

## RESEARCHES REGARDING THE MODERNIZATION OF THE BLADES CONTOUR CUTTING MECHANISM FOR THE LACHAUSSEE TYPE PYROTECHNICAL ELECTRIC INFLAMMATORY

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**ABSTRACT:** In the present paper the author presents the result of his own researches over the modernization of the conductive cutting blades stamping mechanism from the competence of the pyrotechnical electric inflammatory, starting from the demands of a absolute certainty of the production process at Sadu Mechanical Plant. The inadequate shape of the conductive blades represents the main cause of their pulling out from the insulating compound of the pyrotechnical electric inflammatory by mechanical efforts. As a consequence, it is imposed an application in the manufacture process of the most efficient solutions in order to lead to the realization of the above mentioned desiderate, in economy and maximum safety conditions in the manipulation.

**KEY WORDS:** Throw-out mechanism, pulling out blades, insulating compound, thrust lever, mandrel, high bleaching, and pyrotechnic pill

### 1. INTRODUCTION

In some mining plants, hydro technical construction sites, or forest settlements, rock dislocation from the massif are made with the help of explosives. The worst accidents have produced during the preparation and firing operations of the explosive loads, as a consequence of the conduct pulling out blades from the insulating compound of the pyrotechnical electric inflammatory and unexpected trip of the explosion [1].

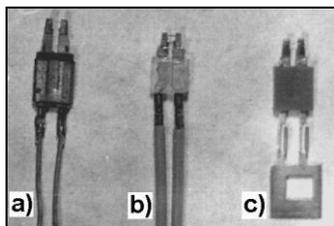


Figure 1. Inflammatory types.

The pyrotechnical electric inflammatory is an active part of the ignition electric band of the electric detonator.

The specialty literature emphasizes little this phenomenon, the solving of cases being specific to each manufacturer in part.

So, the application of the most efficient solutions in the manufacture process is imposed to lead to the realization of the above mentioned desiderate, in economy and maximum safety conditions in the manipulation.

### 2. PERFORMANCES IN THE MANUFACTURE OF PYROTECH-NICAL ELECTRIC INFLAMMA-TORY

There are known many types of inflammatory worldwide, regarding the construction of pyrotechnical electric inflammatory, among which the most important are [2]:

- inflammatory with insulating compounds
- inflammatory with insulating compounds from pressboard consolidated in blades with a steel or brass clip (figure 1.a);
- inflammatory with insulating compound from polypropylene (figure 1.b);
- inflammatory with insulating compound from injected PVC (figure 1.c).

These types are the most used and present the best technical functional and safety parameters. We can mention among the main advantages:

- they are executed on automatic machines with 3000 inflammatory productivity per hour;
- they are suitable in the semiautomatic formation of the ignition pill;
- they are suitable in the automatic control of the ohmic resistance;
- they are suitable for automatic soldering, welding or assembly of the blades on reofori by RPK procedure.

There are used a series of automatic equipment, with a high productivity and safety in the function and exploitation in order to manufacture inflammatory.

These machines have spread a lot after 1960, the idea was applied by many equipment and installation constructing companies for the pyrotechnical industry.

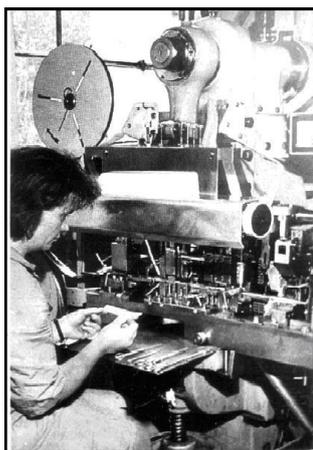


Figure 2. Vertical presser equipped with devices to manufacture inflammatory with polypropylene insulating mass.

So, among them, Lachaussee Company from Belgium, known today under the denomination of New Lachaussee, realized the most automatic equipment. The company has launched many types of vertical presser with crank mechanism on which it set out 11 devices for the manufacture of inflammatory on the market.

