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DESIGN AND FABRICATION OF AN INJECTION MOULDING FOR KEY CHAIN BASED ON A SURVEY

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Abstract: *The aim of the project is the design and fabrication of injection mold for producing plastic components in mass production. The project consists of product development, design, fabrication of an injection mold. This will be able to form a plastic component by the injection of the molten polymer into a closed mold, where it solidifies to give the desired shape. The project design will be done using AUTOCAD software. Then the injection mold for the development of the product will be carried out by the AUTOCAD software. Later the mold will be machined and fabricated by CNC technology with the materials selected. The fabricated mold will be tested on the injection molding machine. The component quality will be checked in the machining department.*

Keywords: *Design, Fabrication, Key chain, Injection molding.*

1.INTRODUCTION

Injection molding is a manufacturing process for producing parts by injecting material into a mold. Injection molding can be performed with a host of materials, including metals, plastics, elastomers, confections. Most commonly thermoplastics and thermosetting polymers. Material for the part is fed into a heated barrel, mixed, and forced into a mold cavity, where it cools and hardens to the configuration of the cavity. These can be used to mass-produce toys, kitchen utensils, bottle caps, and cell phone stands to name a few. Plastic molding is the process of obtaining a desired shape of plastic using the process of molding. In this process the molten plastic is poured in the die of the desired shape, corresponding to the shape of the product we need and then allowed to solidify till it solidifies and obtains its shape.

The progress of the innovations will accompany the fundamental concept of making essential goods and services openings and also improving the financial status of any organization. One of the primary results of the creation of ventures is non-degradable plastic materials, in this way their aggregation after their life or their waste produces severe ecological issues. At present the plastic utilization is more, in contrast, to use of the metallic items, owing to their simplicity in manufacturing. Overall the plastic utilization in recent years at very high rates. The most ideal way is the molds and parts creator must have decent information on the fundamental of infusion shaping procedure. It will assist them with designing for the producer also, a plan which is extremely pleasant as well as can't be made. In this part, we will take a gander at the essential hypothesis of plastic infusion forming including kind of material, item configuration, form plan, and procedure [1]. The most ideal way is the molds and parts creator must have decent information on the fundamental of infusion shaping procedure. It will assist them with designing for the producer also, a plan which is extremely pleasant as well as can't be made. The main factors that influence the cost of an injection mold are the size and intricacy of the part, the material used, and the number of parts being produced. In this part, we will take a gander at the essential hypothesis of

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plastic infusion forming including kind of material, item configuration, form plan, and procedure [2]. This flexible process permits us to harvest improved quality, simplified/complex pats manufacture on a full automat source at higher speed with the materials that have changed the face of manufacturing technologies like Polyethylene, Acrylonitrile Butadiene Styrene (ABS), Polycarbonate, High Impact Polystyrene, Polypropylene, etc. The mold surface is heated, ideally to a temperature above the glass-transition temperature (Tg) of the material, before injection, then injection starts [3] [4]. In the plastic injection molding process, molten ABS at 210 °C is injected into the mold through the sprue bushing on the cavity plate and directed into the product cavity. A two-dimensional (2D) thermal analysis is carried out to study the effect of thermal residual stress on the mold at different regions [5]. In the later years the analysis of warpage and shrinkage properties of injection-molded micro gears polymer composites using numerical simulations assisted by the Taguchi method has been presented [6]. By changing temperatures, pressures, and packing and cooling times, it is possible to mitigate shrinkage. By applying pressure to liquid plastic, you can compress the molecules into a smaller volume and then inject more material into the mold to compensate for shrinkage [7]. The location, size, and shape of the gate can have a significant effect on everything from the structural integrity to the visual appearance of a finished piece [8]. This new method is an improvement on the heuristic method developed previously by the authors because the C-space representation enables an automatic layout design system to conduct a more systematic search among all of the feasible designs. A simple genetic algorithm is implemented and integrated with the C-space representation to automatically generate candidate layout designs [9]. As it exists today, die sinker EDM is used to create complex cavity shapes in tool and die applications, such as metal stamping dies and plastic injection molds [10]. The sections of the die, which are made for forming or cutting, can be made of special metal and hardenable steel and it is also known as Tool steel [11]. Injection molding is one of the most important and efficient manufacturing techniques for polymeric materials, with the capability to manufacture high value-added products. The integration of injection molding machines into a computer integrated manufacturing (CIM) system requires reliable process monitoring allowing statistical process control (SPC) to be implemented [12]. The entire cycle of plastic product development consists of the design concept, engineering analysis of part, design, and feasibility of mold and manufacturing of mold, all these play a very important role [13]. In-process measurements, in particular melt and hydraulic pressures in the primary injection stage, are shown to provide a sensitive means of monitoring changes in the process and changes in the polymer feedstock. Correlations have been observed between real-time process measurements, in the form of specific time integrals of melt and hydraulic pressure, and product quality measures, such as product weight or dimensions [14]. Injection molding process monitoring can record data about many aspects of the process like mold temperature, screw position, cooling time have been presented [15]. To meet these objectives, makers regularly utilize each factor in turn examinations to develop models relating to autonomous procedure parameters to item quality. The models are utilized to devise iterative procedure adjustments that lead to a procedure having a sensible exchange off between process productivity and item quality [16]. These features were considered deeply in carrying our project work to develop a new key chain model using the injection molding process. The motivational factors and methodology we considered have represented.

