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DESIGN AND FABRICATE MOULD SYSTEM IN PLASTIC INJECTION MOULDING

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"I hereby the author, declare this report entitled "DESIGN AND FABRICATE MOULD SYSTEMS IN PLASTIC INJECTION MOULDING" is my own except for quotations and summaries which have been duly acknowledged"

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ABSTRACT

This project (PSM) is carried out with the purpose to design and fabricate the mould systems in plastic injection moulding. The scope of this study is to know the basic system of plastic injection moulding and how to design and fabricate mould. The basic mould system consist 3 unit which called mould clamping unit, injection unit, and controlling unit. The design of mould will be use Solidwork software. And then the fabrication process will be use CNC lathe machine.

ABSTRAK

Projek (PSM) ini dijalankan adalah untuk mereka dan membuat sistem acuan dalam acuan pancutan plastik. Skop bagi projek ini adalah untuk mengetahui sistem asas dalam peracuan pancutan plastik dan bagaimana hendak merekabentuk acuan. Sistem asas dalam peracuan pancutan plastik ini mempunyai tiga unit iaitu unit pengapit acuan, unit pancutan, dan unit kawalan. Proses merekabentuk menggunakan perisian *Solidwork*. Manakala proses membuat acuan menggunakan mesin *CNC lathe*.

CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF SYMBOL

D	Depth
W	Width
L	Length
F	Feed rate
G	Tool movement
M	Miscellaneous function
N	Block sequence number
R	Arc radius
S	Spindle speed
T	Selection of tool
X	X-axis coordinates
Y	Y-axis coordinates

LIST OF APPENDIXS

CHAPTER 1

INTRODUCTION

1.1 Background

To understand the engineering and operation of modern day injection moulding machines, it is useful to first look at the not too distant origins of the process. The first injection moulding machines were based around pressure die casting technology used for metals processing, with patents registered in the USA in the 1870's specifically for celluloid processing. Further major industrial developments did not occur until the 1920's when a series of hand operated machines were produced in Germany to process

although these machines soon became inadequate as materials became more advanced and processing requirements became more complex. The main problem with a straightforward plunger arrangement was that no melt mixing or homogenization could be readily imparted to the thermoplastic material. This was exacerbated by the poor heat transfer properties of a polymeric material.

One of the most important developments in machine design to overcome this problem, which still applies to modern processing equipment today, was the introduction to the injection barrel of a plunging helical screw arrangement. The machine subsequently became known as a 'Reciprocating Screw' injection moulding machine. [C.K Kwong / *Journal of Materials Processing Technology 63* (1997)]

1.2 Objective of the Research

The use of plastic materials and injection moulding processes to produce engineering components has been growing at a tremendous rate over the past two decades. More industries and more markets around the world are joining the move. Accompanying the growth, the advantages of the applications are greatly increased. The objective of my research is to design a new product from the plastic. And then, I will design the plastic injection mould that use to produce the product and fabricate the mould.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Mould is some kind of tool to shape a product. The product usually made from plastic material which the plastic material will melted in core and cavity. Mould size is depends on the product.

There are four types of mould:

i. Injection moulding
ii. Transfer moulding
iii. Compressor moulding
iv. Extrusion moulding

The injection moulding is a process by which the plastic material is melted and then injected into a mould cavity. Once the melted material is in the mould, it cools a shape that reflects the cavity.

The resulting form usually is a finish part, needing no other work before assembly into or use as a finished product. Many details, such as bosses ribs and screw threads can be formed during one-step injection moulding operation.

The injection moulding machine essentially consists of unit namely:

i. The mould clamping unit
ii. The injection unit
iii. Controlling unit

a) The mould clamping unit

Clamp designs in wide use today include toggle clamps, hydraulic clamps and hydro-mechanical clamps. Toggle clamps are popular on small-tonnage machines because the design in inexpensive to manufacturer. Moving the entire toggle mechanism and moving platen assembly along the tie rods do adjusting the clamp to different mould height where to the mould closes before the full toggle extension.

b) The injection unit

The injection unit melts the plastic before it is injected into the mould, then injects the melt with controlled pressure and rate into the mould. Two injection unit designs are the screw pre-plasticator or two stage unit, and reciprocating screw. A screw plasticized uses a plasticizing screw to feed melted plastic into an injection plunger.

c) Controlling unit

Controlling unit will controls the setting of operation parameters and machine settings, cooling circuit etc. Hydraulic Controlling unit serves and pushes oil to all moving parts of machine, which works, on hydraulic system and it is controlled by controlling unit.