The company uses two procedures depending on the safety level at the pulling out of conduct blades from the insulating compound:

- with insulating compound from pressboard consolidated with a brass clip (figure 1.a);

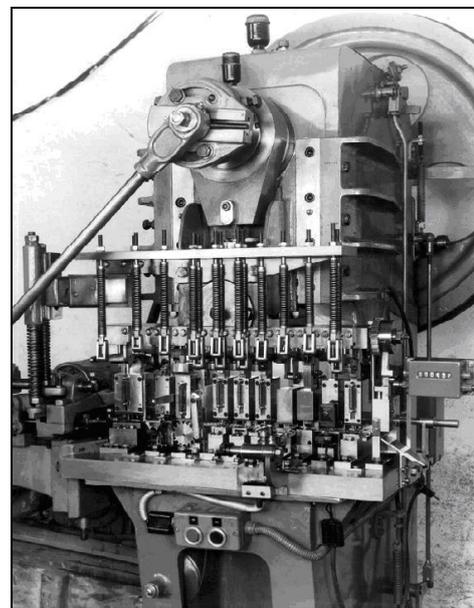


Figure 3. Vertical presser equipped with devices to manufacture inflammatory with pressboard insulating mass consolidated with a brass clip.

- with insulating compound from polypropylene (figure 1.b).

The system is fully automated, obtaining 25 inflammatory cards in the end.

A vertical presser equipped with devices in order to manufacture inflammatory with insulating compound from polypropylene is presented in figure

2, and to manufacture inflammatory with insulating compound from pressboard consolidated with a brass clip in figure 3. The last generation Bi 15 vertical presser, manufactured by Lachaussee Company, is presented in figure 4. This is a very safe presser, being foreseen with a ORLINGHAUS type disc brake which functions independently of the clutch.

Two symmetrical connecting rods which ensure an efficient guidance of the plane guides fixed on frame are being used in order to act the slide block, constructively speaking.

Each elementary position uses devices which carry out simple operations in order to ensure the smooth running of the presser. This method, although the most secure, leads to the construction of long stamps with positions for cutting, cupping, adjustment and trimming, and the resultant forces do not always coincide with the axle of the machine. The presser is endowed with two connecting rods which allow the achievement of a perfect lateral movement of the upper to the lower part of the machine in order to eliminate this shortcoming.

The advance step of the presser is determined by a FESTO type pneumatic system, simple and efficient incorporated in the presser. This mechanism ensures precision and constancy to the successive position of the tape.



Figure 4. Lachaussee Bi 15 type vertical presser.

The tape can be pushed or pulled, depending on the necessity.

Both types of inflammatory can be made by this type of presser. Lachaussee system uses a guidance block with 4 sliding columns on balls (figure 4). There are mounted 11 devices which carry out simple operations, specific for each technological operation, between the upper and lower plate of the guidance block, as follows:

- Device 1 - Contour blades cutting;
- Device 2 - Preheating polypropylene tapes;
- Device 3 - Sticking polypropylene tapes by hot pressing;
- Device 4 - Contour cutting of polypropylene insulating compound;
- Device 5 - Bleaching foot blades;
- Device 6 - Upper margin cutting (towards filament);
- Device 7 - Bending ends of blades at 90° in order to fix the filament;
- Device 8 - Setting filament;
- Device 9 - Welding filament;
- Device 10 - Cutting strap
- Device 11 - Discharged cards with 25 inflammatory.

The devices 2, 3 and 4 realize the discharge, bending and constriction on blades of the clip on blades from pressboard stiffened with brass tape in the procedure with insulating compound from pressboard.

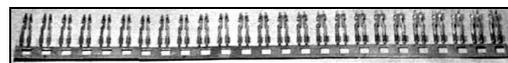


Figure 5. Stamped card, having 25 pairs of blades with Lachaussee type baffles.

În figura 5 se prezintă o cartelă stanțată de cele 11 dispozitive ale unei prese verticale, cu 25 inflamatori tip Lachaussee.

A card stamped by the 11 devices of a vertical presser, with 25 Lachaussee type inflammatory are presented in figure 5.

Starting from the demands of a complete security of the inflammatory, its manufacture implies the change of the conduct blades shape in order not to allow their movement through the insulating compound that surrounds them. It is necessary that the terminal part of the blades to totally surrounds their later surface, also to be able to mechanically assembly with connecting connectors by RPK procedure [2], [4].

The device for blades contour cutting (figure 6) is responsible for these demands. This device is part of the special dies category. It is a device with guidance board, ensuring a very high processing precision.

