HIDROPLAST CENTERING AND FASTENING MECHANISM

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Abstract: The authors present in this work the result of experimental researches for the achienement of a device with hidroplast centralization and fixation mechanisms.

The mechanism being conceived to work with two semiproducts concomitantly, it has the possibility to achieve a regular pressing on each when the pressing diameters are different.

As the mechanism is functioning on the principle of pressing efforts compensation, it opens the prospect to build mechanisms of fixation and simultaneous centralization of fifty – one hundred semiproducts, having a large area of application in the automation manufacturing.

1. INTRODUCTION

The centering and fastening of the semi-products done with the help of some mechanisms with prisms, plungers and others is most often followed by unequal deformations of the base surface or with a local deterioration of it.

This is the reason why the centering precision decreases, it is difficult to fasten the thin walls semi-products and practical impossible to fasten those made from soft materials.

Also, to increase productivity in some of the punching operation, rectification, electro-erosion processing and others it is necessary to catch more semi-products in the centering and fastening device. Because the semi-products are done in a certain tolerance field, some of these are not tight enough and their fastening is deficient.

These disadvantages are usually eliminated by using hidroplast centering and fastening mechanisms. Hidroplast is a plastic material which is very elastic at 20^0 C , does not have any pores and is able to transmit constant pressures in every direction, in this way, it is acting like a liquid.

It does not flow, it ensures a perfect sealing and does not loose anything through interstitions.

Those are the reasons it is used when building a centering and fastening mechanism for semi-products.

2. THEORETICAL PRINCIPLES

Considering the functional and constructive principle we have two different kinds of hidroplast mechanisms:

- self-centered mechanisms – which can do in the same time the centering and the fastening of the semi-product;
- fastening mechanisms – which can only fasten the semi-product; its positioning is done with separate devices which are not related to the hidroplast.

The second types of mechanisms are most often used. The way they function is shown in figures 1 and 2.

In the mechanism from figure 1 , the outside actuating force **F_a** is at the end of a folding lever ***1*** which has inside two plungers. By pressing the plungers on the semi-product we have in the interior of the hidroplast ***3*** a pressure that ensures the forces ***F*** needed to fasten the semi-products.

From the egality of the moments, we have:

$F_a \cdot L = R \cdot l$, în care $R = m \cdot F$,

and from here:

$$F = \frac{F_a L}{m \cdot l}, \qquad (2.1)$$

where:

L – the arm of the outside force ***F_a***;

L – the arm of the resultant ***R***;

m – the number of the semi-products fastened in the same time, which, in this case is the same with the number of the plungers;

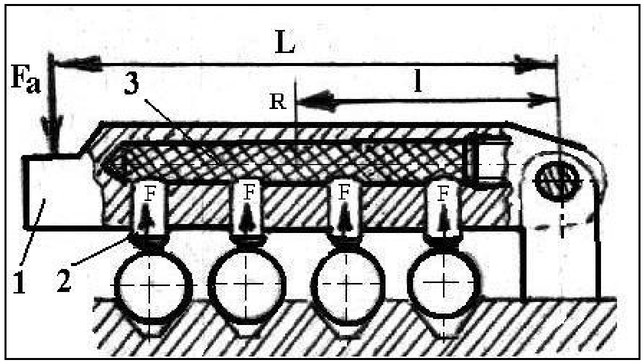

Figure 1. Fastening mechanisms – which can only fasten the semi-product.

