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Development of the Practical and Adaptive Three Steps Die for Sheet Metal Working (part 2)

(Die Design, Making and Tryout)

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Abstract

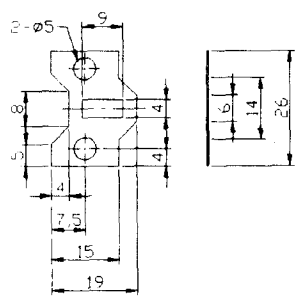
In order to prevent the defects, the optimum design of the production part, strip process layout, die design, die making and try out etc. are necessary the analysis of effective factors. For example, theory and practice of metal shearing process and it's phenomena, die structure, machine tool working for die making, die materials and it's heat treatment, metal working in field, their know how etc. are included in those factors. In this study, we analyzed whole of data base, theoretical back ground of metal working process, and then performed the progressive die tryout with the screw press. Part2 of this study reveals with ultra precision progressive die design, its making and tryout.

Key Words : Progressive die, Clearance, Strip process layout, FEM(Finite Element Method), Tryout

1.Introduction

The progressive die performs a series of fundamental sheet metal working in two or more stations(stages) during each press working for the adaptive die design and it's making has been the aim chosen by strip process layout, which includes in multi-stages. The type of this thesis used part of products is shown in Fig. 1 from ordinary product in industrial production line. Therefore, this study needs whole of press tool data, field experiences, and theoretical background.

According to upper instructions, this study could be obtained approaching the practical and adaptive die design and making, and their theoretical confidences.[1-3]



Unit : mm
Tolerance of dimension : ±0.1
Part thickness : 0.4mm
Material : BsP
Lot size : 10000

Fig.1 Production part drawing

2. Die Design

2.1 Strip Process Layout

Fig. 2 shows the strip process layout. In this layout, the layout followed the collected press die data base and practical experiences.(see part1 of this study).[4~6]

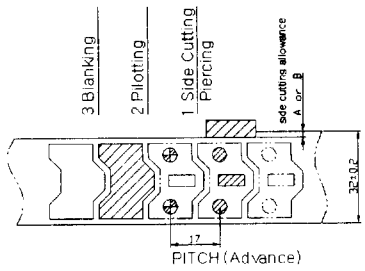


Fig.2 Strip Process Layout

2.2 Die Set and Material of Die Components

There are several kinds of die set in data base according to the industrial regularly. Some time, in especially field they make special type die set for high precision die assembling function with steels.

In this study, we considered the hand feeding of strip that causes are mass production less than 10,000 pieces of lot size of production part and necessary of accurate production part. Hence, the guide post must be installed within die shoe allowance with the fine guide bushing fit. It was selected that the die set is two guide post type for a precision working and high load of thick wide product in this experimental part. The die component materials are followed to machinability, heat treatment and harden-ability, distortion, die component life upon a press working and cost site etc.[7~9]

In this study, we considered that the die is used to less than 10000 pieces of lot size.

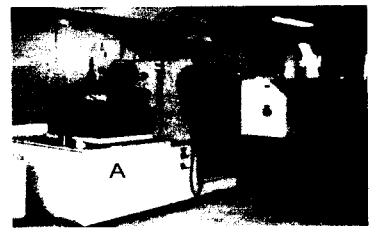
Therefore, die components materials were selected mild steel SM20C mostly except die block and a kind of punches(SKD11).

2.3 Equipments of Die Making

Punch and die block is main part in die making. In this study, We decided the size of punch and die block depending on data base, theoretical background, and experiences.

Fig. 3(a) shows the experimental wire cutting machine and CNC lathe and (b) shows the experimental surface grinding machine too.

The machining of punch and die block can belong to the precision machine tool working, raw material cutting, milling, turning, drilling, shaping, profiling, and then heat treating, electric discharge machining (EDM, WEDM), profile grinding, especially, CNC machining, and mirror machining.