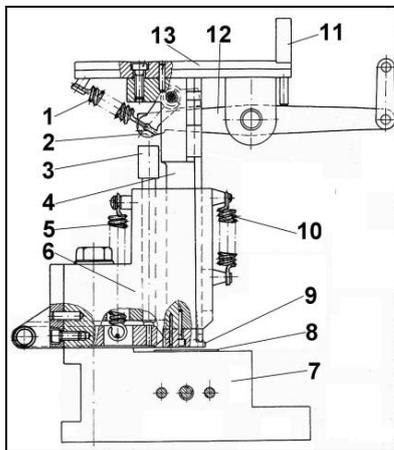


Figure 6. Device for cutting classical type blades contour.

Regarding the operating mode of the contour cutting device, this is part of the simultaneous actions dies category, allowing the obtaining of a part at an active stroke of the ram presser.

The construction of the device for contour cutting is a complex construction, made by an articulated lever system, which under the force action of the slide block presser fulfills a series of functions ensuring the realization of the blades contour cutting of the inflammatory.

The disadvantage of this device is caused by the use of a complicated scheme of the mechanism, with many moving parts and multiple adjustments.

### 3. PROPOSED EXPERIMENTAL MODEL.

#### 3.1. Construction of an upgraded blades contour cutting device

The author practically designed and realized the experimental model of a blades contour cutting device, in order to be integrated in the guidance block with 4 sliding columns on balls, like device no. 1.

Also the author redesigned the contour cutting stamps and mandrels of this device, in order to obtain blades with anti-pulling-out baffles, (figure 5) and bleaching adequate to the mechanical assembly with connecting drivers [2].

The stamp and mandrels have been made like in figure 8, taking into account that the realization of a high bleaching necessities the replacement of the small strap from that area with scissors (figure 7).

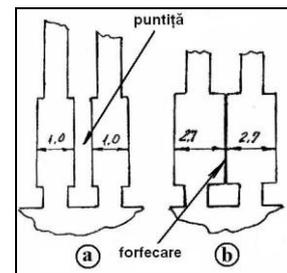


Figure 7. Highlighting the small strap and detrusion



Figure 8. New shape of matrix and mandrels.

The designed blades contour cutting device, presented in figure 9, has the following structure: 1 – upper board; 2 – opposing spring pressing jack; 3 – pressing jack mandrel; 4 – pressing mandrel; 5 – port- mandrel; 6 – sliding block of port-mandrel; 7 – spout tape; 8 – post-stamps block; 9 – stabilization tape

fluid pad. The author designed this device in order to work in vertical position, together with the other devices presented above.

the device from figure 8, the proposed device has the following advantages:

- The pressing mandrel is acted by a single jack with benefits over the precision and rapidity of the action;
- The elimination of lift springs of the pressing post-mandrel and mandrel.
- The change of the attachment of the upper plate.

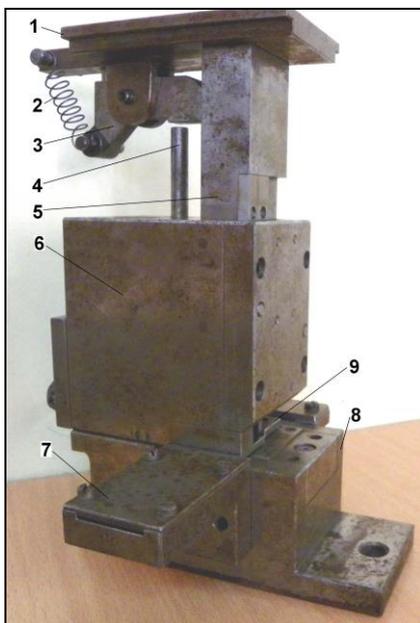


Figure 9. Experimental model of the cutting blades contour device.

The blades contour cutting device from figure 9 operates like this:

When the pile driver of the presser acts over the upper board *1*, this presses on the post-mandrel *5* on which is mounted step stamp mandrel, searching mandrel, profile I cutting mandrel and mandrel for profile II cutting. In the same time, through the pressing jack mandrel *3* is also acted pressing mandrel *4*, which obliges the fluid pad *9* to steady the tape on cutting matrix.

After the finalization of the stamp operation, at the reverse stroke of the pile driver presser, spring *2* and jack *3* enter in function in order for the tape to allow the extraction of the 4 mandrels. Jack *3* presses on the mandrel *4*, jack *9* and stamp tape.

