DYNAMIC ANALYSIS OF A CRIMPING DEVICE WITH MULTIPLE CAMS USING MSC ADAMS

Part I. Implementation of the mechanisms with cams in the crimping of electric detonators

Prof. Univ. Dr. Eng. Gheorghe **Popescu,**
University "Constantin Brâncuşi" of Târgu Jiu
e-mail: gepo@utgjiu.ro

Abstract: *In the present paper, the author presents the result of the researches realized to realize a tightening device with 12 cams to crimping electrical detonators. This can work singular in vertical position, through the agency of a sprocket wheel mechanism or in tandem with another cam device, both auctioned by a sprocket wheel mechanism – cog rack with symmetrical profile. By the application of this device in series production can be obtained an efficient character of crimping in the process of explosions alienation by dynamic tearing of rheophore, as well as against of water penetration inside detonator.*

Key words: Crimping, electrical detonator, mechanism with multiple cams, bac, avulsion conductors.

1. Introduction

Electric detonators used in shoot activities, have in their composition the pyrotechnical detonator and the combustion electrical device [3,4].

The assembly of these two components can be realised by the crimping of the metallic tube of the detonator on the obturator of the combustion electric device, so that the spreading of their rheophores by the miners and the building-up of explosive loads, not to produce intempestive explosions.

Also, in case mine holes are full of water, the detonator should enure the tightness of the explosive loads in respect of them.

Crimping it is realized commonly, with a device of 12 crimping tanks and 3-4 rows of ribs on bac.

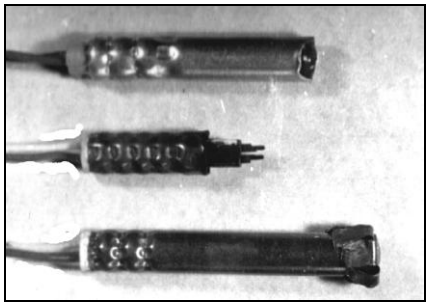

Figure 1. *Crimping with several connection rings.*

Taking into account the fact that the obturator confectioned from plasticised PVC can have an elasticity coefficient different from batch to batch, in an indispensable manner there appear deficiencies of qualitative order in realising the crimping operation.

According to the paper [3] the crimping diameter varies between 4.2 and 5.4 mm.

Starting from these aspects, the author from the present paper, presents the dynamic analyze with MSC ADAMS of the mechanism of a crimping device with 12 connection cams, designed by the author and used in the technological process of assembly of indigenous electrical detonators.

2. Crimping notion

Crimping is the technological operation through which is realized the plastic deformation of the copper, aluminum or steel metallic tube, on the obturator cork, through which are passing electrical conductors, having as effect the consolidation and perfect tightening of the interior of the detonator, against humidity.

Two procedures of detonator's crimping procedures:

- crimping with several connection rings (figure 1);
- doubling crimping (figure 2).

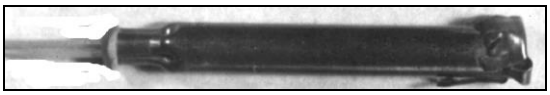

Figure 2. *Contortion crimping.*

The crimping with several tightening rings is the spreadest procedure and can be realized with the aid of some devices of radial tightening, auctioned with mechanisms with cams, plumes and inclined plan or conic mechanisms[3].

Bac's penetration depth varies from 1.25 mm to 1.55 mm and it is realized depending on the number of circles that are used, the shape of the tanks, plasticity of the obturator cork and disturbances that can be produced in the area of assembly of the rheophores.

The tightening force of each bac can be allocated uniform on each tightening circle.

3. Proposed experimental pattern

The author has designed and realized practical the experimental pattern of a crimping device for detonators with 12 tightening bacs, auctioned with cams which are part, in their turn, from a sprocket wheel rack mechanism[2].

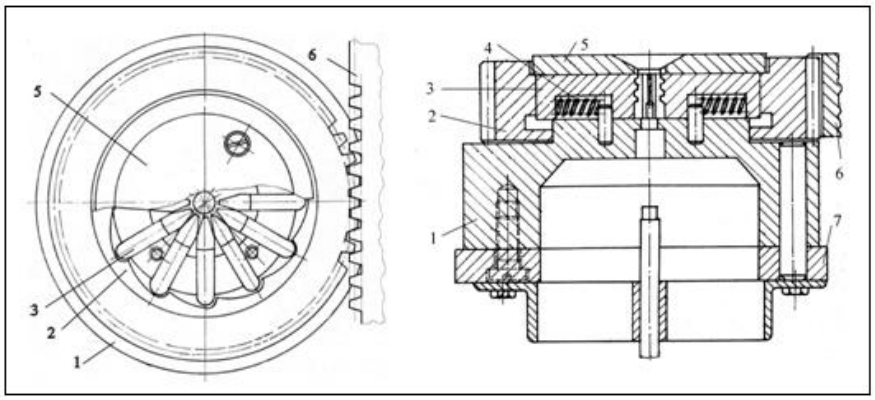

Figure 3. *Crimping device with 12 tightening bacs.*

In figure 3 it is presented the crimping device having the following component: 1- fixing block; 2 – cogged sector with 12 internal cams; 3 – crimping bacs; 4 – return resorts; 5 – cog; 6 – double rack; 7 – basic plate. The author has designed this device to work singular in vertical position (figure 4) through the agency of a sprocket wheel mechanism or in tandem with other device with cams, both auctioned by a sprocket wheel – rack mechanism, with symmetrical profile.