2. MOTIVATION AND OBJECTIVES

The rule of injection molding is extremely straight forward. The plastic material is warmed-over its dissolving point, bringing about the change of the strong polymer to a liquid with a sensibly low thickness. It is then constrained into a shut form that characterizes the state of

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the article to be produced. Making shrewd and effective utilization of your materials is another key tip for improving your infusion shaping procedure and the nature of your completed item. One thing to attempt is to diminish the shot size. You're likely enticed to utilize the biggest shot size your hardware will permit, yet pause for a minute to re-evaluate. The chief bit of leeway of injection molding is the capacity to scale creation as a group. When the underlying expenses have been addressed the cost per unit during infusion formed assembling is amazingly low. The cost likewise will in general drop radically as more parts are created. The final process used to make keychains is known as injection molding. Injection molding is the process most commonly used to shape plastic. This includes not just keychains, but also water bottles, chairs, toys, and many other products. Injection molding is the most common way to mass-produce plastic products. Many promotional keychains, such as the ones you see at trade shows or fundraisers, are made using this process. These features motivated us to develop a key chain in a mass manufacturing scale. These key chains can be distributed for business promotions. A business firm can get various benefits from the use of publicity as a promotion mix. Its credibility, greater number of readers, adequate information, low cost, and greater speed of passing information are the main causes to make it important.

The objectives of the present work include:

- To understand how the injection molding process works
- To be able to identify the processes used in the creation of plastic products.
- To study the manufacturability of plastic parts
- To develop the designed key chain into the production process

3. METHODS AND METHODOLOGY

3.1. Injection molding machine

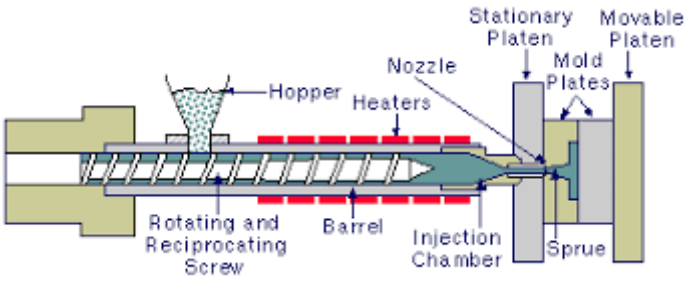

Fig. 1. Injection Moulding Machine

The injection molding machine is the machine used to make plastic accessories. In this project an automatic type in-line screw plastic injection-molding machine was used. The injection molding machine has been represented in Figure 1. An in-line screw is utilized for the molding of a high quality product with any thermoplastic material. The machine working cycle stages are shown in Figure, The injection speed is adjusted by applying a voltage between zero and ten volts to either solenoid of the proportional directional and flow control valve. A proportional pressure relief valve is used to regulate the backpressure of the injection cylinder.

