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IMPLEMENTATION OF WORKING AND AUTOMATIZATION DEVICES IN A FLEXIBLE PROCESSING SISTEM

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Summary

This paperwork is based on a scientific research, made by the authors with the scope of grooving the work productivity and the precision of processing, by using mechanization and automation devices, with intention of processing a product made on a large scale.

The flexible processing system proposed and presented by the authors, a system composed from a work device and a transfer device, is realizing in a automatic way the transport and the processing of the mark *frame.*

1. Introduction

Starting from the premise that, mechanization and automation of the work cycle of the tool machines, together with the automation of devices, creates conditions for expanding the exploitation possibilities of the universal tool machines, for their transformation in semiautomatic or automatic machines, contribute to the improvement of the exploitation conditions and to the grown of the work productivity. This paperwork authors proposed the conception and the integration of an orientation and fixing system with a transfer device, for the process in a flexible processing system of a mark.

The chosen mark for this paperwork is the mark *frame*, obtained from aluminum alloy cast under pressure in a mold. This procedure of obtaining of the product is for a large scale production. Is a fast procedure, it allows the obtaining of pieces with a complex configuration, a good quality of the surfaces and a good dimensional stability, which allows to process only the surfaces which require high precision.

In figure 1 is presented the 2D drawing of the mark *frame,* upper view and sections of the mark, also is presented the orientation and fixation of the mark in the device.

2. Establishing the technological route of the chosen mark. The phase succession in the processing order.

a) The semi product obtained by casting under pressure. Processing addition will appear only in bores of ϕ40 and ϕ30; on a flat surface which is used when mounting, respectively in the scale of ϕ10 which will be used to direct the piece.
b) The milling of the flat surface (necessary for mounting, and it will be used as a base surface for the upcoming operations).
c) Bore ϕ40 processing
d) Hole ϕ10H7 processing
e) Bore ϕ30 processing – for whom we will develop the guiding and fixing device

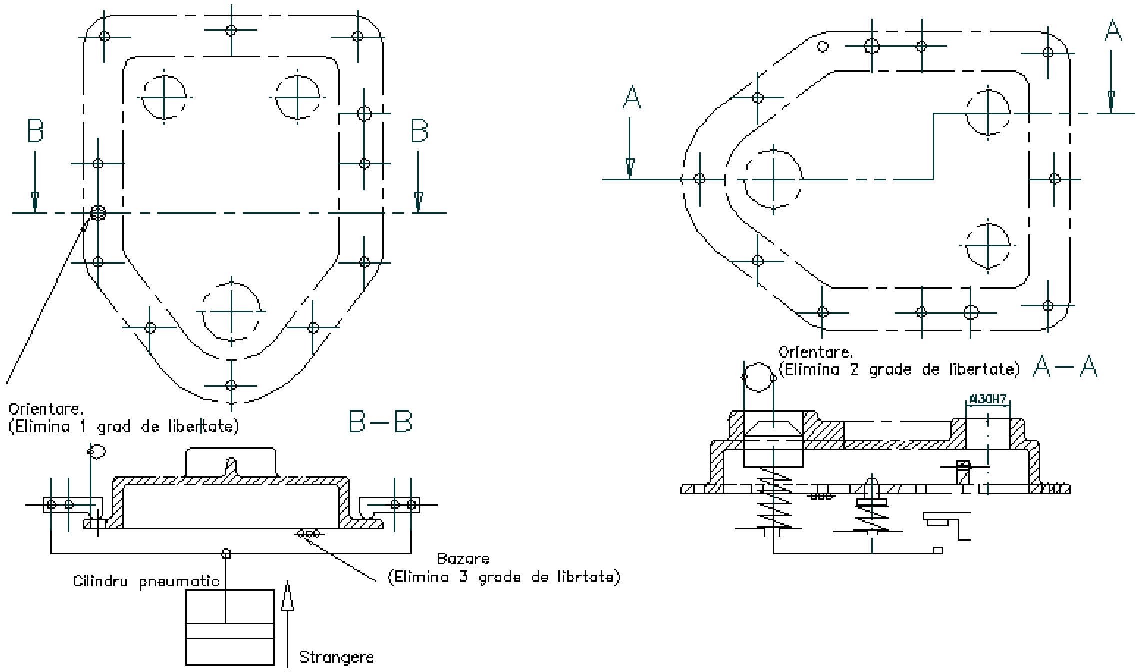

Figure .1 .2D Drawing of the mark frame.