2.1 Basic Terminology for Mould

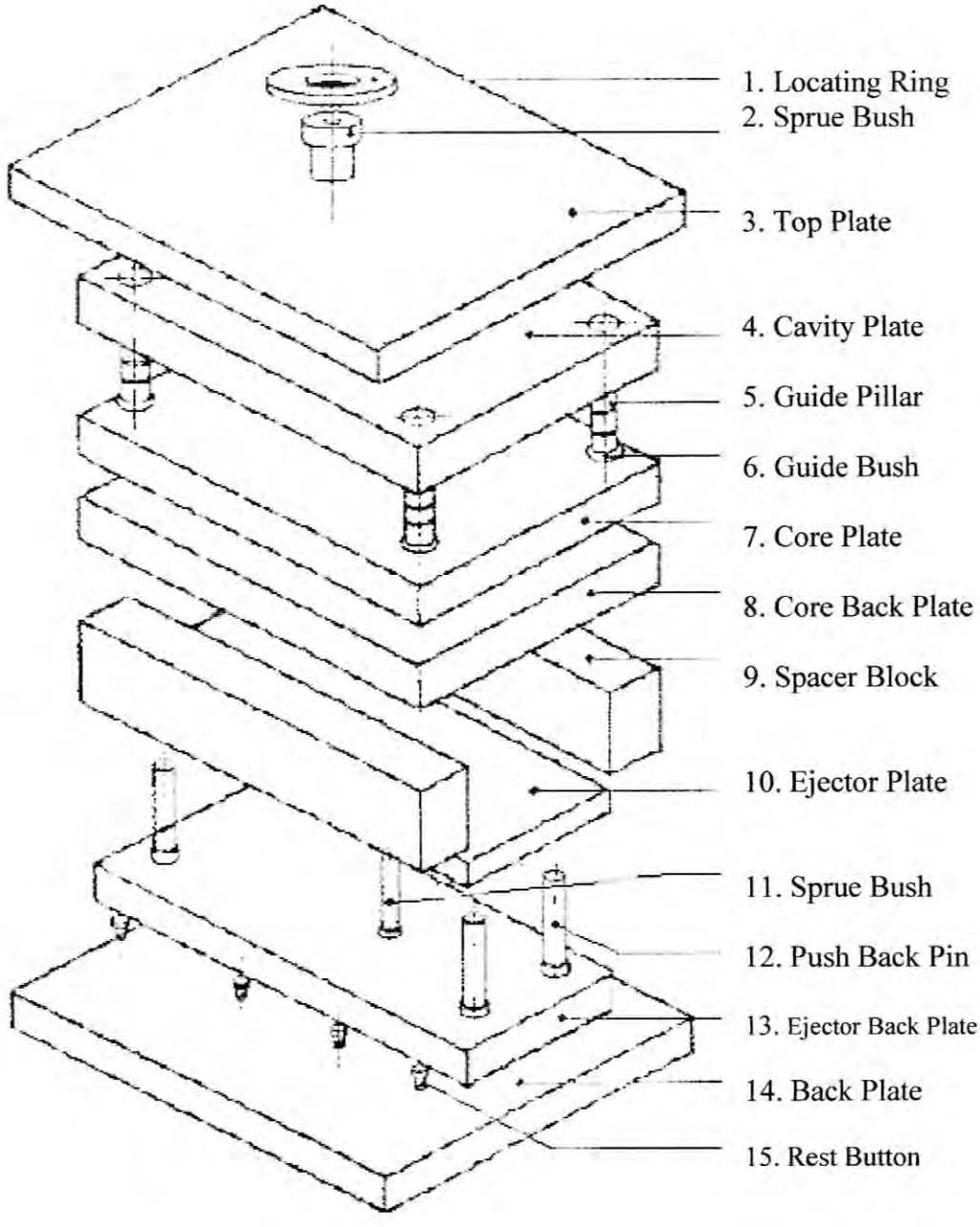

Figure 2.1: Injection Moulding Parts

2.1.1 Fixed Half and Moving Half.

A mould is generally divided into two parts:

i. Fixed half
ii. Moving half

The half that is attached to the stationery platen of the machine is termed the fixed half. The other half of the mould attached to the moving platen of the machine is known as a moving half. Generally the core is situated in the moving half for easiness of providing and ejector system.

2.1.2 Impression

The injection mould contains within in an impression into which plastic material is injected and cooled. The impression gives the moulding its form. Therefore the impression is defined as that part of the mould which imparts shape to the moulding. The impression is formed by two mould members:

i. The cavity: It is the female portion of the mould and gives the external form to the moulding.
ii. The core: It is the male portion of the mould and forms the internal shape of the moulding.

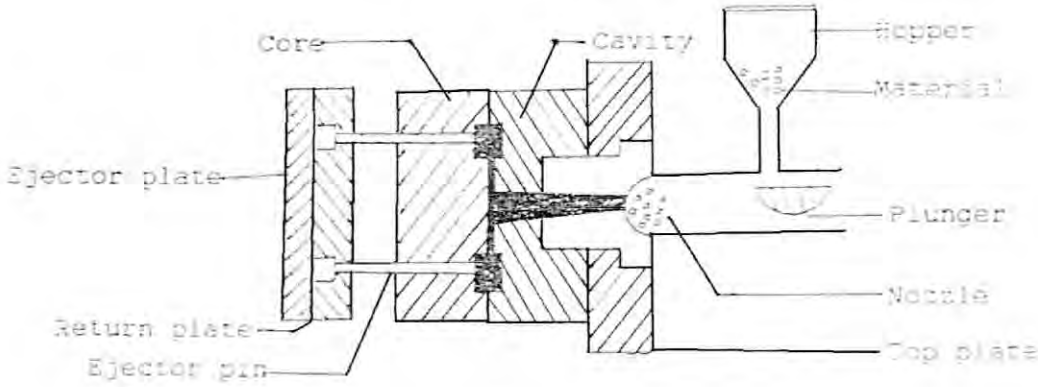

Figure 2.2: Fixed half, Moving half, Core and Cavity.

