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Development of Milling Fixture by Practical and Adaptive Tooling System(Part1)

— System of Data Base, Instructions and Fixture Design —

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Key Words : Locating, Supporting, Clamping, Set block, Loading and unloading, Feeler Gauge.

Abstract : *Milling fixture is one kind of machining device according to the industrial demands for multi manufacturing products on the growing at alarming rate. In the field of design and making for machine tool working, welding, assembling with fixture for mass production is a specific division. In order to prevent the production defects, occurring, the optimum design of product, fixture putting in the field is very significant manufacturing method. They require analysis of many kinds of important factors, theory and practice of machine tool operating process and its situations, fixture and its structure, machining condition for tool making tool materials, heat treatment of fixture components, know-how and so on. In this study we designed and constructed a milling fixture of mass production and performed tryout under the AUTO CAD, database, I-DEAS and WINDOW environment. Especially part 1 of this study is reveals with the analysis of part drawing, fixture planning, fixture design etc.*

1. Introduction

The milling fixtures perform a series of fundamental machine tool working for mass production mostly of whole, of their using. Among them, the fixture is a special device that supporting, locating, and clamping are placed on a part to be machined. It is a product tool so made that it not only locates and holds the workpiece but it also guides the milling cutters as the operation is performed. milling fixtures are usually fitted with hardened steel set block for guiding milling cutter or other cutting tools.

In this paper part1, we designed one of a milling fixture also production planning peformed, So, this paper's goal is the accomplishment to optimization of small size milling fixture design and making the practical and adaptive milling fixture with a theoretical background, database, experiences, AUTO CAD, I-DEAS of software and WINDOW environment.

2. Locating System

Fig. 1 shows an object which unrestricted movement occurs. This object is free to move in any of twelve possible directions. To visualize this, the lanes have been made X-X, Y-Y, and Z-Z. The directions of movement are numbered from one to twelve.[1)]

Fig. 2 illustrates the principle of restricting movement. By placing the part on a three pin-locator base, five direction of movement(#2, #5, #1, #4, #12) are restricted. Flat bases may also be used, but these should be installed rather than machined into the base. To restrict the movement of the part around the Z-Z axis and in direction #8, two more pin-type locators are positioned. To restrict direction #7, a single, a single-pin locator is used. The remaining directions, #9, #10, #11 are restricted by using a clamping device. This 3-2-1, or 6-point locating method is the most important external locator for square or rectangular part.[1)]

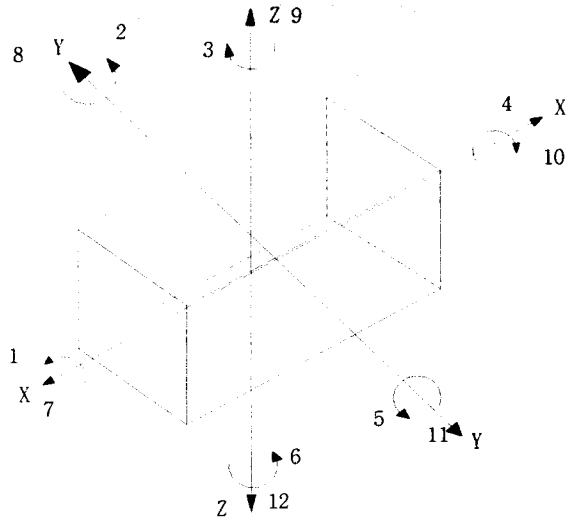


Fig. 1 planes of movement

3. Set block for milling fixture design

A common practice is to mount feeler surface permanently in the fixture base or body at a predetermined distance(3mm used in this study) below the proper cutter setting, as shown in Fig. 3. A feeler gage is then used to determine when the cutter is in correct position. This avoids damage or wear on these surfaces because they are set by the thickness of the feeler gage from the cutter[6].

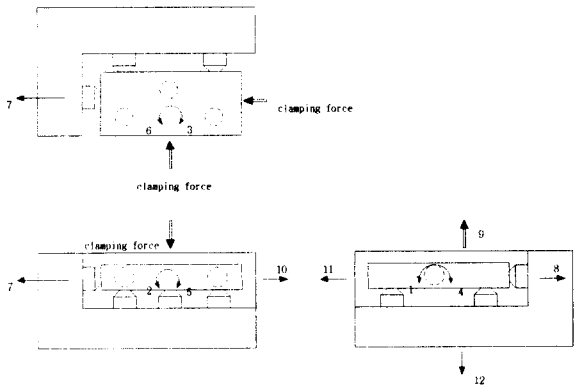


Fig. 2 Six-pin locators base restricts nine directions of movement with three kinds of clamping force.