2.1.Base time calculus for the chosen operation for which the guiding and fixing device is projected.

- The ϕ30 bore are processed simultaneously
- The tools used are knifes with fixed hard plates in the blade holder
- The piece obtained casted under pressure, dimensional precision is good, so the processing addition will be over 0,5÷ 1 mm on phase
- We choose the Chip removal = 100 m/min and the advance = 0, 08 mm/rev
- In the following phases we will calculate the tools revolutions:
  n = 1000·v / D [rev/min], namely n = 1000·100 / 30 = 3333,33 rev/min.

We adopt the revolution of the tool at 3300 rev/min.
The advanced speed calculus of the tool is:

S_{mi} = S·n [mm/rev], namely S_{mi} = 0, 08 mm/rev · 3300 rot/min = 264 mm/min.

According to the scheme from figure 2 it can be determined the work-race length l_c:

$l_c = l_a + l_p + l_d$.

l_a – approach length 2 ÷ 3 mm

l_p – work length= 25 mm

l_d – exceiding length = 2 mm

l_c = 30 mm

The base time calculated for the Chip removal will be $t_b = l_c / S_{mi}$ [min], that means
t_b = 30 mm / 264 mm/min = 0,11 min [6,6 s].

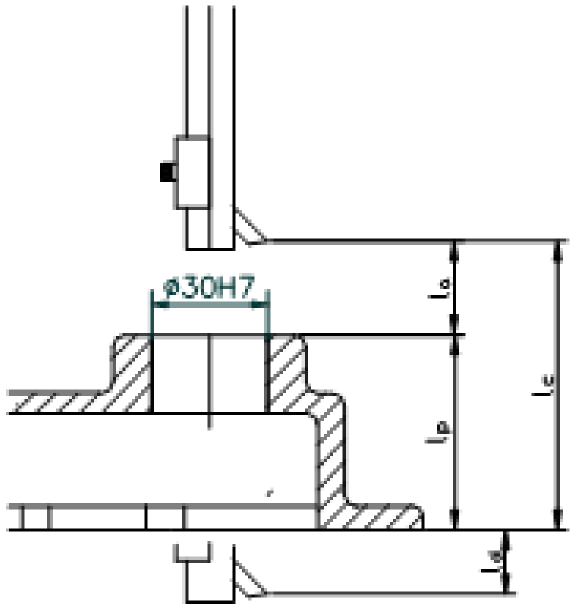

Figure .2. The determination of the work-race l_c length scheme.

3. Calculation and establishment of the orientation elements of the device

For establishing the orientation elements of the device we conceived the scheme of orientation of
the semi product in the working device, accordingly to the scheme from figure 3, being realized on a flat surface and two catch pins.

D_1 = 40H7

- At orientation on catch pin ϕ40 we'll have an adjustment of ϕ40H7/f7

That means:

The bore in the piece = $40_{0}^{+0,025}$

The catch pin in the device = $40_{-0,050}^{-0,025}$

Calculating: $J_{1min} = D_{1min} – d_{1max}$ = 0,025 mm

- At the orientation on the catch pin ϕ10, milled ϕ10H7/f7

  The bore in the piece = $\Phi 10_{0}^{+0,015}$

  The catch pin in the device = $\Phi 10_{-0,028}^{-0,013}$

Calculating: $J_{2min} = D_{2min} – d_{1max}$ = 0,013 mm.

