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## ANALYSIS OF TECHNOLOGICAL OPERATION – FLAT SHEET METAL FORMING OF CAR BODY PANELS

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*Abstract.* The group operations of magnetic-pulse metal working were considered. The analysis of technological operations carried out according to the scheme flat sheet stamping has been conducted.

*Key words:* magnetic-pulse metal working, magnetic-pulse forming, inductor, car body panels.

## АНАЛІЗ ТЕХНОЛОГІЧНОЇ ОПЕРАЦІЇ – ПЛОСКЕ ЛИСТОВЕ ШТАМПУВАННЯ КУЗОВНИХ ПАНЕЛЕЙ АВТОМОБІЛІВ

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*Анотація.* Розглянута група операцій магнітно-імпульсної обробки металів. Проведено аналіз технологічних операцій, здійснюваних, за схемою плоске листове штампування.

*Ключові слова:* магнітно-імпульсна обробка металів, магнітно-імпульсне штампування, індуктор, кузовна панель.

## АНАЛИЗ ТЕХНОЛОГИЧЕСКОЙ ОПЕРАЦИИ – ПЛОСКАЯ ЛИСТОВАЯ ШТАМПОВКА КУЗОВНЫХ ПАНЕЛЕЙ АВТОМОБИЛЕЙ

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*Аннотация.* Рассмотрена группа операций магнитно-импульсной обработки металлов. Проведен анализ технологических операций, осуществляемых по схеме плоская листовая штамповка.

*Ключевые слова:* магнитно-импульсная обработка металлов, магнитно-импульсная штамповка, индуктор, кузовная панель.

### Introduction

There exists a group of operations in the magnetic-pulse metal working performing technological operations sheet metal forming of car body panels.

This scheme consists of an inductor and workpiece (car body panels). The inductor and the car body panels for working are represented as parallel flat forms divided by an insulating insert.

Actually, the inductor is an single-turn solenoid. The magnetic pressure forces are directed from the inductor to the car body panels [1].

The magnetic-pulse stamping of articles from sheet workpieces also can be performed with the help of the flat spiral single-turn and multi-turn inductors. According to the flat sheet forming scheme they fulfill stamping of the car body panels (Fig. 1), membranes and the shallow dishes, the pictures and inscription embossing, hole punching and soon. The workpiece shape is

defined by the matrix under magnetic pulse stamping. The square of processed surfaces can achieve  $0,2 \text{ m}^2$  in dependence of the power capacity of the device. By realization of the stamping operations it should be appreciated that the magnetic pressure at the central part of inductor system is practically lacking. This fact is detected by the constructive execution of the matrixes and the form of its section must be attached to the workpiece and the practical possibilities of the flat sheet forming scheme.



Fig. 1. – Car body part made by using magnetic-pulse stamping

#### **Analysis of technological operations with flat sheet stamping**

Realization of some technological operations in sheet metals flat stamping sometimes demands concentrating of pressure forces for “angles filling in” accordingly to ordered shape of completed part [2]. The term “angles filling in” is a special term from forging stamping production. Practically it means realization enough strict angles with the rounding off level according to production operation conditions (Fig. 2).

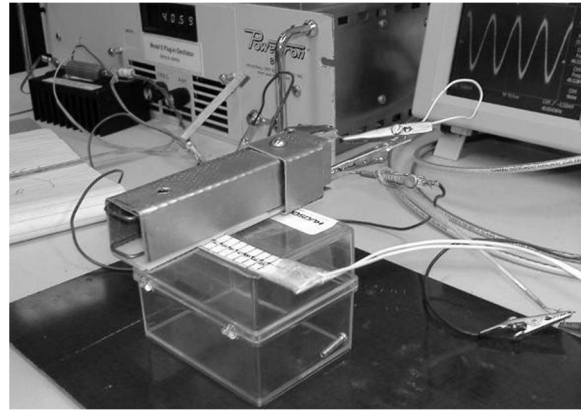


Fig. 2. – Model configuration for magnetic-pulse “angles filling in”

As it is shown in scientific works on pressure working [3] a high-speed pulse action leads to appearance of some new properties in behavior of processed metal. This new property was designated as hyper-plasticity. Its practical usage allows to deform without destruction and to stamp articles which could not be produced by conventional methods.

The magnetic-pulse stamping is practically realized by the powerful force-action mode in microsecond's interval time. The main particularity of the processing methods of this sort is the inextricable connection of the inductor-tool and the workpiece (car body panels) which is the subject for deformation (Fig. 3). If the puansone efficiency during the mechanical stamping is not immediately connected with the inner processes in the processing metal, the magnetic pulse force action is physically possible only when the electrical dynamic connection between the coil current of inductor-tool and the current induced in the work-piece. Their interaction leads to the appearance of powerful ponder-motor forces the value of which is proportionally to the product of amplitudes of primary and secondary currents.

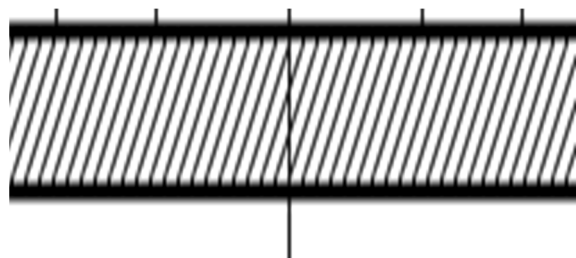


Fig. 3. – The flat sheet stamping scheme: 1 – inductor; 2 – workpiece

One of the main problems in designing of the magnetic pulse methods tools is the problem of the reasonable force action on the car body area [3] which must be deformed out according to the manufacturing order. In this place as started above it is necessary to carry out an analysis of electrical magnetic processes in the “inductor-workpiece” system with the following recommendations by their constructive making and their relative position.

### Conclusions

From the result obtained after the carried out analysis it may be concluded that the magnetic-pulse metal stamping of car body panels is a progressive technology in a modern automotive industry.

The work tool of the magnetic-pulse metal stamping is an inductor system consisting of single-turn wire or multi-turn wire solenoids and a processable workpiece. The nomenclature of a product produced with the magnetic pulse stamping, includes sufficiently a wide set of products (car bodies, membranes, embossing pictures,

“angles filling”) in metal sheet material.

Main advantages of the magnetic-pulse metal stamping are transition to hyper-plasticity mode of the workable metal sheet and deficiency of any mechanical contact between working tool and workpiece. The force action on the workpiece is carried out by the physical process of interaction of external magnetic field with induced current.

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