If on each of the semi-products we have ***n*** plungers actuating, then each plunger will have a fastening force ***F':***

$$F' = \frac{F_a \cdot L}{n \cdot m \cdot l}. \qquad (2.2)$$

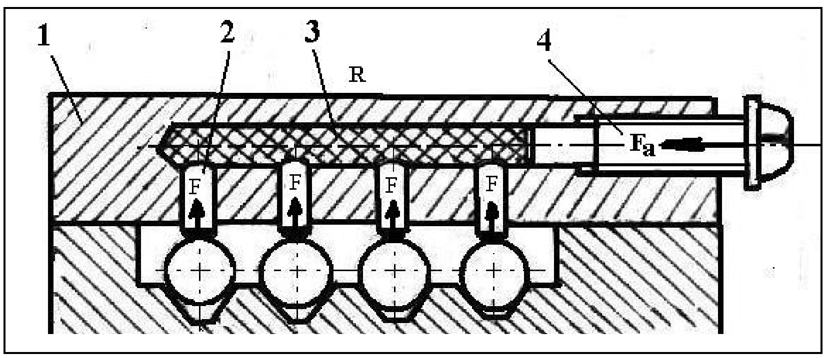

Figure 2. Fastening mechanisms – which can only fasten the semi-product.

As you can see from the formulas above, the clamping force of a semi-product depends of the number of semi-products fastened in the device and it is not dependent of the number of plungers that press them in the same time. So, if you clamp a big number of semi-products the force **F** on each of the semi-products is low. It results from here that this device can be used only to clamp together more pieces in the same time when the cutting forces are small. The folding lever **1** must be firm because the system does not work properly if any deformity appears during the clamping.

In order to obtain a clamping with a big force of all the semi-products you use the scheme from figure 2. In this case the force on the plungers **2** is obtained from the pressure created by the hidroplast when the screw **4** is rotated.

When the screw's external force ***F_a*** appears, the hidroplast's pressure **p** is

$$p = \frac{4 \cdot F_a}{\pi \cdot D^2}, \qquad (2.3)$$

Where ***D*** is the diameter of the actuating plunger pressed by the screw.

But, in the same time:

$$p = \frac{4 \cdot F}{\pi \cdot d^2}, \qquad (2.4)$$

Where ***F*** is the clamping force of the semi-product, equal, here, with the force of a plunger with a diameter ***d.***

Taking these into consideration, we have:

$$F = F_a \left(\frac{d}{D} \right)^2. \qquad (2.5)$$

If, there are plungers actuating on each of the semi-products, the force **F'** realised by each of the plungers can be calculated by the formula (2.5). The total clamping force of a semi-product F_t depends directly by the total number of plungers which press in the same, time, on it $(F_t = n \cdot F)$ and is not influenced by the number **m** of the semi- products.

Even if it is very advantageous, figure 2 is limited because when we remove force $\boldsymbol{F_a}$ the pistons that clamp the semi-products do not move to their initial position, or they move, but unequal, and that is why we may find it difficult to remove or insert the semi-products.

3. THE EXPERIMENTAL MODEL PROPOSED

In order to increase productivity in the process of drilling in the coordinates, we have designed a hidroplast fastening and centering device (figure 3). This mechanism was designed to work with two semi-products **1** in the same time and its clamping is uniform on each of them. The gripping jaws **2** were designed for pieces cylindrical, tubular and prismatical. The clamping force on each of the gripping jaw is ensured by the plungers **3** . Those plungers are moved in bushings **5** by the force generated by the mass of hidroplast **6** through piston **7**. The piston is moved towards a screw mechanism **8**, which is worked manually.

For the return pass of the plungers the mechanism was equipped with a return spring **4** which is placed on each of the plungers. We built the mechanism with a proper mounting shoe in order to be able to fit it up on the robot's table. In figure 3 is presented a plunger and in figure 5 you can see the way the piston works.

The body of the plungers **9** was equipped with two bushings with thin walls and two plungers which were made as it is shown in figure 4. After the thermo-chemical treatment, chroming on the inside and polishing the bushing were pressed in the plungers' body **9.**

The body of the port-plungers ***9*** was equipped with two bushings with thin walls and two plungers designed as it is shown in figure 4. After the thermo-chemical treatment, chroming on the inside and polishing, the bushings were pressed in the body of the port-plungers ***9***. Since the correction of the plungers was done on mechanisms with high precision, after the chroming and polishing, their tolerance towards the nominal level was between the limits (- 0,005 mm la - 0,010 mm).