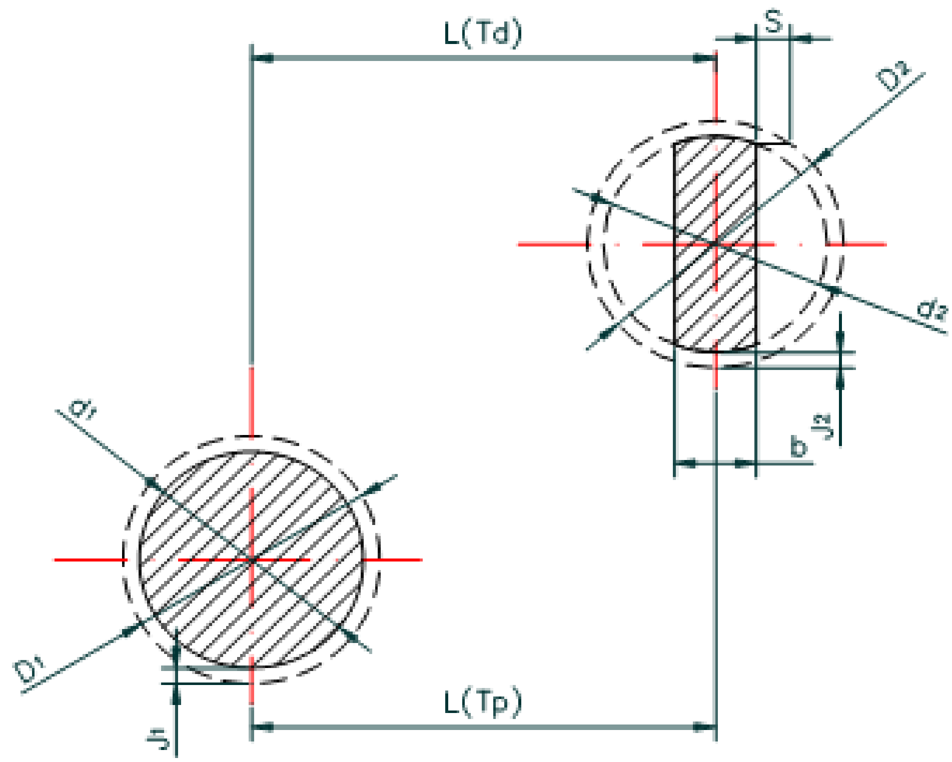

Figure .3. Establishment scheme for the orientation elements of the device.

3.1.Projecting the orientation and fixation of the device

In figure 4 is presented the 2D drawing of the orientation and fixation device. The device realizes in the first phase the orientation of the mark, and after this the fixing of the device will be realized, and this operation is done mechanized with the help of a mechanism with two levers operated by a pneumatic cylinder with double action.

The pneumatic cylinder 26 will push the plaque 10, which by the help of body 5 will push the catch pin 1, respectively with the help of rod 11 and spring 12, the milled catch pin 27. The two catch pin realizes the orientation of the piece on the diameters ϕ40H7 and ϕ10H7. The cylinder piston - plaque 10 – continues the race (now the catch pins stay on foot, the supplementary race is being assumed by the compression of the springs, position 12, and the spring component of catch pin1). With the help of the buffer 23 the plaque 21 will be pressed, which will guide the rods 19. Plaque 21 will operate on rods 18, which will operate at their turn the clips 16, realizing in this way the grip of the piece on the layout surface of the device.

After processing the cylinder will retract pulling down the orientation catch pins, and the springs 21 will push the plaque 21, which will open the grip clips, and the piece will be pulled out by another manipulator.

In spite of the automatic supplying and the orientation and fixing the piece in an automatic way, is costly, the series production on a large scale is still very profitably. The fixing and adjustment period is eliminated, towards the discrepancies of a classic device, the human effort is eliminated for gripping – outgripping, as also the orientation errors, or the mistakes which can appear in case of human operator use.