2.1.3 Cavity and Core Plate

The basic mould consists of two plates. The plate in which the cavity is formed is known as cavity plate. Similarly the plate from which a core projects is termed the core plate. When the mould is closed, the two plates come together forming a space between the cavity and core which is the impression.

2.1.4 Sprue Bush

During the injection moulding process the plastic material is delivered to the nozzle of the machine as a melt. It is then transferred to the impression through a passage. This passage is a tapered hole within a bush. The material in this passage is termed the sprue and the bush is called sprue bush. Thus, the sprue bush can be defined as the part of the mould in which the sprue is formed.

Sprue bush is the connecting member between the machine nozzle and the mould face. Sprue bush should be made from 1.5 % nickel chrome steel and should be hardened to withstand the stresses.

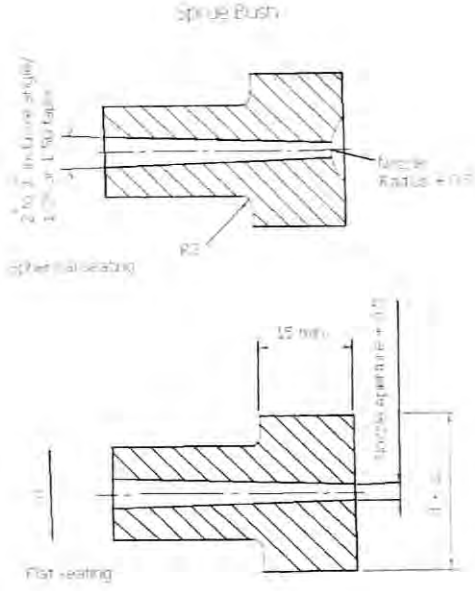

Figure 2.3: Sprue bush

The backward movement of the sprue bush is prevented by stepping the end fitting a register ring which serves a dual purpose of securing the sprue bush and mould location. The internal aperture of the sprue bush has included taper of 3° and 5° which facilities the removal of the sprue from the mould. The taper should be highly polished. There are two basic types of sprue bush:

i. Sprue bush with a spherical front ended nozzle

ii. Sprue bush with perfectly flat rear surface and corresponding nozzle used.

If the alignment between the nozzle and bush apertures is perfect a leak free joint is achieved with the spherical seating. However, misalignment result in gap and leakage occurs. But in case of a flat-faced nozzle no leakage can occur if the two aperture slightly out of line.

2.1.5 Register Ring.

The nozzle and the sprue must be correctly aligned if the material has pass without hindrance into the mould. By including a register ring the mould can be aligned to machine. The register ring is a flat circular member fitted on to the front face of the mould. Its purpose is to locate injection machine platen.

When the mould is mounted on the register ring fits into a circular hole which is accurately machined in the injection platen on the nozzle is in direct alignment with the sprue bush hole. The register ring forms a direct connection between the sprue bush and the hole in injection platen of the machine.

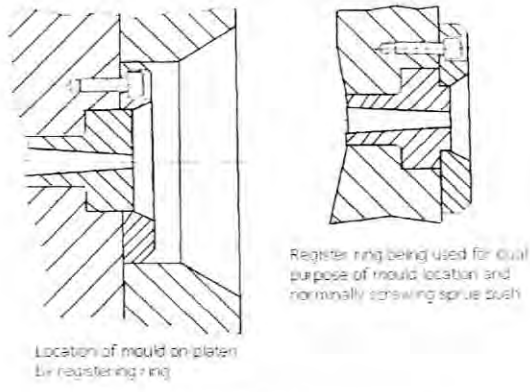

Figure 2.4: Register ring

Register ring is located the outside diameter of the sprue bush. Register ring can also be located on the stepped end sprue bush where the register ring secure the sprue bush in position. In case the mould which necessitates a long reach nozzle, the register ring cannot be located on the sprue bush.

2.1.6 Runner and Gate System.

The material can be directly injected into the impression through the sprue bush or for multi impression moulds it can be pass through a rubber and gate system before entering the system. the runner is a channel machined into the mould plate to connect the sprue with the entrance to the impression. The gate is a channel connecting the runner with the impression. It has a small cross sectional area when compared with the rest of the feed system.

2.1.7 Guide Pillars and Bushes.

To mould an even walled mould it is necessary to ensure that the cavity and core are keep in alignment. This is achieved by providing guide pillars and guide bushes on the mould plates. The guide pillar has its working diameter smaller than fitting diameter, a flange is provided on the fitting diameter side.

This step pillar has certain advantages over a constant diameter pillar. If the working diameter is bent it can be easily removed, without damaging the fitting hole. But the attempts to remove a bent constant diameter pillar will damage the fitting hole.

A guide bush is incorporated in the mould to provide a suitable wear, resisting working surface for the guide pillar and to permit replacement in the event of wear or damage.