Journal for Technology of Plasticity, Vol. 25 (2000), Number 1-2

THE TRANSPORTATION OF PARTS IN THE FORGING SHOP BY CONTROLED THROWING

Šebo D., Králiková R., Vargová J.
Technical University of Košice, Faculty of Mechanical Engineering – Department of Environmental Studies and Process Control

ABSTRACT

The robototechnology development, scanning and controlling technique as well enable the application of the equipment that was patented in Slovakia under N. 275514/92 for transport of objects by throwing mainly for interoperation transport by extreme technologies working for example with incandescent objects. The short moment of the contact of an object with tongs or grip does not allow contact transfer of heat penetration, heat radiation. This is how to protect the equipment against overheating. However the manipulating operation is very fast so the objects are not getting cold too much.

1. INTRODUCTION

In the old forging shops and mills there have been often transported from workstation to the other workstation incandescent objects with tongs the way a forger had made annular motion and threw the object. Than the other forger could easily catch it or he skilfully threw it on the following technology operation.

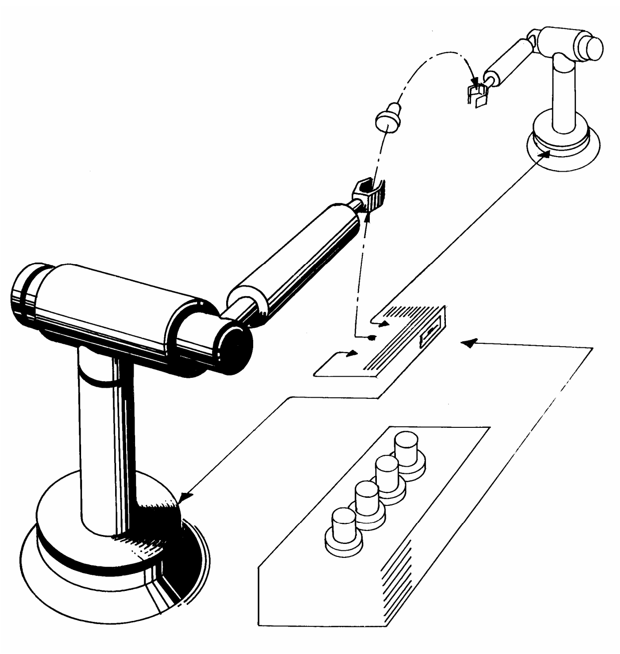

Fig.1 The transportation of parts by throwing

2. DEFINITION OF THE PROBLEM

The idea of transportation by throwing is shown on the Fig.1. Throwing robot according to designed conception there is on the vertical turning stanchion horizontally and rotary imbedded vertical arm with linear element and grip, Fig.2. The jaw of a grip yawns by the circle motion of the arm upward in certain moment and throws a part that will be caught by robot of similar construction. The fly of projected part is controlled by the regularity of oblique throw; slightly copying ballistic curve and the length of throwing depends on kinematics conditions of throwing. By constant values it does not depend on the weight of a part.

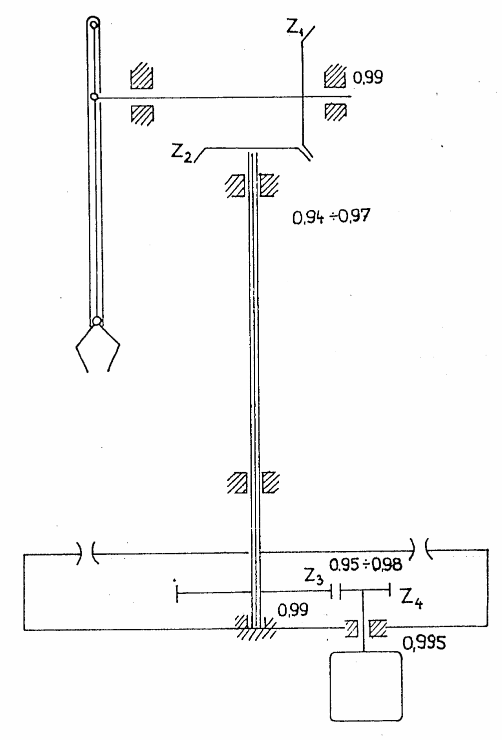

Fig.2 Kinematic scheme of the robot

3. CALCULATION OF THROWING CHARACTERISTICS

The definition of characteristics of throwing for given distance is possible to determine on the basis of following example. There are given radius r_1 and r_2 of the arms of robots and the distance between axes of robot's stanchions l', Fig. 3.