Table 1 shows the applicated tolerances in milling fixture design. Table 2 shows the applcated fitting tolerances of representatives in milling fixture design.

Table 1 Applicated tolerances in milling fixture design

unit : 0.001mm

Purpose						Jig body	
	d	D	L	d	D	D_t	L_t
set block bushing	p6	G6	0	m5	G6	H7	+500 0
H7 hole pins	p6		0 -500	m5		H7	+500 0
Tight fitting components	p6		0 -500			H7	+500 0

Table 2 Applicated fitting tolerances of representatives in milling fixture design.

unit : 0.001mm

Size / Kind / -ness Grade		1 to 3	3 to 6	6 to 10	10 to 18	18 to 30	30 to 50	50 to 80
Shaft	p6	+16 +9	+20 +12	+24 +15	+29 +18	+35 +22	+42 +26	+51 +32
	m5	+7 +2	+9 +4	+12 +6	+15 +7	+17 +8	+20 +9	+24 +11
Hole	G6	+10 +3	+12 +4	+14 +5	+17 +6	+20 +7	+25 +9	+29 +10
	H7	+9 +0	+12 +0	+15 +0	+18 +0	+21 +0	+25 +0	+30 +0

4. Production System and Fixture Planning of Process.

Fig. 4 Shows the departmental organization in product manufacturing field. In this figure we can find the importance of tool manufacturing department.

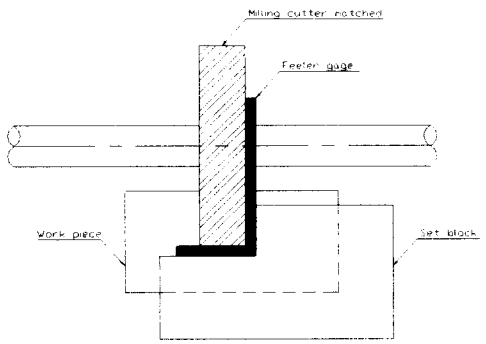


Fig. 3 Use of set block to locater milling fixture

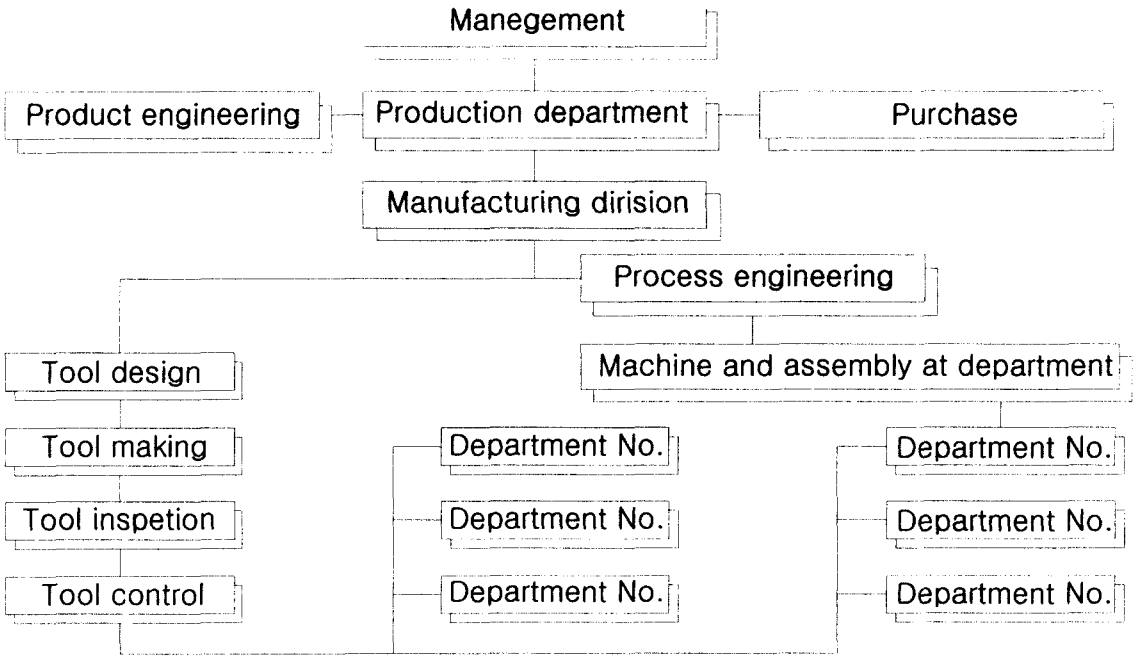


Fig. 4. Departmental organization in product manufacturing field.