The input voltage to the valve is also of range zero to ten volts to drive its solenoid. The displacement of the plasticizer screw is measured by a rotary potentiometer. The voltage output from the potentiometer is digitized by the A/D inside the embedded system and the velocity is obtained from the digitized data by a difference algorithm stored in the

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microcontroller. Any deviation from the pre-set velocity is fed to the proportional-plus-integral controller. Improving productivity at different stages means increasing the output for the same or reduced input. The entire cycle of plastic product development consists of the design concept, engineering analysis of part, design, and feasibility of mold and manufacturing of mold, all these play a very important role [12]. The controller output is sent to the solenoid of the proportional and flows control valve which regulates the oil flow.

3.2. The Control System

The control arrangement of the Plastic infusion shaping machine framed by electric transfers and exchanging valves has numerous deficiencies, for example, intricacy wiring, low control exactness, bother support, and absence of adaptability. The block diagram is shown in Figure 2, which comprised of the main control unit i.e. Basic X microcontroller and other peripheral devices. The screw displacement and the cylinder backpressure are measured by a potentiometer through a rack and pinion assembly and a pressure transducer coupled with an amplifier, respectively. The two analog signals are digitized by the 10-bit A/D converter which is inside the microcontroller.

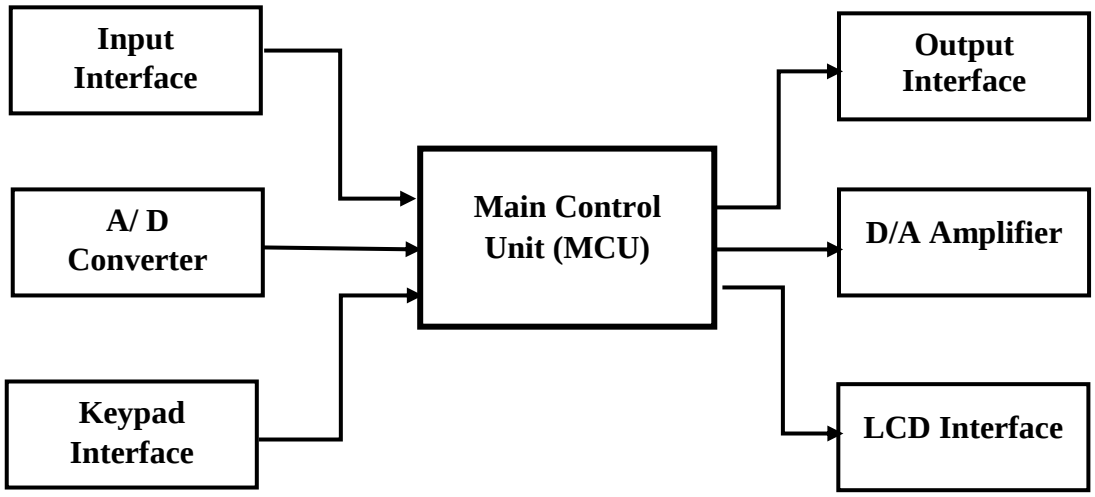

Fig. 2. Input and Output Interface

3.3 Die Making Process Components

Chart Die making (TDM) industry, due date reliability and product time to market have been identified as key success factors for global competitiveness by past researchers. Customers demand customized quality products at less cost and fast delivery. Hence there is a need for firms in the TDM industry to increase their flexibility and speed. The flow chart for the process is shown in Figure 3. The main components for die In a hole toolsets are:

Die Block:-This is the main part that all the other parts are attached to.
Punch Plate:-This part holds and supports the different punches in place.
Blank Punch:-This part along with the blank die produces the blanked part.
Pierce Punch:-This part along with the pierce die removes parts from the blanked finished part. **Stripper Plate:-**This is used to hold the material down on the blank/pierce die and strip the material of the punches.

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Pilot:-This will help to place the sheet accurately for the next stage of operation.

