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INPUT PARAMETERS INFLUENCE ON PARTS HEIGHT DEVIATION OBTAINED THROUGH BLOCK DRAWING

Gramescu T., Mocanu C., Carausu C.*
„Gheorghe Asachi” Technical University of Iasi, 59A Mangeron Ave., 700050, Iasi, Romania
*e-mail: c_carausu@yahoo.com

The cold plastic working continue to develop compared to machining by molding or hot deformation. A number of advantages, both technical and economic, can be obtained by the plastic deformation. The experimental researches were carried out for three materials: aluminum, brass and copper. There are presented the influence of the number of whirls, of the discharge energy and of the discharge voltage on the deviation from the height of the part for different thicknesses of the sample. In case of aluminum there is a significant decrease of the deviation from height if the sample is of 0.15 mm thickness and a reduced decrease when using material with a thickness higher than 0.15 mm. When the brass material was used the increase of discharge energy leads to a significant decrease in height deviation of the parts. At different values of discharge energy the increase of the number of whirls leads to the almost comparable decreases of the deviation when the thickness was 0.15 mm and 0.5 mm. In the case of copper the increase of the discharge energy leads to the decrease of height deviation of the part with comparable values for the two thicknesses of the used material. The same observation can be drawn in case of the influence of the number of whirls on the deviation from the part’s height.

Keywords: parameter, height, deviation, part.

Prelucrarea plastică la rece continuă sa se dezvolte, comparativ cu prelucrarea prin turnarea sau deformare la cald. Deformarea plastică poate duce la obținerea unor avantaje atât tehnice cât și economice. Cercetările experimentale au fost efectuate pentru trei materiale: aluminiu, alamă și cupru. Sunt prezentate influența numărului de spire asupra abaterii de la înălțime a piesei, influența energiei de descărcare asupra abaterii de la înălțime a piesei și influenta tensiunii de descărcare asupra abaterii de la înălțime a piesei pentru diferite grosimi ale semifabricatului. În cazul aluminiului se înregistrează o scădere semnificativă a abaterii de la înălțime în cazul în care grosimea semifabricatului este de 0,15 mm și o scădere mai puţin intensă atunci când se utilizează un material de grosime mai mare de 0,15 mm. În cazul în care a fost utilizat materialul alamă cresterea energiei de descarcare conduce la o scădere semnificativă a abaterii de la înălţime a piesei. La diferite valori ale energiei de descărcare, creșterea numărului de spire a dus la scăderi aproape comparabile ale abaterii în cazul în care grosimea este de 0,15 mm și 0,5 mm. În cazul cuprului creșterea energiei de descărcare duce la scăderea abaterii de la înălțime a piesei, cu valori comparabile pentru cele două grosimi ale materialului folosit. Aceeaşi observaţie poate fi trasă şi în cazul influenţei numărului de spire asupra abaterii de la înălţime a piesei.

Cuvinte-cheie: parametru, înălţime, abatere, piesă.

INTRODUCTION

The electromagnetic forming process is based on the use of a concentrated source of energy which releases the workpiece. At the moment, due to increased accumulation of practical and theoretical research results, there are various construction-tool devices that allow high concentrations and thus electromagnetic energy flow distorting a certain areas of the piece. Magnetic shaping applications were extended peak areas such as automotive, civil engineering, aviation and space, etc.

The process is based on the electromagnetic induction phenomenon. According to this phenomenon, when a coil is driven by an electric current i(t), that varies with the frequency f, creates in the space around it a magnetic field B(t) of the same frequency. If this field is inserted inside a massive piece (wire) made of a material with good electrical conductivity, the eddy currents are induced therein (also called Foucault currents) which have the same frequency f but meaning less opposite current i(t). They are located close to the sample surface because of the skin effect. This effect was first described by Lamb (1883) for the case of circular conductors and was generalized to conductors of any shape by Heaviside (1951) [1].

For in-depth study of the phenomena of the electromagnetic field deformation process was necessary to know, by specialists of the mechanics of a dynamic process created high power electrical circuits, in which the parameters vary during the process. It should be noted that during deformation the blank is to induce an electromotive force in the coil, the inductor, which also can lead to a reduction in the transfer of energy from the magnetic field formed for the track is formed [2, 3].