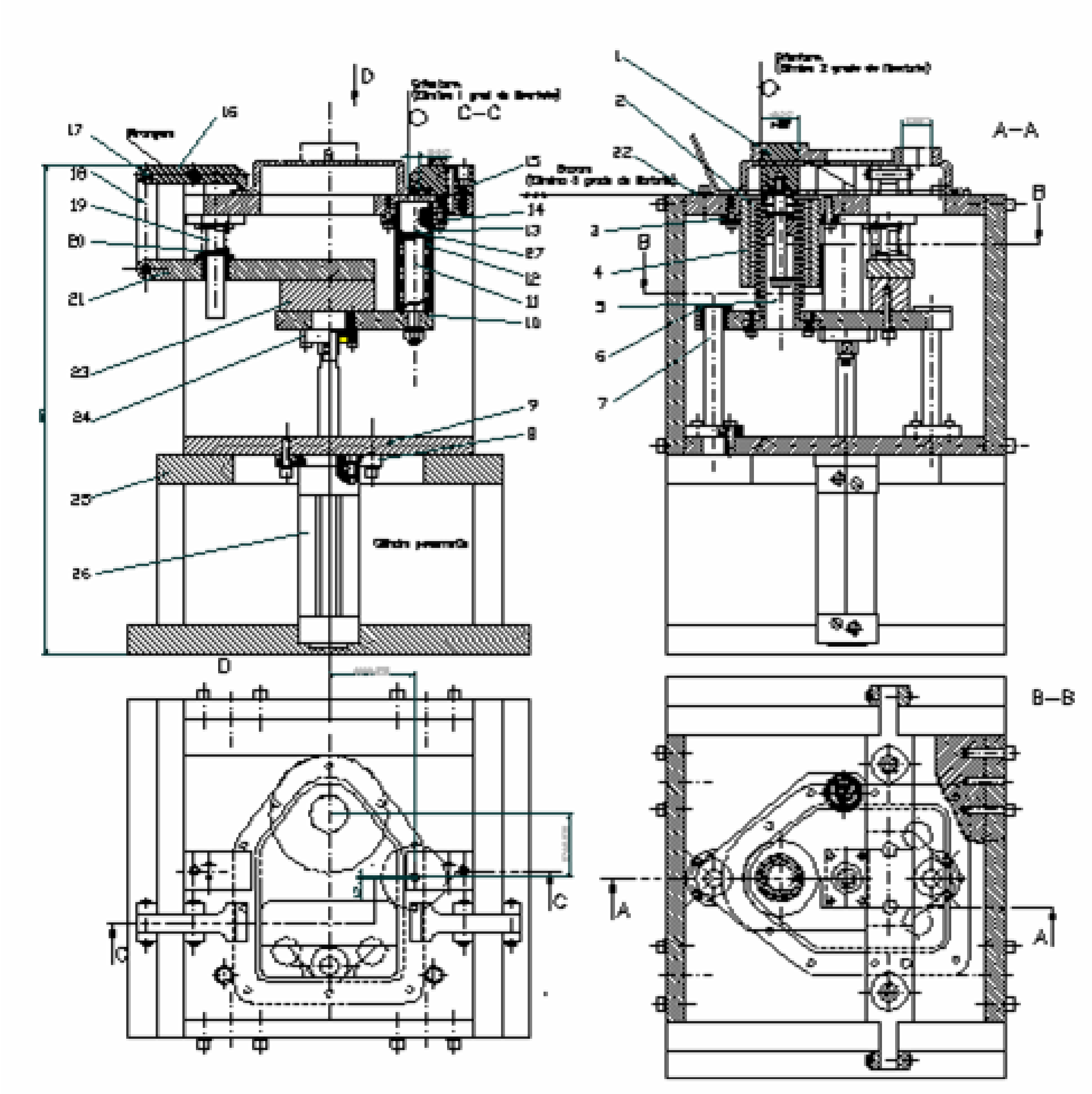

Figure .4. The orientation and fixing device assembly

The mechanized fixing operation of the mark frame in the orientation and fixing device is schematically presented in figure 5.

