CONSTRUCTIVE OPTIMISATION OF THE GRIPPERS IN HANDLING ROBOTIZED OPERATIONS OF THE AUTO BODYWORK SUBASSEMBLY COMPONENTS

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Key words. Handling grippers, components and sheet-metal subassemblies, auto bodywork structure, modulated systems for gripping type clamp, fixed and mobile central pin, pneumatic drive system, proximity sensors.

Abstract

The paperwork is based on a applied scientific research, made by the author, with the goal of an constructive and functional optimisation of a gripper model realised from typical constructive elements, designed with the aim of robotic handling of a sheet-metal subassembly, composing a auto bodywork.

The functioning of a handling robotised system is integrated by a computer program, making handling operations, from one point to another, after a programmed technological waypoint. The robotic handling of these subassemblies presents multiple advantages, consisting in time reduction intended for handling operations of a subassemblies, for eliminating the physical effort, the reduction of the number defect pieces, the growth of the entire manufacturing system productivity of auto bodywork.

1. INTRODUCTION

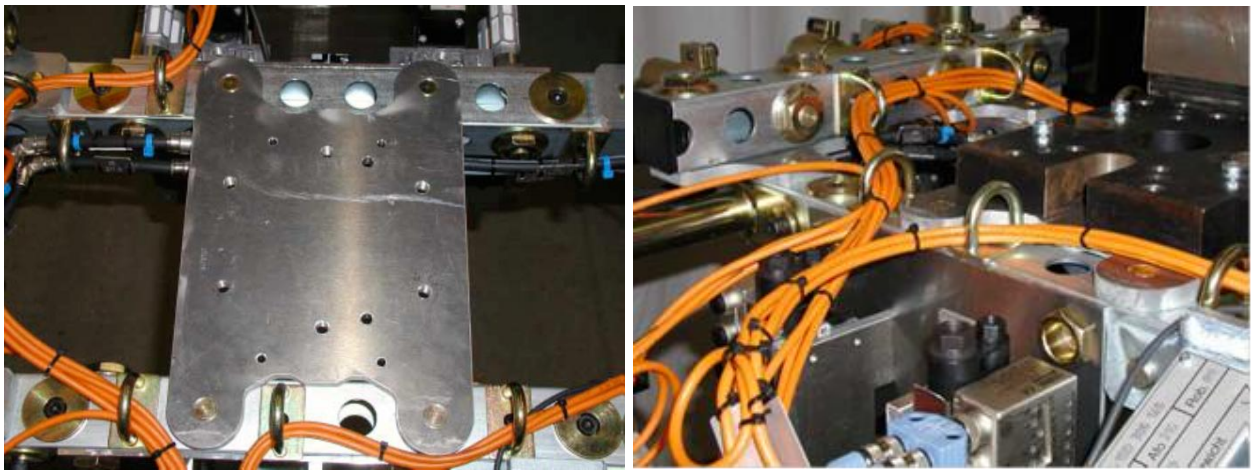
Introduction in the production flux of a new vehicle design, assumes two designing stages, execution of the SDV, adequate for the manufacturing of a new design of bodywork, respectively implies after the designing stage the realisation according to the technical documentation for designing, of some device models for fixation, from the gripper's category, specialized for robotised handling of some elements and sheet-metal subassemblies, from the auto bodywork assembly composition..

The gripper still in the designing phase, must be conceived and built from a sufficient number of constructive elements, with a typical modular structure, the main goal being to have the capacity to maintain fixed, in safe conditions, a bodywork element, without the danger of detaching from the fixing systems while handling. At the manufacturing a gripper from this category, based on the information's received from the designing compartment of the bodywork manufacturing company, is known it's 3D design, offering to the costumer the exact information's referring to the geometrical structure, the thickness of the sheet metal, the weight and linear and angular measures of the sheet-metal element which will be handled by the gripper.

As a starting base for the effective production of the gripper we use the technical documentation which contains the assembly drawing, and the specified details of the designer.

