Bachelor's Thesis Engineering Technology

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Automating the production process of the heat exchangers

Tom Ramakers & Olivier Leroi

Specialization Preparation program for Master of Electromechanical Engineering Technology

1 Situation and problem

The bachelor's thesis takes place at the company Jaga in Diepenbeek. Jaga is specialized in designing and producing radiators. This project is located in the assembly department of the standardized heat exchanger. The heat exchanger consists of a series of *fin* plates with a *galva* plate on each end. Copper tubes are pushed through the holes of the *galva* plates, which hold the plates together. At the moment this process is still performed completely manually by an operator which is not efficient enough. The operator always has to manually place the *galva* plates on the ends and then lay them flat on the table, which requires a lot of physical strength due to the weight of the *fin* plates. When pushing the copper tubes through the plates, the cubes can sometimes get stuck due to human inaccuracy causing twisting and damage. All of this can lead to a lot of wasted time.

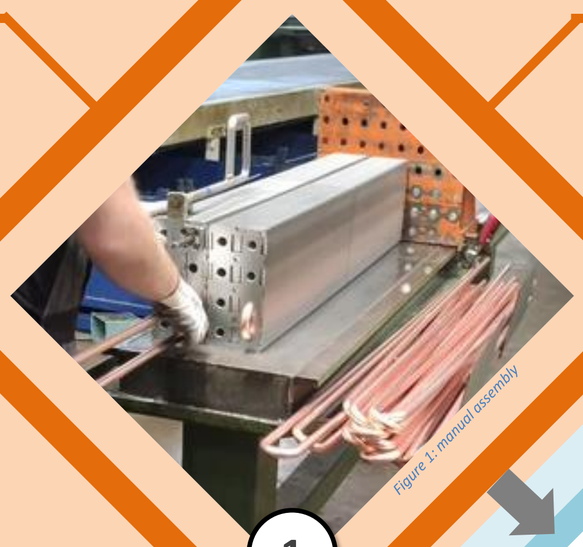

Figure 1: manual assembly

Objective/Requirements 1

The objective is to automate the production of heat exchangers so that a heat exchanger can be produced without an operator. This way the operator will only need to refill *fin* and *galva* plates every certain time. The most important requirements that are imposed:

- Equipped with a buffer for copper pipes and *galva* plates.
- Accuracy for assembling a heat exchanger is ± 1 mm.
- Produce daily between 115-200 heat exchangers.
- Installation dimensions are limited to 3x5x3m.

2 Assembly table

This table is designed to assemble the heat exchanger. The series of *fin* plates are placed on top of the tabletop and slid against the two stops for correct alignment. The table height is adjusted using a **linear actuator** (fig.7) and two **linear guides** (fig.6). The accuracy in height is determined by two stops which are attached to the legs of the frame.

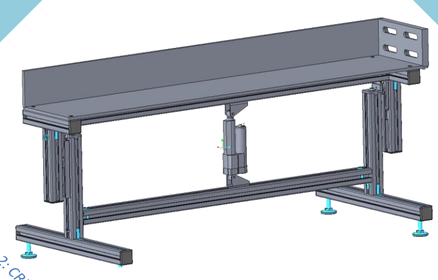

Figure 2: CREO design assembly table

Figure 6: linear guides

Figure 7: linear actuator

Figure 6: linear guides

3 Buffer for copper pipes

This part of the installation has two important functions: the first function is to provide a buffer with a quantity of copper tubes. The tubes are discretized by means of a **feed separator** with two piston rods (fig.8). These will always be placed in pairs in a provided mold. The second function is to slide the copper tubes into the series of *fin* plates of the first table. This is done by means of a **linear drive** (fig.9) which is attached to the underside of the table. This is connected to a pusher that fits in the mold.