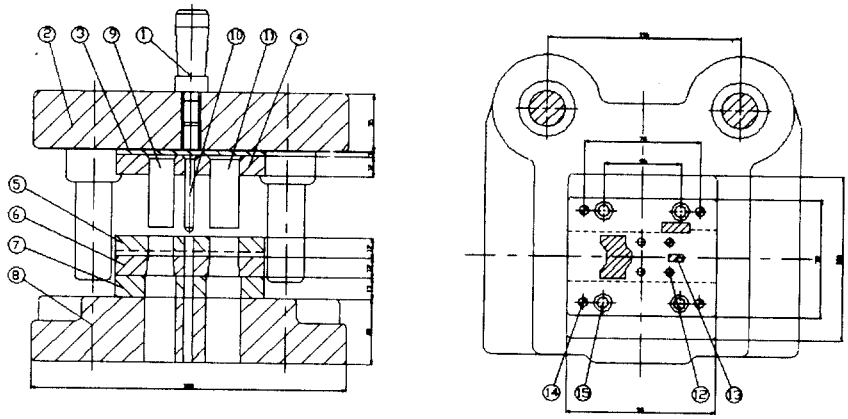
(a) Experimental Wire cutting M/C Ⓐ and CNC Lathe Ⓑ

(b) Experimental surface grinding M/C Ⓐ and Cylindrical grinding M/C Ⓑ

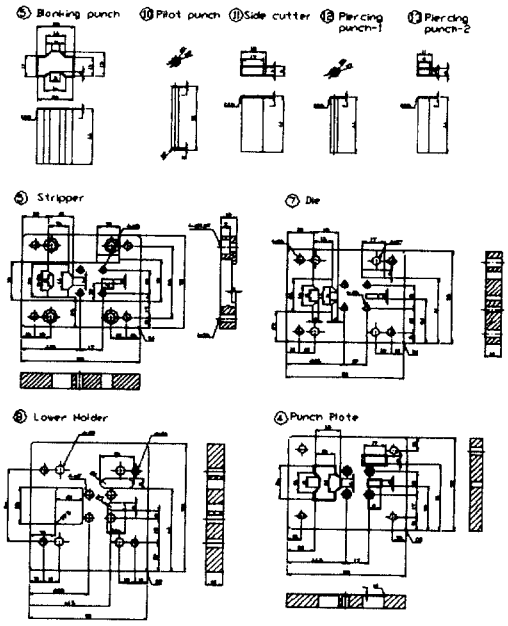
Fig. 3 Experimental machine tools

2.4 Result of Die Design

Fig. 4 shows the drawing of die design result. In the figure, we can find the best conditions of the die design database and tooling experiences in working. Especially, the fixed stripping method is effective press working for lower lot size less than 10.000 pieces through the side cutting system.



(a) Die assembling drawing



(b) Die components drawing

NO	DESCRIPTION	MATERIAL	S I Z E	MEMO	QTY
15	Bolt	Standard	M5×25		8
14	Dowel pin	STC-4	ϕ6×30		8
13	Piercing punch-2	STD-11	4×9×45	HRC60±2	1
12	Piercing punch-1	STD-11	ϕ5×45	HRC60±2	2
11	Side cut punch	STD-11	6×17×45	HRC60±2	1
10	Pilot punch	STD-11	ϕ5×50	HRC58±2	2
9	Blanking plate	STC-4	90×72×12	HRC60±2	1
8	Die set(Lower)	GC20	Standard		1
7	Lower holder	SM20C	90×100×13		1
6	Die	STD-11	90×72×12	HRC60±2	1
5	Stripper plate	SM20C	90×72×12		1
4	Punch plate	SM20C	90×72×12		1
3	Backing plate	STC-4	90×72×4		1
2	Die set(Upper)	GC20	Standard		1
1	Shank	SM20C	M16×20		1

(c) Material list

Fig.4 Drawing of die assembling and its components

3. Die Making

3.1 Die making Plan and Process

Fig. 5 shows the die making plan and process. In this figure, we can take to a notice that the whole of press die components belong to the precision machine tool working, heat treatment and fitting skills.