Also we must take account from the material, geometrical shape of the used profiles used at the production of the central support modular structure; the chosen typical shapes will be foreseen with multiple systems with holes and muzzles, with the goal to realise the assembly with fixing modular systems without affecting its resistance because it represents the structure on which are assembled the other modular element components of the assembly. Their installation on the central support is realised by fixing systems with thread, using typical adequate elements, and for the execution time of the gripper to be shorter. In picture 1 a), b) are presented images with the physical design of the central support of the gripper with modular structure, on the lateral side having installed the quit interface system, by which is assured the quick mechanical interface, the energetically interface containing the flexible tubing for the compressed air and the informational

interface which assures the bound by the computer software with the driving system of the robot.



a) **b)**

Picture.1 a) , b) Pictures with the physical design of the central support of the gripper with modular structure.

2. CONSTRUCTIVE OPTIMISATION FOR THE GRIPPER DESIGNED BY USING TYPICAL CONSTRUCTIVE ELEMENTS

In general when executing this type of grippers, for fixing a certain design of element of auto bodywork, are used four systems of grabbing, with modular structure, and the auctioning of the fixing rods is realised pneumatically because it presents different advantages. The name met in the speciality literature for the fixing systems by which is fixed the sheet-metal, is clamp.

When designing and realising a gripper like this all the degrees of mobility of the element of the handled bodywork must be cancelled meaning that the translations and rotations on the three axis X, Y and Z must be cancelled.

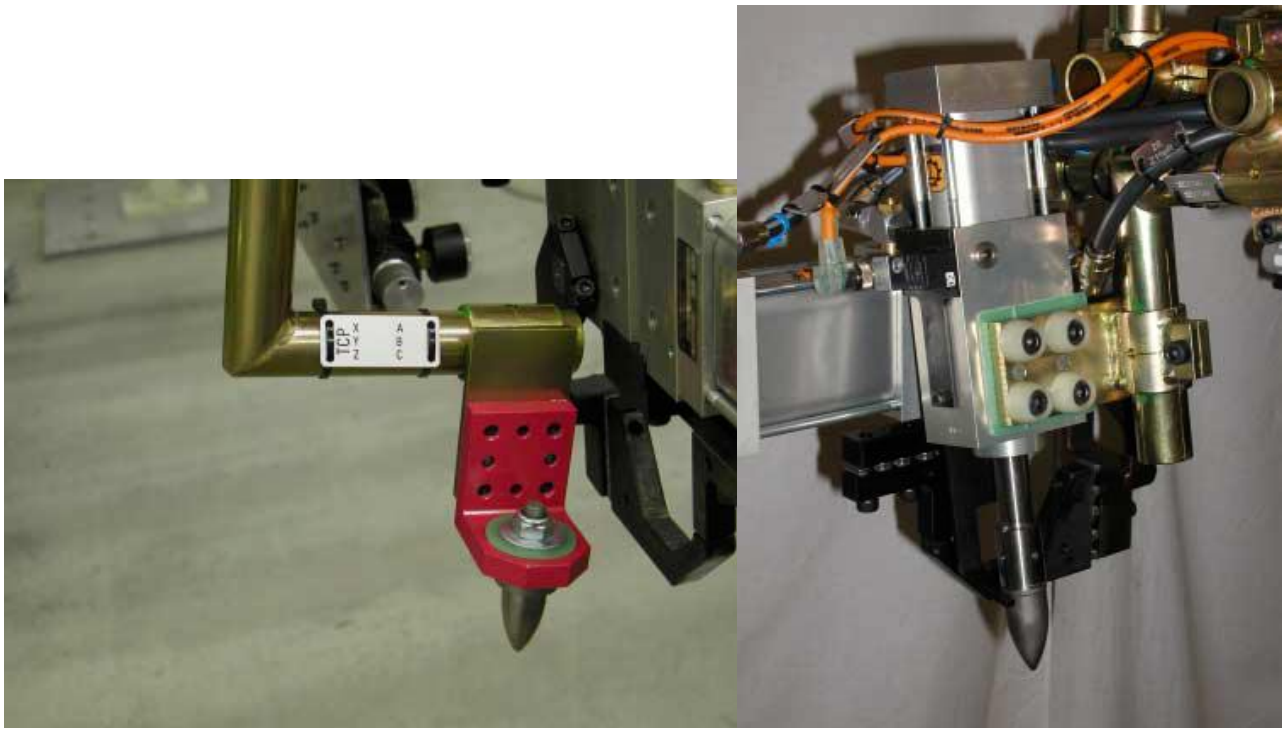
The first step in designing the gripper is to choose from the designing phase the two holes existent in the metal sheet structure from the blanking-moulding phase for the element, in which will be introduced two centring elements, named centring bolt or pin. The function for these pin, used for guiding–centring 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. 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 2^0.