Figure 8: Feed separator

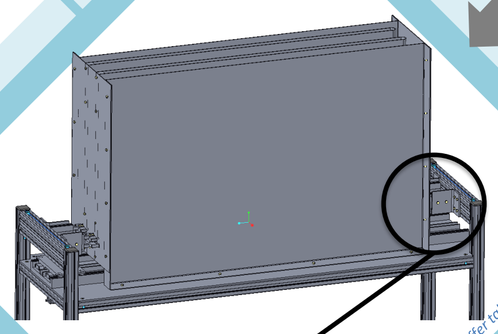

Figure 3: CREO design buffer table

Figure 9: linear drive

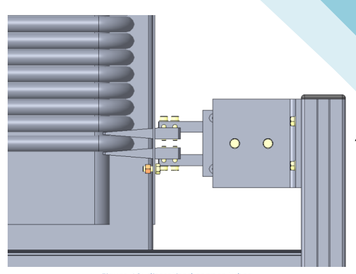

Figure 10: discretized copper tubes

4 Buffer for *galva* plates

In the buffer, the *galva* plates are stacked on top of each other. A special mechanism (fig.12) discretizes the plates one by one. If one *galva* plate falls, the next one will always be stopped. This is controlled by a **linear cylinder** (fig.11). The *galva* plates fall straight down through the pins of the *fin* plate holder.

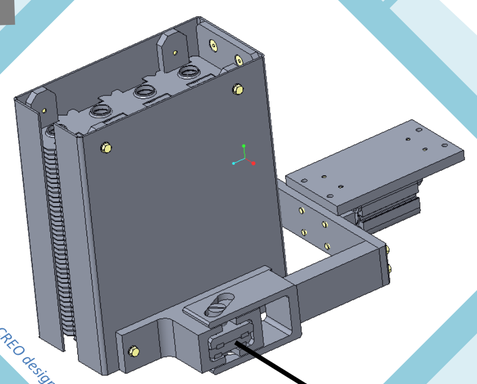

Figure 4: CREO design buffer galva plates

Figure 11: linear cylinder

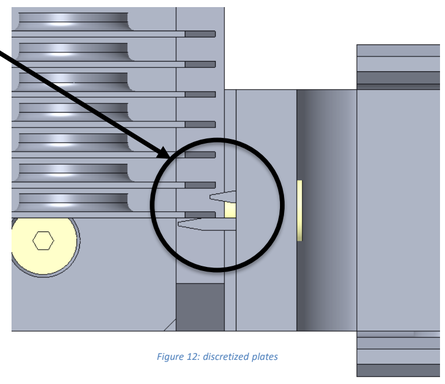

Figure 12: discretized plates

5 Result and conclusion

This is the complete installation with the robot included (fig.5). The robot will move the holder with *fin* plates and the *galva* plates on each end, on to the assembly table. Then the linear drive slides the tubes into the series of plates. After this, the heat exchanger is finished and is placed on a conveyer belt by the robot. By automating this process, the operator will no longer have to carry heavy loads. The automatic production will also lead to more accuracy. The operator only has to refill the buffer of *fin* plates and *galva* plates every certain time. The operator can now operate several production lines simultaneously.

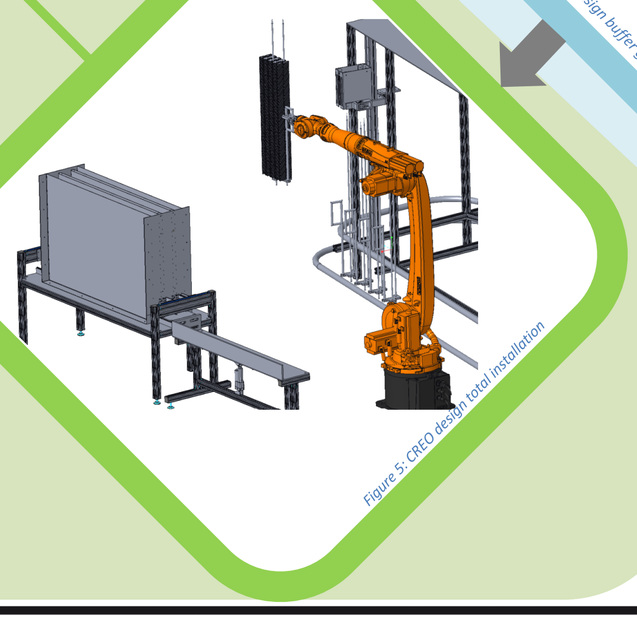

Figure 5: CREO design total installation

Supervisors / cosupervisors: Prof.Dr.Ing. Karel Kellens, Prof.Dr.Ir. Michael Daenen, Prof.Dr. Jeroen Lievens, Ing. John Bijnens, Dhr. Patrick Huygen

[1] PTC Creo Parametric version 8.0.1.0
[2] https://www.jaga.com/benl/
[3] https://www.festo.com/us/en/
[4] https://vansichen.be/
[5] https://www.kuka.com/en-be