In processing equipments through the electromagnetic field, as noted above, energy is accumulated in the capacitor. When high voltage switch closure occurs discharge the capacitor. It will therefore be a discharge of energy that will be transferred in a very short time the coil-inducer. From here, through the electromagnetic field the energy passes to the workpiece, which will change shape due to the pressure exerted by it.

The way energy is split capacitors (energy stock) during its transfer, is suggestively shown in fig. 1.

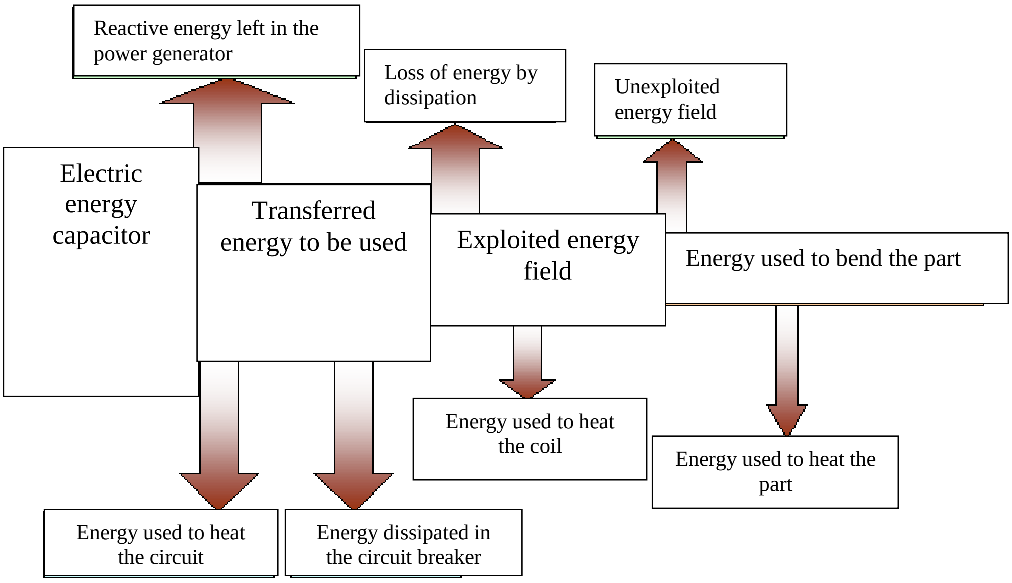


Fig. 1. Transfer of energy in electromagnetic energy systems [1]

The main parameters that influence the processing system in electromagnetic field are: electrical conductivity; deformed plate thickness; deformed shape and size of parts and mechanical characteristics of machined parts [4, 5].

METHOD AND RESEARCH EQUIPMENT

As input parameters that influence the process of forming through the electromagnetic field was chosen the following: discharge energy E; number of whirls N of the coil; thickness of the sample.

As process output parameters chosen to study the following parameters: relative elongation at drawing; workpiece thickness after deformation at drawing; firing the piece at the height of the block.

Starting from choosing to study the three input parameters chosen to organize a full 2^3 factorial experiment.

Inductor coil construction is shown in fig. 2.

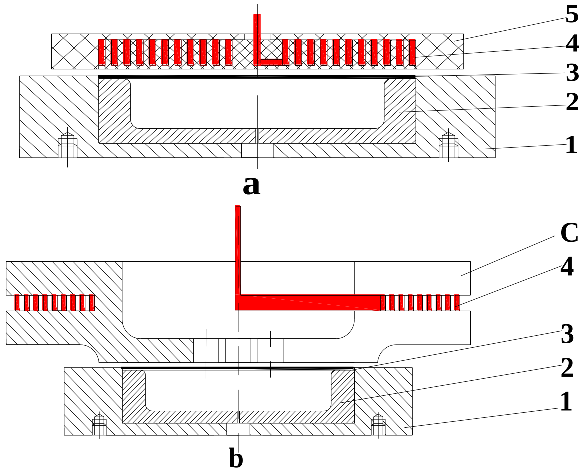
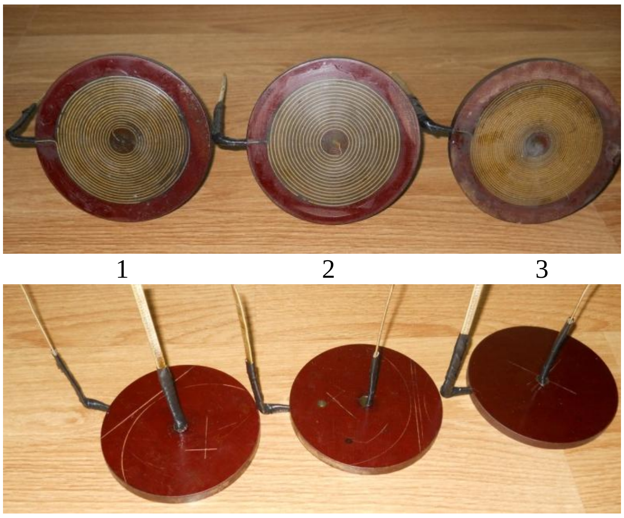