The device with the two centering and fastening mechanisms was equipped for experiments (figure 6) with five different balancing masses:

- with Rul S180 vaseline;
- with graffited vaseline ;

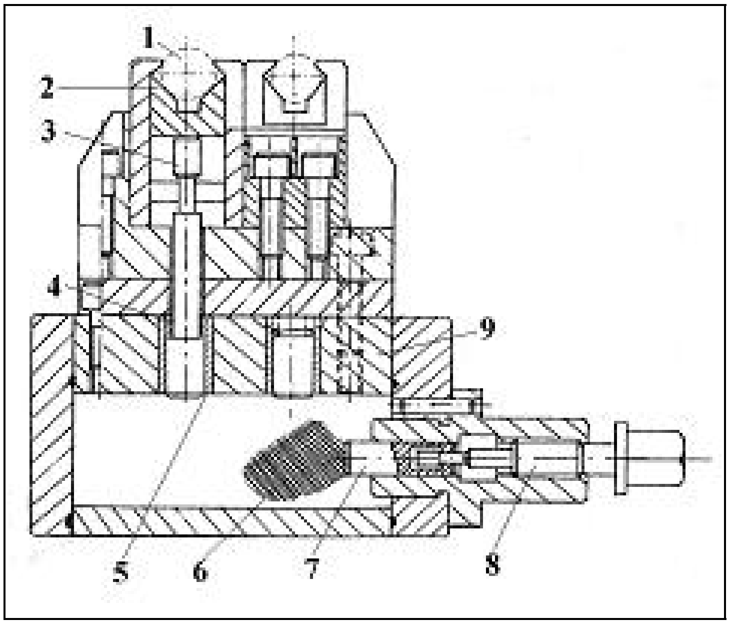

Figure 3. Hidroplast fastening and centering device.

- with SM hidroplast ;
- with DM hidroplast ;
- with hidroplast MATI - 1 - 4;

The device was inserted in the drilling flow sheet of the spigots for pressure controller from U.M.Sadu, for 80 hours. This was done for each of the balancing mass considered. The device worked two shifts a day, with a 30 minutes break between them. A shift lasted for 7,5 hours.

Every hour we measured with a thermo-coupler the temperature of the auxiliary material.

When liquid leeks appeared between the plungers and the bushings and when some of the plungers got stuck we registered the temperature of the auxiliary material and the number of pressing cycles done (with the help of the counter placed on the port-chuck's axis of the drilling machine in coordinates).

For the stuck plungers, after we un-stuck them, we analyzed the possible factors which influenced them(stuck with auxiliary material, the bushings were oval, expansion factors, improper thermo-chemical treatments).

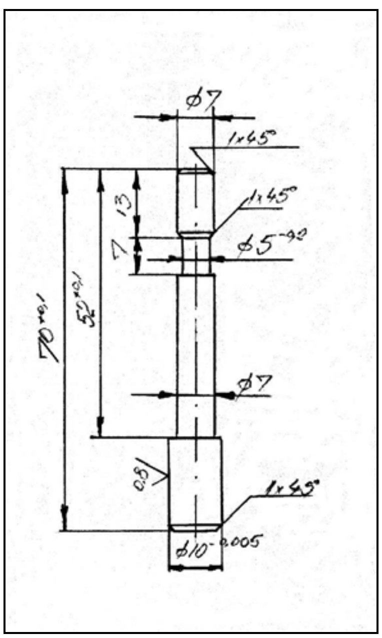

Figure 4. The plunger.