When lifting the pile driver presser and slowing the action force over the mechanism, the spring *2* has the role to bring back the elements which it acts in the initial position.

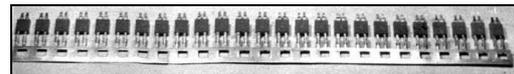


Figure 10. Card with PVS insulating mass, injected for 25 inflammatory.

### 3.2. Construction of a device for injection of insulating mass

The realization of an insulating mass with constant density has led to the design of a device that injects 25 inflammatory at once[3]. In figure 5 is presented a card with 25 stamped blades, and in figure 10 is presented a card with PVC insulating mass, injected for 25 inflammatory. In figure 11 is presented the device designed by the author for which was obtained the innovative certificate no. 197/84.



Figure 11. Device to inject the insulating mass.

The device is designed with the folding upper side, in order for the operator to easily introduce and clear up the preforms. Also, closing the upper over the lower jaw was designed and made to be sealed so that the fluid material does not come out in the pressing process. The finite parts result without bits so they can be used without other processing in the immersion operations in pyrotechnical materials. The injection was made on vertical presses with 3 tf piston.

#### 4. THE RESULT OF THE EXPERIMENTS

In order to demonstrate the efficiency of the experimental model use of the contour cutting device and to highlight the contribution of the insulating mass at the blades movement, when over them acts a dynamic force of shock, three types of inflammatory presented in figure 1 have been analyzed.

An interior layers friction of the pyrotechnical pill is also produced due to an extremely small movement of the blades through the insulating mass, the dynamic shock pulling out method of the reofori can be considered as a more conclusive method to establish the sensitiveness of each of them. In both cases, the method has special importance because it establishes with certainty, which blades isolation procedure ensures a higher safety range and which pyrotechnical compositions are not being initialize by friction. A dynamic pulling out test of the reofori, with the weight of 3 kg and fall height weight of 50 cm is used after the reofori adhesion at inflammatory with applied pyrotechnical pill [4]. The test was applied on 100 inflammatory pieces from

the above presented types.

In table 1 is presented the result of the experiments:

#### 5. CONCLUSIONS

The following conclusions can be formulated analyzing the blades stamped with the new device, respectively the inflammatory equipped with insulating mass, pyrotechnical pill and after the realization of the dynamic pulling out test:

- The new device set on a Lachaussee manufacture Bi 15 type presser and working in 3 shifts of 8 hours, behaved excellently, without causing jamming and premature tear of the cinematic elements existing in movement;

- The rotation center change of the pressing presser and the elimination of the moment generating jack did not change the pressing force in the fluid pad stabilization of the tape;

- The elimination of bringing back springs in initial position of the port-mandrel and defense mandrel have been successfully substituted by the two rockers of the pile driver of the presser;

- The type I inflammatory do not resist at their dynamic pulling out with a weight of 2 kg and fall height of 50 cm; Due to frictions that appear during the pulling out, the explosion of pyrotechnical pills is unavoidable;

- In type II inflammatory, the number of explosions is as small as in type III, but the procedure involves multiple technological operations, doable on the equipment from the U.M. Sadu endowment; also, the blades have been executed with baffles in order to avoid pulling out;

**Table 1. The result of the experiments**

| Current no. | Type of inflammatory | Proved pieces | Test mass [Kg.] | Explosions | Without explosions | Pulling out blades |
|-------------|----------------------|---------------|-----------------|------------|--------------------|--------------------|
| 1           | Type I               | 100           | 2               | 87         | 13                 | 13                 |
| 2           | Type II              | 100           | 2               | 0          | 100                | 0                  |
| 3           | Type III             | 100           | 2               | 1          | 94                 | 5                  |

- In type III inflammatory, the explosions are substantially reduced as a consequence of the hot compressing over the blades of the inflammatory of two polypropylene tapes; also the blades have been executed with baffles in order to avoid pulling out;

- The injection of the insulating mass in the device has proved to be the best solution, also due to the homogeneity of mass and special shape of blades, these are not pulled out;

- The procedure applied by the author in the year 1988 has brought an annually 3,5 million lei economy, it constitutes a novelty in the domain and was extended to the entire manufacturing detonators of U.M. Sadu.

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