Fig. 2. Shape of induction coils used in the experimental research: a) induction coil without concentrator; b) induction coil with field concentrator:
1 - support plate; 2 - active plate; 3 - workpiece; 4 - inductor; 5 - insulated plate; C - field concentrator

Based on the theoretical consideration, coil form with Archimedes concentrator spiral field (fig. 2a) was designed and built in three variants (fig. 3a), which have the same outer diameter (D=100 mm), but different steps which led to the different lengths of the conductor winding and the coil of the field concentrator (fig. 2b) has been designed and made in a single embodiment (fig. 3b), the outer diameter D=200 mm, and the diameter of the active surface of 120 mm.



a)

b)

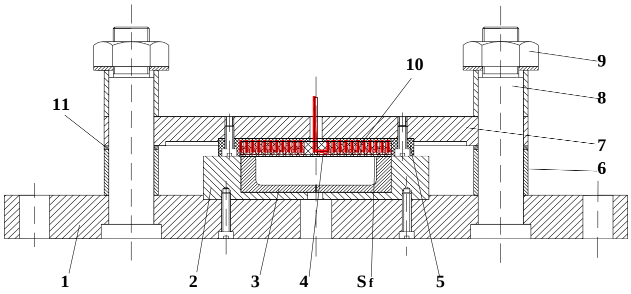
Fig. 3. Induction coils built for experiments:
a) induction coil without concentrator; b) induction coil with field concentrator

Based on the principle of electromagnetic field for processing is required mold to shape the sample. For this purpose it was necessary to concept, design and implementation of a device similar to a conventional molds, mechanical processing principle. Besides the device itself is a stamping die that punch is made of high intensity magnetic field generated by a coil charge.

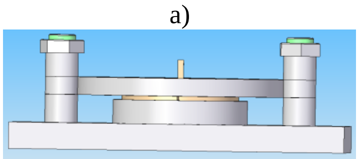
Designed mold with inductor without concentrator for semiflat deformation is shown in fig. 4. In this construction there is a base plate 1, a support plate 2 on which is mounted the active plate 3, which will shape the plan sample S_f. "Stamp" is created through the coil 10 is placed on top of the sample in such a way that the whole field created by it interfering with the sample. Coil made of electrically conductive material is fixed in epoxy 4, considered a good insulating material with good mechanical strength. It is fixed to a plate 5 made of insulating material (textolit), the whole assembly being fixed to a top plate 7. The movable part centering is ensured by means of two guiding columns 8.

After positioning the sample in the working position, the mold is closed by using of two nuts 9, which can be screwed into the threaded portions on the ends of the guide columns.

For adjusting the distance between the coil 10 and the sample S_f between the bushing 6 and the coil holder plate 11 is inserted additions of different thicknesses.



a)



b)

Fig. 4. a) Layout of the working mould with inductor, no concentrator for planar deformation of blanks;
b) 3D view of the work mould:
1 - base plate; 2 - support plate; 3 - active plate; 4 - epoxy resin; 5 - insulated plate; 6 - bush; 7 - top plate; 8 - guide column; 9 - nut; 10 - inductor; 11 - surplus

It should be noted that the induction coil with field concentrator is fitted with an insulating material between the field concentrator and plates 7 and 5 (rubber, lacquer, epoxy resin, etc.). Its purpose is to contain the electromagnetic field of the concentrator thus increasing process efficiency.

RESULTS AND DISCUSSIONS

In the case of aluminum experimental conditions and results of stamping parts are shown in table 1. Fig. 5 shows the influence of the number of whirls on the height part deviation.