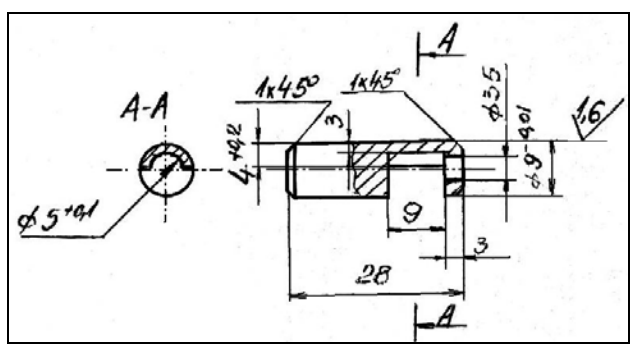

Figure 5. The piston.

4. MATERIALS USED.

- To build the body of the port-plungers ***9*** (figure 3), we used OLC 45 - STAS 880 - 86, (figure 3);
- For the plungers (figure 4) and the piston (figure 5), we used OSC 10 - STAS 1700 - 81;
- For the bushings we used C 120 - STAS 3611 - 86;
- To realise the three types of hidroplast we used the materials shown in table 1, keeping the indications from the work [3] ;

In order to fill all the holes from the auxiliary mechanism, this was heated first until it reached 130 °C. After that on one side of it was poured the hidroplast in a liquid state. For the same purpose, both types of vaseline were introduced with a special screw pump.

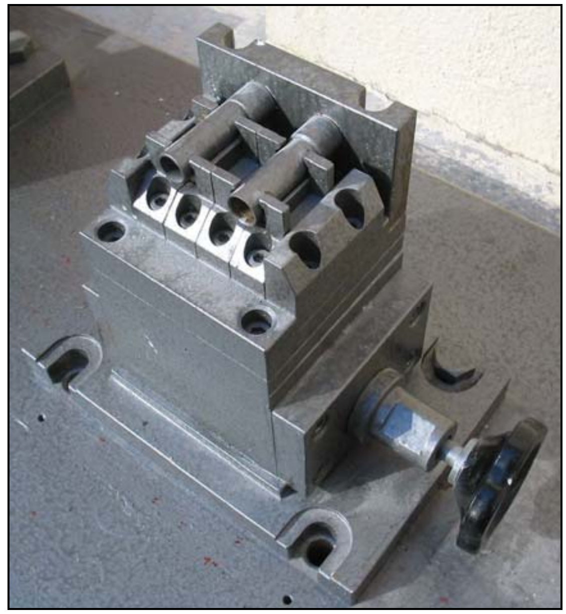

Figure 6. The device with the two centering and fastening mechanisms.

Table 1

Name	UM	State	Type of hidroplast		
			SN	DM	MATI-1-4
Polymerized vinil chloride	%	Powder	20	10	20
Dibutyl phthalate	%	Liquid	78	88	59,2
Calcium stearate	%	Powder	2	2	0,8
Vacuum oil	%	Liquid	-	-	20

5. THE RESULTS OF THE EXPERIMENTS

With the help of the device with two fastening and centering mechanisms, equipped as in figure 3 with bushings and plungers, we obtained the results noted in table 2.

Table 2

Effects	Number of pieces				
	Rul S 180	Graffited	SM	DM	MATI-1-4
Jamming after 80 hours of functioning	1	0	0	1	1
Liquid leaks after 15 hours of functioning	2	2	0	2	0
Temperature after 15 hours of functioning	87	88	86	87	87

6. CONCLUSIONS.

After analyzing the results from table 2 and all the plungers that got stuck, we came to the following conclusions:

a) Since the mechanism was designed to work with two semi-products in the same time, it is able to realize an uniform clamp on each of the semi-products when the clamping diameters are different.

b) After 15 hours of continuous functioning the temperature of the auxiliary material does not exceed 88 °C, and the hidroplast SM acts as the best auxiliary mass when it has a 0,014 mm gap between the bushings and the pistons;

c) The mechanism works after the principle of balancing the efforts for the clamping and it opens the perspective for building devices for centering and fastening 50 -100 semi-products, in the same time, which can be used on a large scale in robotized working.

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