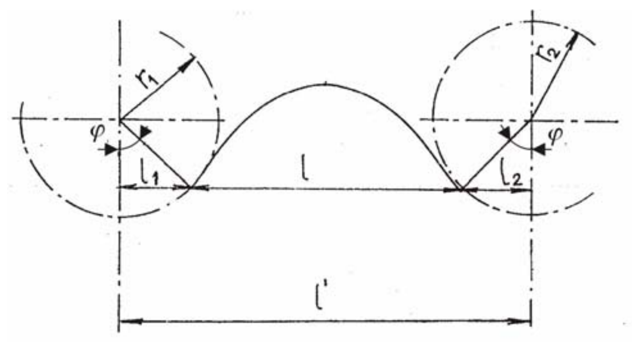

Fig.3 Distance of robot's stanchions

Turning of the arms is in time of throwing and catching constant angular velocity. The task is to find values for speed and revolution of arm of robot by throwing an object. By the calculation use the relation (1).

$$v_0 = \sqrt{g.\frac{l}{sin\, 2\varphi}} \tag{1}$$

There are given:

Radius of arms of robot:	$r_1 = r_2 = 0{,}5$ m
Distance of axes of robot's stanchions:	l = 3m
Angle of throwing and catching of a part:	$\varphi_1 = \varphi_2 = 30^0$
$g = 9{,}81\ m.s^{-2}$	

$$\begin{aligned} &l_1 = r_1.sin\varphi_1.30^0 \\ &l_0 = l_2 = 0{,}25m \\ &l = l^{''} - (l_1 + l_2) \\ &l = 3 - (0{,}25 + 0{,}25) \\ &l = 2{,}5m \end{aligned} \tag{2}$$

$$\begin{aligned} &v_0 = \sqrt{g.\frac{l}{sin\ 2\varphi}} \\ &v_0 = \sqrt{9{,}81.\frac{2{,}5}{sin\ 60^0}} \\ &v_0 = \sqrt{28{,}3190307} \\ &v_0 = 5{,}32156\ m.s^{-1} \end{aligned} \tag{3}$$

$$\begin{aligned} &v_0 = \omega.r \\ &\omega = \frac{v}{r} \\ &\omega = \frac{5{,}32}{0{,}5} \\ &\omega = 10{,}64.s^{-1} \end{aligned} \tag{4}$$

$$\begin{aligned} &n = \frac{60}{2.\pi}.\omega \\ &n = \frac{30}{3{,}14}.10{,}64 \\ &n = 101{,}6\ min. \end{aligned} \tag{5}$$

For example there is a view of parameters v, ω, n in relation of the throwing angle change according to concrete distance of robot's stanchion axes (2, 3 and 4 m) is shown in Tab. 1.

Tab.1

l´[mm]	2000			3000			4000		
φ	**v**	**ω**	**n**	**v**	**ω**	**n**	**v**	**ω**	**n**
20^0	5.03	10.06	96.12	6.37	12.74	121.6	7.47	14.9	142.7
30^0	4.12	8.24	78.76	5.32	10.64	101.6	6.3	12.6	120.3
40^0	3.56	7.12	63.03	4.74	9.48	90.6	5.68	11.4	108.6
50^0	3.57	7.14	66.95	4.76	9.49	90.61	5.69	11.4	108.6
60^0	3.58	8.27	79.08	4.92	9.88	93.91	5.96	11.9	113.8

