. Optional

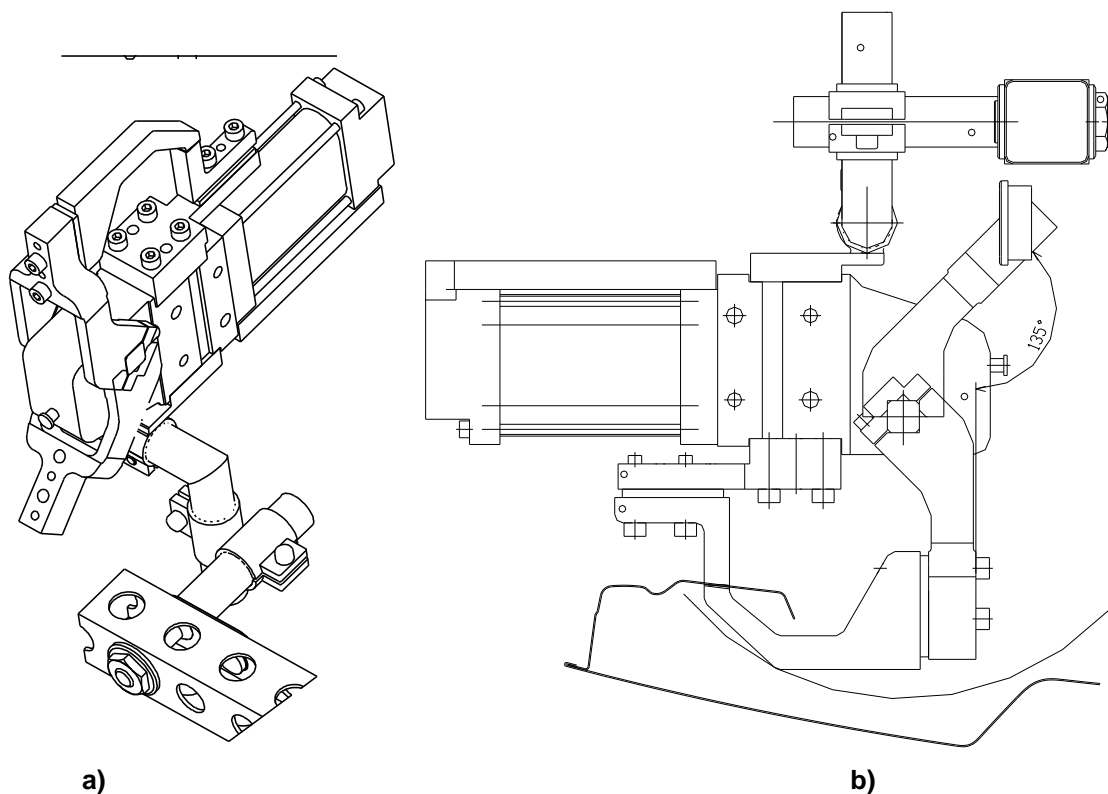
these are fitted with a grabber which allows the manual blocking, this handler can be installed on one of the lateral parts of the clamp according to the requirement.

The clamp is installed on the associated element using a installation system with thread composed from 4 screw bolt and 2 cylindrical cotter. The constructive and functional system of the clamp is equipped with a bumper, for a smooth closing, element which could bring to the damage of the surface of the bodywork metal-sheet in the contact zone.

The grip force of a V40 clamp is 120 Nm, its weight is approximately 2 kg, length 235,5 mm, width 83 mm, height 50 mm. The clamp has a vertical or horizontal arm, on the left, right or middle side, according to the necessities.

The weight calculation with which the clamp may be loaded is made by graphics put at disposal by their manufacturer.

In pictures 5a) and 5b) are presented 3D designs of a clamp fixing system of the sheet-metal and from the picture it results the fixing mode on the central support structure using fixing bridle and tubular rods, and in picture 5b) is presented a side view from which we can see by graphically design the close position of the associated NC systems by which the sheet-metal is fixed, being represented by a curve line and the movement trajectory of the mobile fixing element, realised at the sheet-metal fixing-unfixing operation.



Picture.5 a) , b) 3D design of the clamp modular fixing system

CONCLUSIONS

The grippers designed and manufactured in this way from modular constructive elements used in robotized manufacturing systems for vehicle bodywork, are the best in handling operations with objects and subassemblies from the structure of the auto bodywork, these being characterized in general by complex geometrical shapes. The conception, designing and execution of such handling grippers is absolutely necessary at

the entrance in serial production of a new vehicle bodywork design, contributing with the obtained technical performances to the elimination from the handling circuit of the human operator, and giving him the role of following the robotized circuit for receiving the sheet metal made by the robots and making the quality control on it according to the specified quality requirements.

It is required that beside the pin centring units and the clamp units for fixation, the designer must equip the gripper with sensors, their role being to sense the presence of the metal-sheet. The sensors used are proximity sensors and their number is chosen according to the shape and the metal-sheet size. If the modular construction of the gripper allows, the sensors will be positioned as close as they can be to the centring pin or to the NC's.

The weight of the gripper together with the handled subassembly of metal-sheets mustn't exceed the weight that the chose robot can handle. For this there must be made calculations in especially conceived programs like Kuka Load Calculation.

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