Table 1

Experimental conditions and results obtained in stamping aluminum parts

Experimental conditions	Part code							
	IIIA1	IIIA2	IIIA3	IIIA4	IIIA5	IIIA6	IIIA7	IIIA8
Thickness g, [mm]	0,15	0,3	0,15	0,3	0,15	0,3	0,15	0,3
Discharge energy, [J]	150	150	150	150	600	600	600	600
Whirls number of coil	16	16	26	26	16	16	26	26
Deviation from the height of the piece, [mm]	**0,2**	**0,1**	**0,13**	**0**	*	*	*	*

*irrelevant

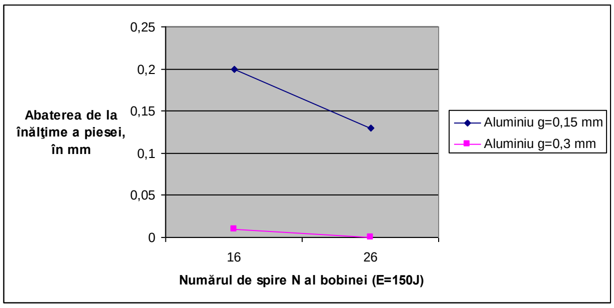


Fig. 5. Influence of the number of whirls on the deviation from the height of the piece

In the case of aluminum increasing the number of whirls N at an energy of 150 J and a thickness of 0.3 mm for insignificant sample result in a decrease in the deviation from the height of the piece. When using a thickness of 0.15 mm occurs significant precious drop of this offense.

Moving to the study of the second material, brass, experimental conditions and main results obtained are presented in table 2 and the influence of discharge power on the deviation of height for different thicknesses is shown in fig. 6 and fig. 7.

Fig. 8 and fig. 9 show influence the number of whirls at different values of discharge energy.

In the case of brass material with a thickness of 0.5 mm and 0.15 mm but increase energy discharge from a total of 16 whirls leads to a significant decrease in height deviation parts. At different values of discharge energy, 150 J and 600 J, increasing the number of whirls resulted in decreases almost comparable offenses if a thickness of 0.15 mm and a thickness of 0.5 mm in the case.

Table 2

Experimental conditions and results obtained from brass stamping parts

Experimental conditions	Part code							
	IIIB1	IIIB2	IIIB3	IIIB4	IIIB5	IIIB6	IIIB7	IIIB8
Thickness g, [mm]	0,15	0,5	0,15	0,5	0,15	0,5	0,15	0,5
Discharge energy, [J]	150	150	150	150	600	600	600	600
Whirls number of coil	16	16	26	26	16	16	26	26
Deviation from the height of the piece, [mm]	**2,67**	**2,15**	**2,11**	**2,92**	**0,61**	**0,43**	**0,38**	**0,29**

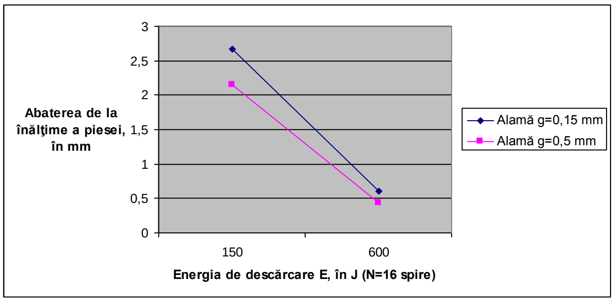


Fig. 6. Influence of discharge power on the deviation from the height of the piece

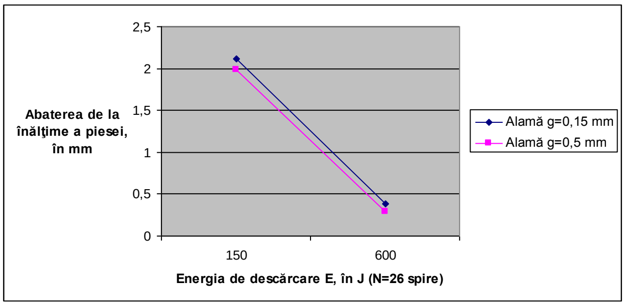


Fig. 7. Influence of discharge power on the deviation from the height of the piece