It can be shown that the optimal values of angle of throwing and catching objects are by horizontal application of the same robots with angle 45°. By constant conditions of calculated regimes the distance of throwing does not depend on the weight of a part (by neglecting ballistic distortion of a trajectory) that was verified by practical tests. The transportation trajectories are designed for the distance of few metres; the weight of transported objects depends on construction and parameters of equipment and can vary according to needs up to tens of kilos. A laser direction finder is with advantage used for longer transport distances and parameters of throwing are tested by n-coder. The part motion shows a characteristic rotation round the centre of gravity the way of catching is designed so it will be no impact because the place of catching is in the point of common tangent of the trajectory of oblique throwing and the circle that is circumscribed with the arm of catcher. Both robots fulfill the function of manipulation mean as well and can serve to a machine or locate parts by the following operation. The robots can also work in various height, on the various floor, etc.

The advantage of described way of parts transportation by throwing is mainly in creating of conditions for energetically unpretending way of object transportation in space and specially their reliable catching, placing, selecting and etc. The transport is possible to random place or various numbers of places all this without usage of conventional transport means, transporting passive things and even with the possibility of connection of equipment into the other difficult manipulation and production operations. To double the function of throwing and catching and their parallel or serial location in the path and range of throwing enables high flexibility of throwing equipment activities and the whole manipulation system in combination with control of their exact survey and catching in various distances and heights.

4. CONCLUSION

There is shown unconventional way of transportation of objects by throwing in the forging shops and in the other plants as well. It has a lot of advantages. The most important are high rate of flexibility, low requirement on the transporting trajectories and manipulation space and economical acquisitions coming out of consolidation of service, manipulation and transportation operations. At the Department of Environmental Studies and Process Control, Mechanical Engineering Faculty, Technical University of Košice are functional models of the equipment and in present are used for disassembly according to grant project 9377 "Theory and methods of products disassembly for the needs of recycling logistics."

5. REFERENCES

1. Hodolić, J.: Integralni prilaz postprocesiranju upravljačkih informacija u sistemu za automatizovano programiranje fleksibilnih tehnoloških sistema za obradu rotacionih izradaka, Novi Sad, 1990.

2. Gatalo, R. - Klarič, R. - Hodolic, J.: Grafička sinteza ulaznih informacija u SAPOR-S programskom sistemu, Novi Sad, 1990.

3. Plančak M., Francuski P.: Analiza kombinovanog procesa sabijanja-istiskivanja, Zbornik radova Instituta za proizvodno mašinstvo, Novi Sad 1991, pp. 89-101.

4. Badida, M. – Majerník, M. – Šebo, D.: Strojárska výroba a životné prostredie. Vienala, Košice, 1998, pp. 201.

5. Zelenović D.: Projektovanje proizvodnih sistema. Naućna knjiga, Beograd 1987, pp. 324.

6. Perović M., Arsovski S.: Proizvodni sistemi. Naućna knjiga, Beograd 1989, pp. 284.

TRANSPORT DELOVA U KOVAČNICAMA POMOĆU KONTROLISANOG BACANJA

Šebo D., Králiková R., Vargová J.
Technical University of Košice, Faculty of Mechanical Engineering – Department of Environmental Studies and Process Control

REZIME

Primena robota, tehnika skeniranja i upravljanja omogućila je kreiranje uređaja (koji je patentiran u Slovačkoj pod brojem N. 275514/92) za transport objekata, pretežno između dve međuoperacije, pomoću principa bacanja.

Ovaj uređaj/postrojenje koristi se uglavnom u teškim uslovima obrade (užarani/zagrejani komadi) u kovačnicama. Kratak period kontakta između zagrejanog komada i hvatača uređaja omogućava transfer toplote na elemente uređaja a sa druge strane hlađenje radnog komada u toku transporta je minimalno.

Rad ilustruje ovu nekonvencionalnu metodu transporta radnog komada u kovačnicama kao i u drugim pogonima. Ova metoda odlikuje se sa nizom prednosti od kojih su najznačajnije: visoka fleksibilnost, ne postoje zahtevi za posebne transportne staze i sl., relativno niska cena uređaja.

Na mašinstvu fakulteta u Košicama, Slovačka izrađen je funkcionalni model uređaja, koji je u radu detaljno opisan.