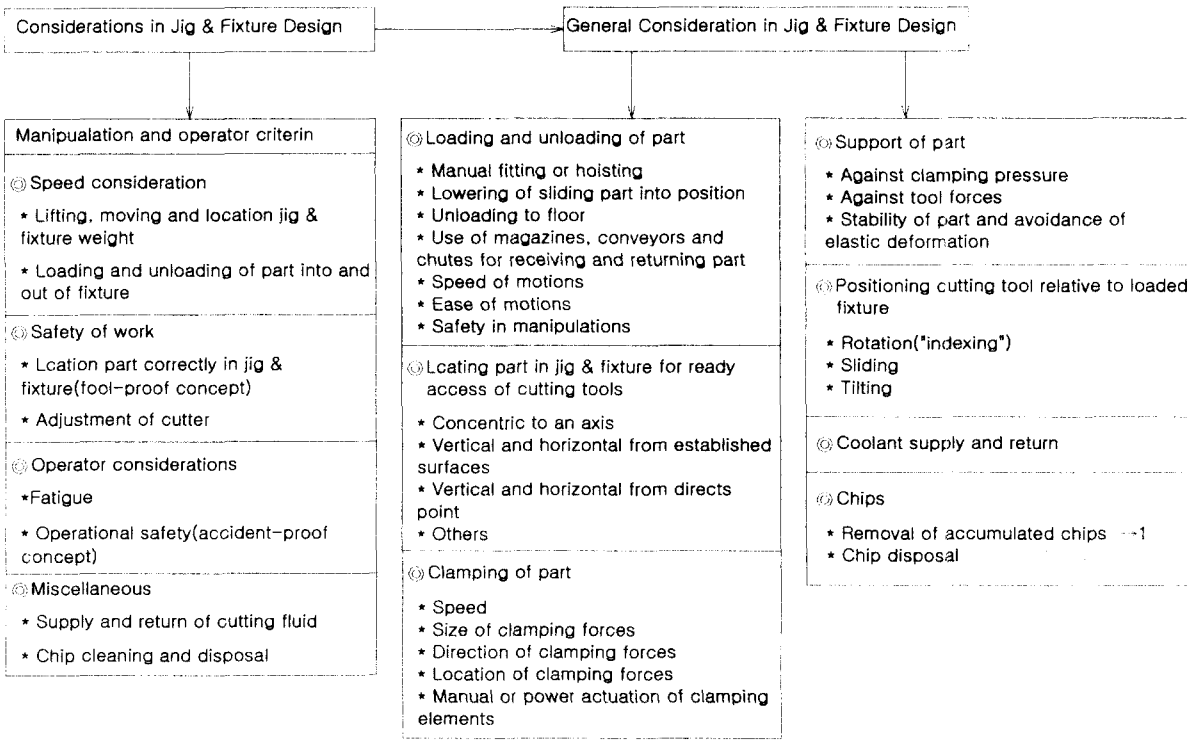


Fig. 5 Outline of consideration in jig and fixture design.