3.2 Tryout and Its Analysis

Fig. 6 shows the result of actual process layout die components and assembly, part of

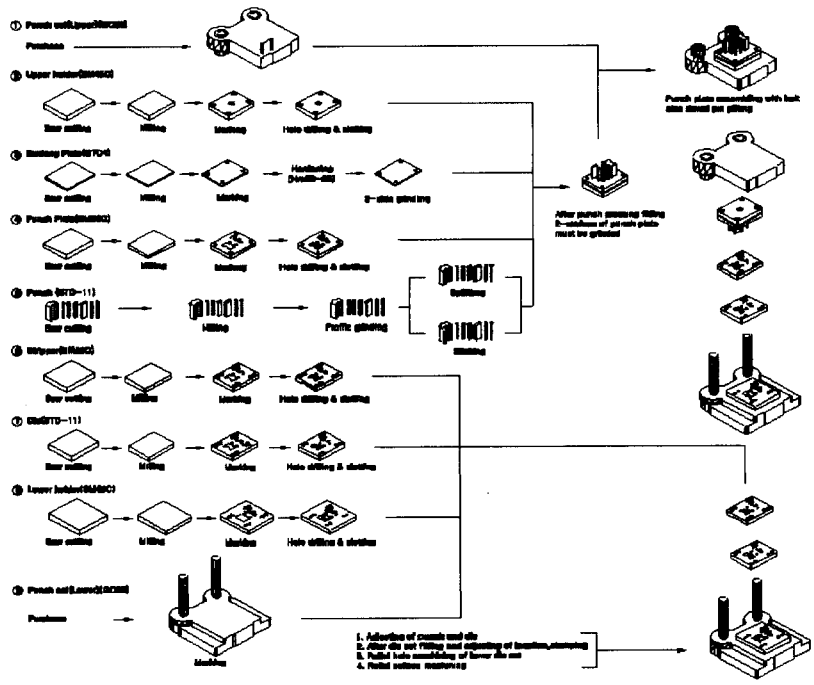
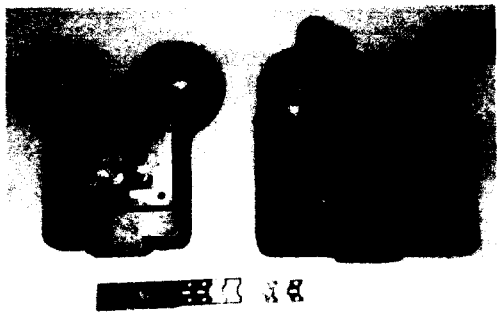
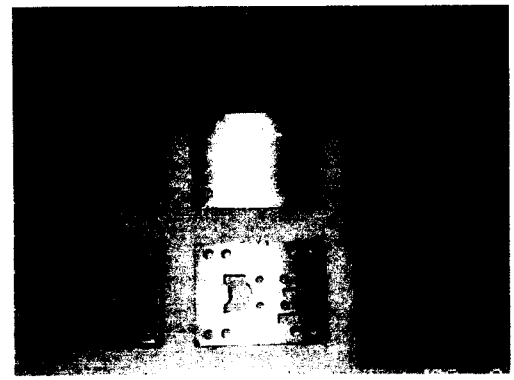


Fig.5 Experimental die making plan and process

production by tryout by photograph. In this figure, we can be known the practical and adaptive result of this experiment. The production part through the die shoe was adaptive size with accurate tolerances by assembling function. In here, it is proved that the database and tooling experiences is are suitable outputing. The checking result of part of production by tryout was so fine as its product tolerances obtained trough the precision measurement.



(a) Actual assembling die and its actual strip process layout by tryout



(b) Actual die components without die set

Fig.6 Die Assembling and Its Components

4. Conclusion

In order to prevent defects of die development for thin sheet metal working (piercing and blanking). We studied die design and making through the database analysis, tooling experiences, and then we designed the die assembly and its components.

The results and consideration of actual die making and tryout was obtained the following conclusion.

1. It is effective result that the side cutting and fixed striper type three steps die for the less than 10,000 pieces of lot size.
2. Corresponding to the actual press die tryout is no problem in the production part quality, the simulation of punch and die block's occurring stress during press working can be proved nevertheless outstanding on the site of strength exactly.
3. The development of practical and adaptive die obtained by database and tooling experiences, the reduction of lead time could be obtained too.

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