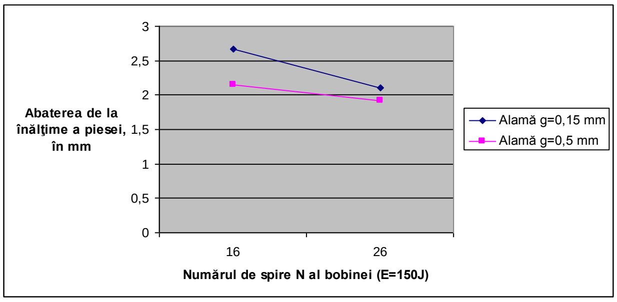


Fig. 8. Influence of the number of whirls on the deviation from the height of the piece

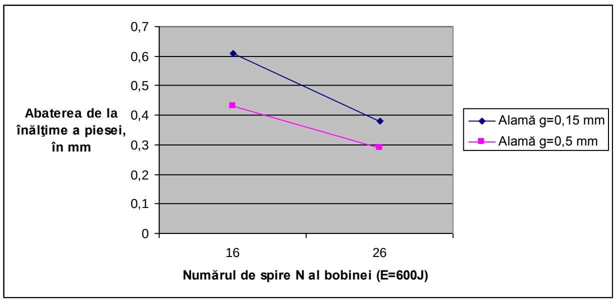


Fig. 9. Influence of the number of whirls on the deviation from the height of the piece

For copper discharge energy increase leads to decrease deviation from the height of the piece with comparable values for the two thicknesses of 0.25 mm and 0.4 mm used. The same observation can be drawn and where the influence of the number of whirls on the deviation from the height of the piece respectively influence discharge energy.

Experimental conditions and results for copper are shown in table 3 and fig. 10 shows the influence of discharge power on the deviation from the height of the piece obtained. Influence of the number of whirls on the deviation from the height of the piece is shown in fig. 11.

Table 3

Experimental conditions and results obtained on copper stamping parts

Experimental conditions	Part code							
	IIIC1	IIIC2	IIIC3	IIIC4	IIIC5	IIIC6	IIIC7	IIIC8
Thickness g, [mm]	0,25	0,4	0,25	0,4	0,25	0,4	0,25	0,4
Discharge energy, [J]	150	150	150	150	600	600	600	600
Whirls number of coil	16	16	26	26	16	16	26	26
Deviation from the height of the piece, [mm]	**0,15**	**0,2**	**0**	**0,1**	**0**	**0,1**	*****	**0**

*irrelevant

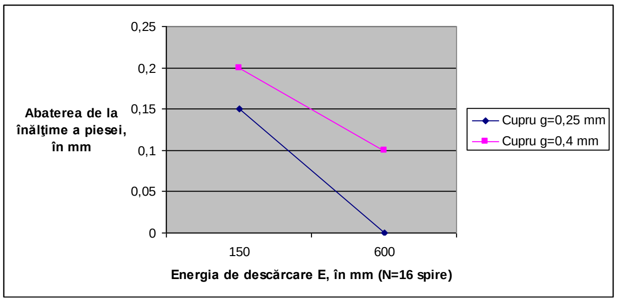


Fig. 10.Influence of dischargepower on thedeviationfromtheheight of thepiece

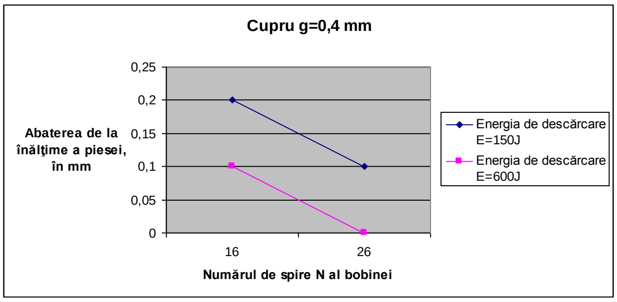


Fig. 11.Influence of the number of whirls on the deviation from the height of the piece

CONCLUSIONS

In case of aluminum is a significant decrease of the deviation from height if a sample with 0.15 mm thickness and a decrease in reduced when using a 0.15 mm thick of material. In case of brass material discharge energy increase leads to a significant decrease in the deviation from the height of parts. At different values of discharge energy, 150 J and 600 J, increasing the number of whirls resulted in decreases almost comparable offense so if a thickness of 0.15 mm and a thickness of 0.5 mm in the case. In the case of copper discharge energy increase leads to decrease deviation from height part with comparable values for the two thicknesses of material used, the 0.25 mm and 0.4 mm. The same observation can be drawn and in the influence of the number of whirls on the deviation from the height of the piece for the two values of the discharge energy of 150 J and 600 J.

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