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 2a) and 2b) are presented the pictures of the physical design of the mobile and fixed centre pin, and from the picture results the anchorage mode to the structure of the central support, and in picture 4 b) is presented a side view of the mobile centre pin

from which we can see its adjusting position and the fixing mode on the central support structure using bridles and tubular rods.



a) **b)**

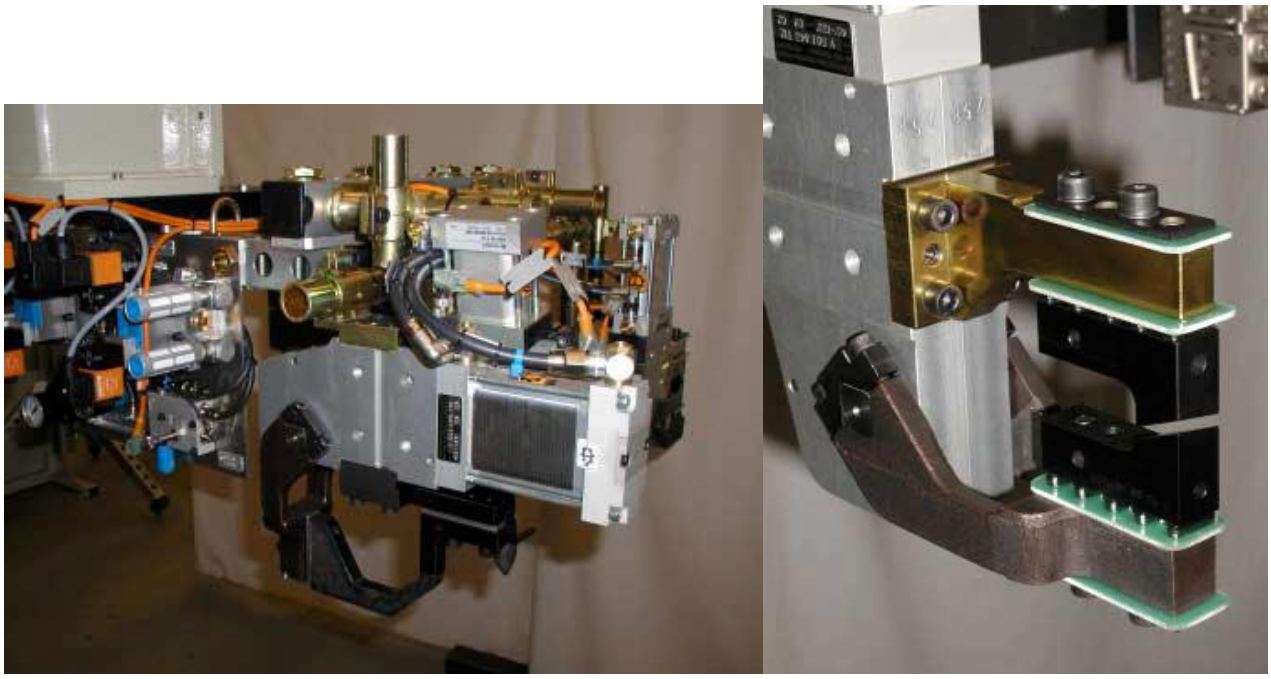
Picture.2 a) , b) Modelele fizice ale bolţurilor de centrare fix şi mobil

The next step of the designer is the choosing and positioning, as efficient as the project requires, of the clamps fixing systems, used for the gripper.

Constructively these will be assembled on the central support structure 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 manufacturing a gripper which can handle a component from car bodywork are frequently used modular typical equipments like Trunkers model V/V2 40 Vario.