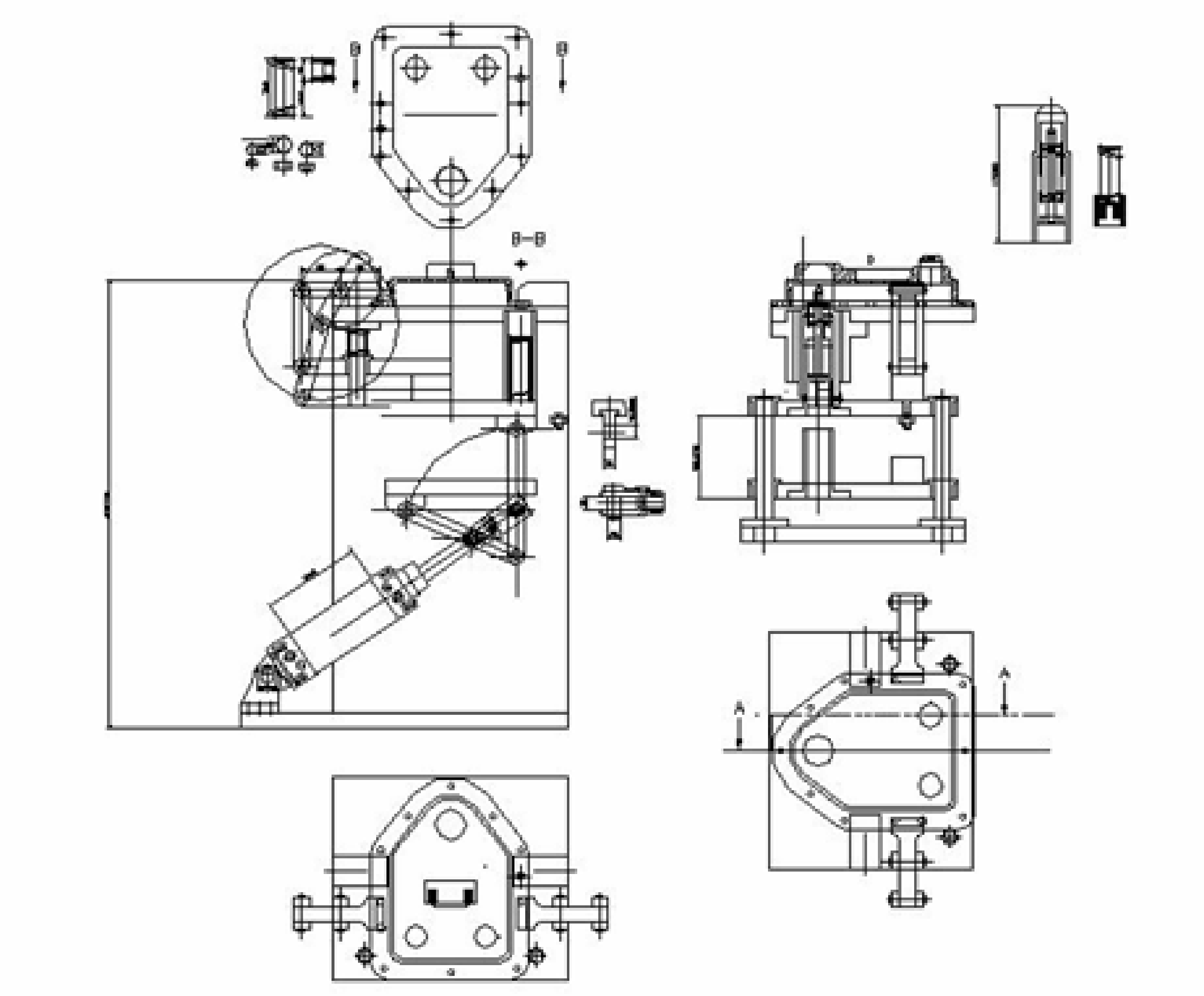

Figure .5. Fixing scheme of the semi product in the orientation and fixing device.

3.2. Calculating the productivity of the flexible system of processing

The pieces processed previously by milling of the flat surface, before falling in the empty seat of the transfer strip system, are primness in the same position on an orientation surface leaned with an angle of 15 degrease. The shape and the dimensions of the vat and the leaned surface, imprint to the pieces a precisely order. In the superior part of the accumulating system, is working a capture-extraction system with claws and forks, pneumatically operated, allowing the access towards the transfer system of a single piece.