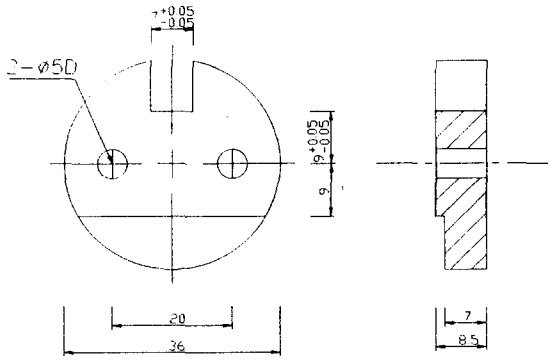
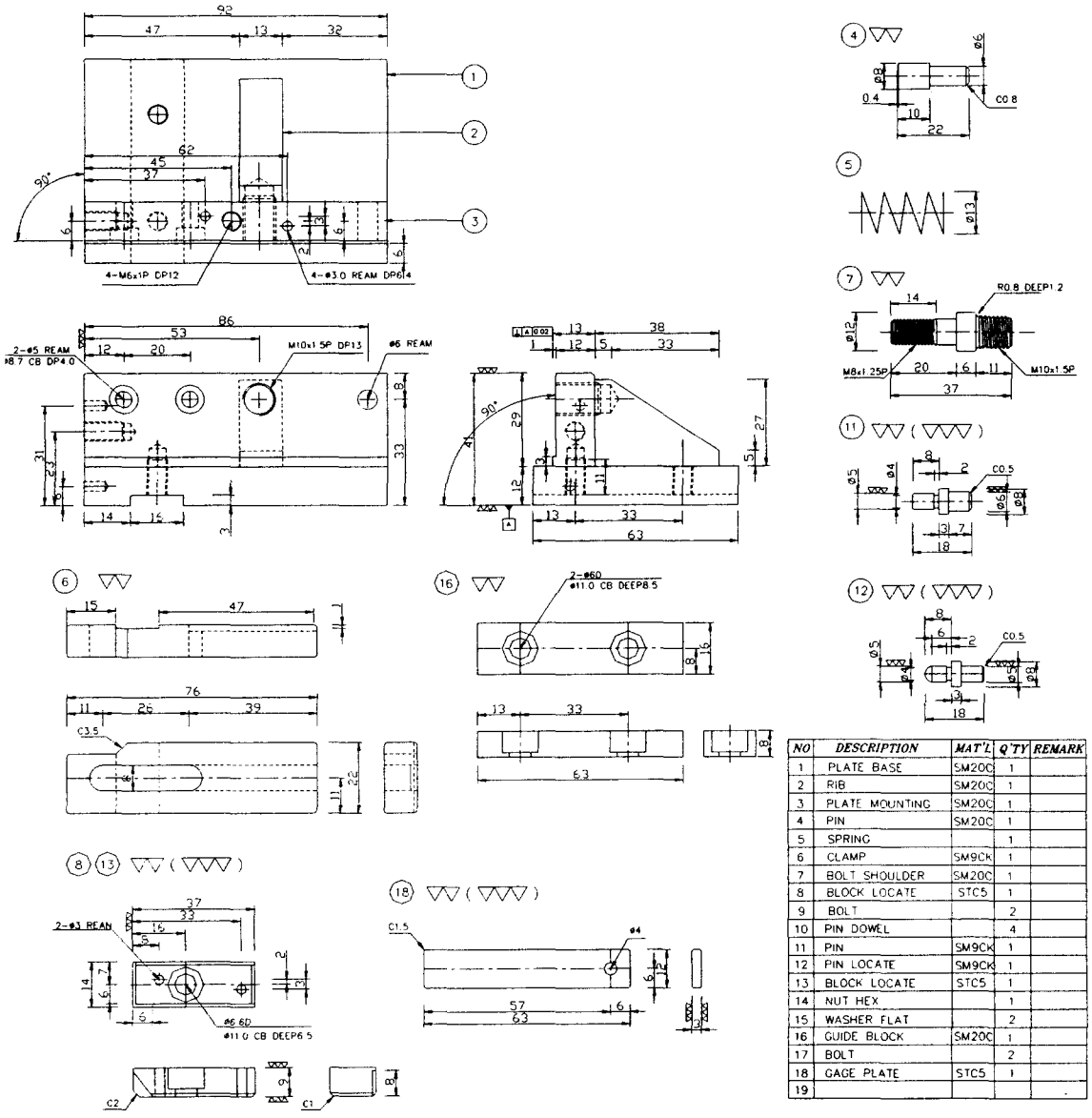


Fig. 6 Production Part Drawing



NO	DESCRIPTION	MAT'L	Q'TY	REMARK
1	PLATE BASE	SM20C	1	
2	RIB	SM20C	1	
3	PLATE MOUNTING	SM20C	1	
4	PIN	SM20C	1	
5	SPRING		1	
6	CLAMP	SM9CK	1	
7	BOLT SHOULDER	SM20C	1	
8	BLOCK LOCATE	STC5	1	
9	BOLT		2	
10	PIN DOWEL		4	
11	PIN	SM9CK	1	
12	PIN LOCATE	SM9CK	1	
13	BLOCK LOCATE	STC5	1	
14	NUT HEX		1	
15	WASHER FLAT		2	
16	GUIDE BLOCK	SM20C	1	
17	BOLT		2	
18	GAGE PLATE	STC5	1	
19				

Fig. 7 Milling fixture drawing and its material list

6. Conclusions

In order to prevent the defect of fixture design and making, this study developed the practical and adaptive milling fixture design, then its analyzing was Performed. This study could be carried out by the theoretical back ground, data base and our own field experiences.

The conclusion of this study is as follows

(1) The data base and practical experiences were available for milling fixture design.

(2) The set block and locators should be accurate in their needed necessary making tolerances.

(3) Milling fixture components accuracy in data base was effective for fixture design.

(4) 3-2-1 locating system could be transferred to pin point or plane surface suppose.

(5) Also 3-2-1 locating(6 pins locating)system was effective loading and unloading as well as accurate location for production part.

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