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

In pictures 3a) and 3b) are presented different physical designs of a clamp fixing system of the sheet-metal, used at the grippers construction, and from the picture it results the fixing mode on the central support structure using adjustable typical modular elements like fixing bridle and tubular rods, and the positioning of the energetically and informational interface system.



a) **b)**

Picture.3 a) ,b) Pictures with the physical models used in the modular fixing system of the gripper with clamps

3. FUNCTIONAL OPTIMISATION OF THE CENTRING AND FIXING SYSTEMS OF THE GRIPPER

The fixing systems of the metal sheet presumes to individual equip each clamp with two associated elements called NC's.

These contact elements are called so because they are manufactured after a program, realised on tool machines with numerical command, CNC type. After manufacture on these machines, the resulted geometrical shape represents the 3D negative mould of the bodywork in the contact zone. The position adjustment of these pairs is very important from a functional point of view and is made by measuring the coordinates, this procedure assumes a high measuring precision realised with the laser equipments.

In pictures 4a) and 4b) are presented graphically the position adjustment of these pairs, the orientation of the NC's, operation being realised by coordinate measuring. The precision of the execution and installation of the fixing elements and of the entire gripper is checked with the help of the control points for the elements which came in contact with the metal sheet.

The designer and the manufacturer must keep in mind that he must make access for the measuring devices for the control points, no matter if they are materialized only by surfaces or holes precisely adapted.

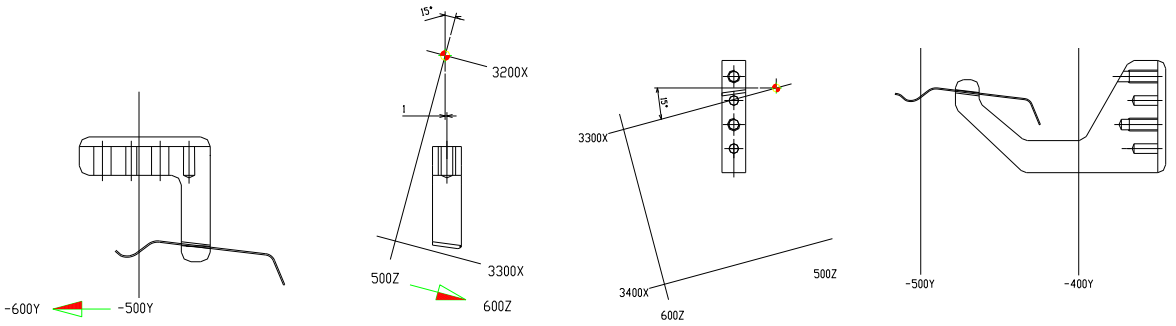
For the centring and fixing elements of the gripper, which came in contact with the metal-sheet, to have a high precision, they will be measured with the FARO laser, and after measuring, the adjustment will be made (Adding or decreasing) from the package of adjustment holds.

The package is composed by different holds with thickness between 0,25 – 20 mm.

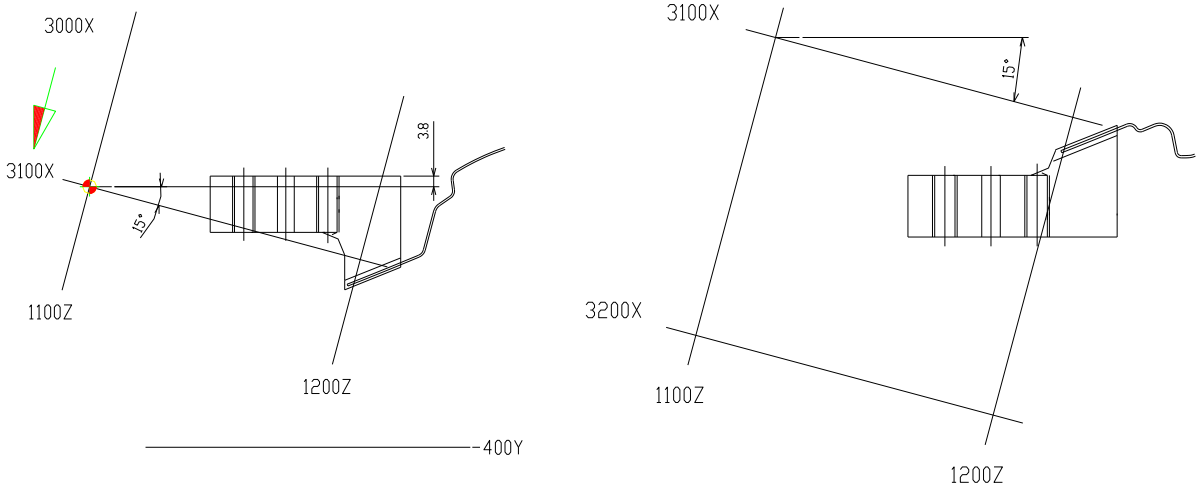
The execution and installation precision for the elements (and for the entire gripper) is checked by the control points (for elements for fixing and orientation). In our gripper's