While going step by step, because the leaned position of the seats, the pieces are orientated in so way that they will slide on the layout surface of the bore surface, in the corresponding position for orientation and fixation.

The system of the transfer device will be calibrated by de pawl mechanism so that it will respect the time-line. At each 8, 5 seconds the piston will push the pawl lever, the driven wheel will spin with 45º and the last piece will slide in the processing device.

The piston will be pulled back, and the transportation strip will remain unmoved because the pawl isn't allowing the backward rotation of the wheel.

The line productivity is calculated with the expression $Q = \frac{N}{z \cdot h \cdot s}$ [piece/hour],

where:

N – planned production (including the change parts) = 1.000.000 pieces/year
z – number of working days per year ≅ 250
s – number of shift's per day = 2
h – number of hours per shift

$$Q = \frac{1000000}{2 \cdot 8 \cdot 250} = 250 \text{ piece/hour}$$

The time-line is calculated:

$$R = \frac{60 \cdot \eta_u}{Q}$$

where:

η_u – coeficient of utilizing the technological line, which takes account of the time consumptions for removing the possible defections, the tools adjustments, a.s.n. Is adopted 0, 85.

$$R = \frac{60 \cdot 0{,}85}{250} = 0{,}204$$

The auxiliary times are calculated:

- The time for the approach of the multiaxis – post-tool:

$$t_{ac} = \frac{l_{cs} \cdot 60}{1000 \cdot v_{cs}} \text{[s]},$$

where

l_{cs} – the length of the head race till near the piece – we adopt 50 mm

v_{cs} – the fast movement speed of the head – we adopt 10 m/min

$$t_{ac} = \frac{50 \cdot 60}{1000 \cdot 10} = 0{,}3 \text{ s}$$

- Time for pulling beck the multiaxis – post-tool head

$$t_{rc} = \frac{(l_{cs} + l_c) \cdot 60}{1000 \cdot v_c} [s]$$
(6.)

$$t_{rc} = \frac{(50 + 30) \cdot 60}{1000 \cdot 10} = 0{,}48 \text{ s}$$

▪ The necessary time for moving in and from the device the piece depends of the manipulating system (mechanized, automate), and the transport step given in mm:

$$t_t = \frac{60 \cdot P_t}{1000 \cdot v_t} [s] \quad (7.)$$

We adopt P_t = 300 mm

v_t = 10m/min

$$t_t = \frac{60 \cdot 300}{1000 \cdot 10} = 1{,}8 \text{ s}$$

- The necessary time for orientating and fixing the piece depends of the given device.

We admit t_{of} = 1 s.

We have a sum of auxiliary times:

$t_a = t_{ac} + t_{rc} + t_t + t_{of}$ = 0,3 s + 0,8 s + 1,8 s + 1 s = 3,9 s.

The base time is calculated with the relation:

$$t_b = 60R - t_a \quad (8.)$$

$t_b = 60 \cdot 0{,}204 – 3{,}9 = 8{,}34$ s.

The base time will be realized by tuning at each work place and it will be 8, 5 seconds.

3.3. Projecting a transfer device implemented in a flexible manufacture system of processing

The 2D drawing of the transfer device conceived by this paperwork authors is presented in

figure 6, being an integrated part of the flexible system of processing of the mark *frame.*

The device will be tuned in such way that immediately after discarding the piece from the

processing device, this device will transfer step by step the marks so that in will bring another piece for processing in the work device.