In the second case, the devices have been assembled in horizontal position on the table of a hydraulic press of 3 tf, (figure 5). On the skull of the press has been assembled the rack, and in its lower part has been assembled a course limiter so that crimping can be done at a minimum diameter of 3.8 mm. Behind each crimping device has been assembled a detent chamber for eventual detonations that might be produced during the tightening process.

The crimping device from figure 3, functions this way:

At the displacement of the press's skull, the rack involving the cogged sector with internal cams, displaces radial the 12 bacs to the tightening centre. The 4 claws of each bac deform plastically the tube of the detonator, diminishing its diameter and at the same time realizing its tightening over the obturator cork, being obtained the ensemble from figure 1. At the reverse course of the rack, bacs are displaced reversely to resort **4**.

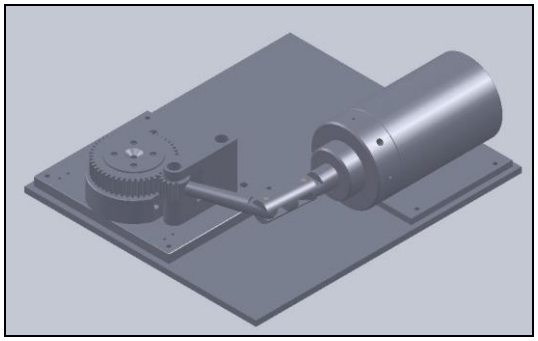

Figure 4. *Singular device.*

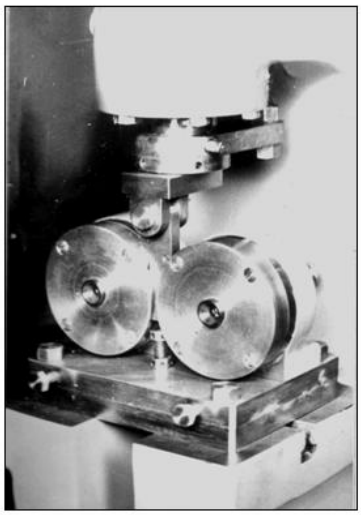

Figure 5. *Tandem of two dispositive.*

4. Result of the experiments

In order to show the efficiency of using this device, we have initiated two types of experiments [5]:

- efficiency of the crimp for the alienation of the accidental explosion of the detonator at dynamic removal ;
- efficiency of the crimp against the penetration of the water inside the detonator and the compromising of the explosive load; at this test has been verified also if the exaggerated tightening of the tanks did not lead to the perforation of the tube in this area, the separation of the rheophores from the inflamator, the short-circuit or grounding of the rheophores.

The first type of experiments has been realized with the aid of stand from STAS 8136/1985, and the results of the experiments are presented in table 1.

The second type of experiments required according to STAS 8136/1985 norms, the introduction of the detonators in a water recipient at the depth of one meter and the realization of the electrical measurements followed by detonations after being maintained at this depth for 24 hours.

The result of the experiments are presented in table 2.

Table 1

Diameter of the crimping ring [mm]	Crimp with 3 ribles		Crimp with 4 ribles	
	No. of tested detonators	Explosions or displacements from the insulated table	No. of tested detonators	Explosions or displacement from the insulating mass
Ø 6,6	100	38	100	32
Ø 5,4	100	8	100	2
Ø 4,6	100	0	100	0
Ø 4,2	100	0	100	0

Table 2

Diameter of the crimping ring [mm]	No. of tested detonators	No. of functioning detonators	Failures
Ø 6,6	100	8	92
Ø 5,4	100	43	57
Ø 4,6	100	98	2
Ø 4,2	100	100	0

6. Conclusions

The analyse of the results lead to the following conclusions[1]:

- By modifying the penetration depth of the crimping bacs, from a maximum value of Ø 4.2 mm to a minimum values of Ø 6.6 mm, it can be observed an accentuated increase of the rheophores displacement from the obturator cork, followed in some cases by explosions;
- Concerning the variant with 3 ribles (rings) of crimping, no removal of the rheophores with diameter of 4.2 mm is realized, meanwhile at the variant with 4crimping circles, these can not be produced starting with the diameter of 4.6 mm;
- The crimping with 4 crimping ribles presents the best safety against water penetration inside the detonator, starting with a diameter of 4.2 mm;
- Mechanised crimping represents a safe solution for the removal of the un-uniform crimping of the detonators, followed by explosions at manipulation or flegmatization of the explosives in composition;
- Using cams in operating the tanks- pegs constitutes a reliable solution in building tightening mechanisms with several fingers.

Bibliography

1. **Popescu Gh; Ghimiş Ştefan; Stancioiu Alin.** *The results of the researches reguarding the use of cams mechanisms in assembling electrical detonators.* Annals of the Oradea University- Fascicle of Management and Technological Engineering, Volume VII (XVII),2008, Editura Universităţii din Oradea, pag. 1040.
2. **Popescu Gh.** *Cercetări experimentale pentru realizarea unui dispozitiv de sertisare detonatori electrici.* Proceedings scientific conference 9-th edition with international participation – „Constantin Brâncuşi" University of Târgu Jiu, 2004, pagina 81.
3. **Popescu Gh.** - *Implicaţiile dopului opturator injectat asupra siguranţei detonatorilor.* Analele Universităţii "C-tin. Brâncuşi"Târgu Jiu – nr. 1, seria A, 1994.
4. **Leţu Nic. Popescu Gh**. - *Posibilităţi de înlăturare a exploziilor necomandate, provocate de smulgerea reoforilor la capsele detonante electrice.* Revista " Mine, Petrol, Gaze", vol 33, Bucureşti, 1982.
5. *** * *** STAS 8136/1985.