case the repeatability consists in the checking process of the grabbing of the handled element, having as goal the precise handling of a interchangeable product.

The repeatability is executed after making a geometrical control as a last step before starting to handle the first series of bodywork elements.



a)

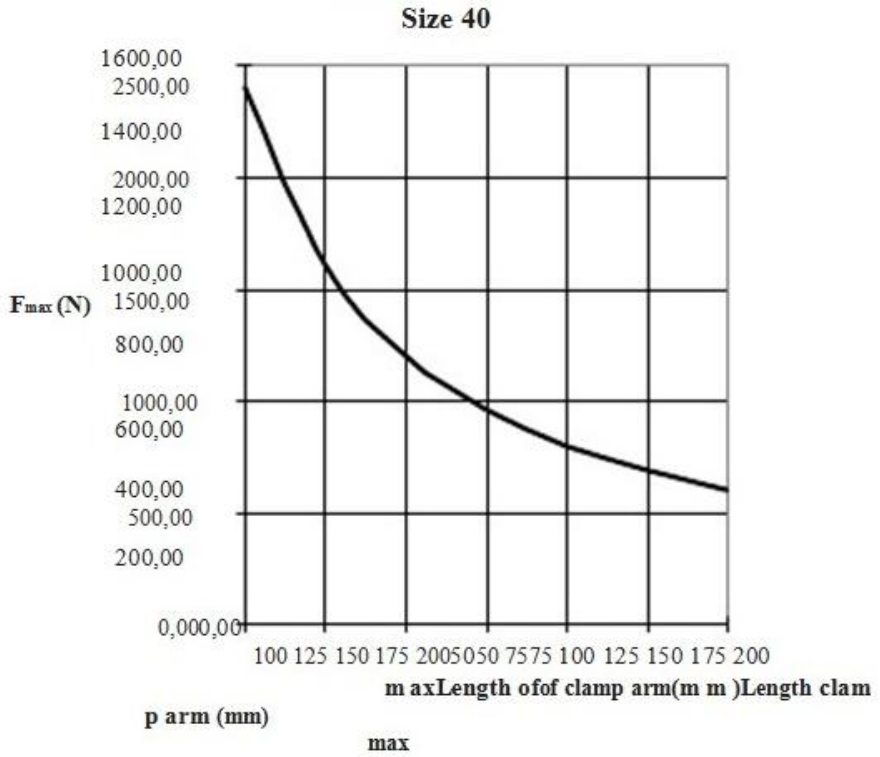


b)

Picture.4 a) , b) Graphical representation of the coordinate position for the adjacent pairs, operation being realised by measurement with a laser beam

The grip force realised by a system of fixation type clamp V40 is 120 Nm, its weight is approximately 2 kg, length 235,5 mm, width 83 mm, height 50 mm.

The weight calculation for the clamp capacity to carry is made after two graphics put at use by their producer. In picture 5 is graphically presented the variation of the gripping force realised by a V40 clamp fixing system.



Picture.5 Graphically presentation of the variation of the gripping force realised by a V40 clamp fixing system

CONCLUSIONS

The grippers manufactured 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. 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.

The weight of the gripper realised from this king of typical elements, together with the handled subassembly of metal-sheets mustn't exceed the weight that the chose robot can handle.

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