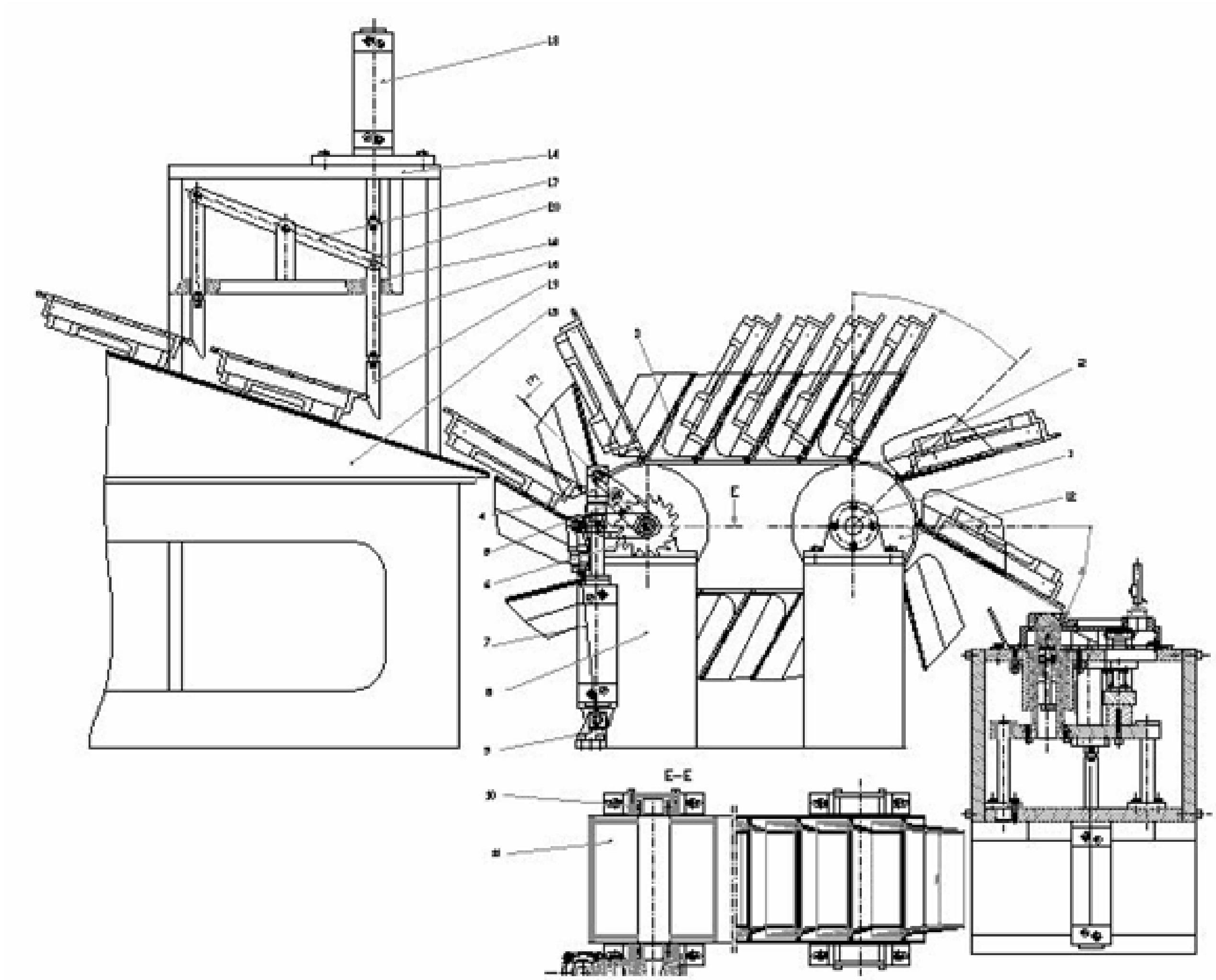

Figure.6. the 2D assembly drawing of the transfer device integrated in a flexible processing system.

4. Conclusions

Utilizing the flexible processing system, proposed and presented by the authors, realizes a very high level of work productivity, realizing while processing superior precisions, compare with the classical processing system.

The fully automatic processing system, presented can be utilized with success in processing other types of marks, by projecting a set of devices in conformity with the technological process and the claims of the beneficiary. For example the extraction of the processed mark from the work device could be realized robotically, the robot being programmed to extract and transfer the mark to a stand for verifying and control.

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