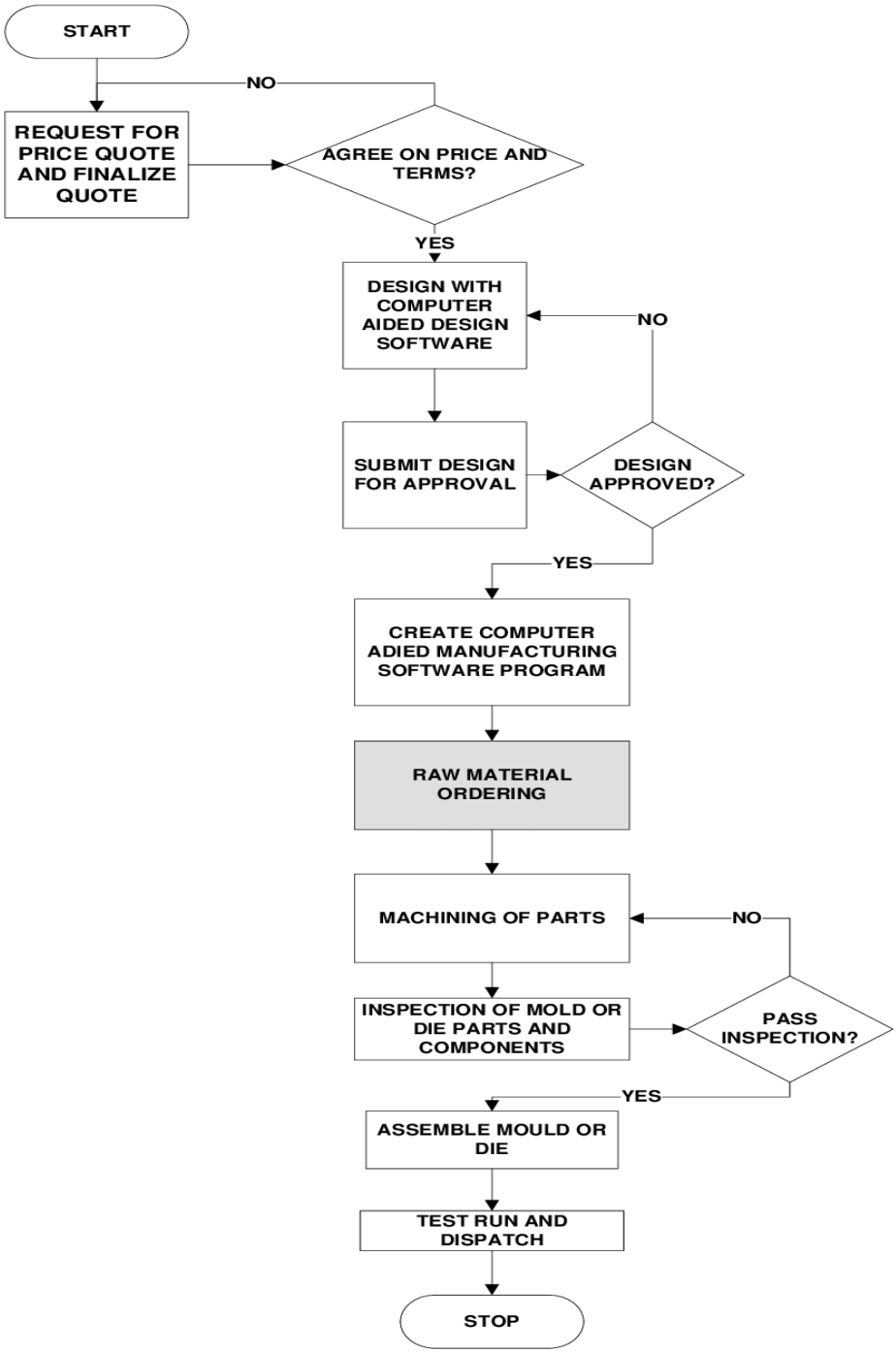

Fig. 3. Flow chart for the Process

3.4. Material selection for the present Die making Process

EN 24 Steel: It is the combination of carbon, silicon, manganese, nickel, sulfur, chromium, molybdenum, Phosphorous. It is a very high strength steel alloy which is supplied hardened and tempered. The grade is a nickel-chromium-molybdenum combination – this offers high tensile steel strength, with good ductility and wear resistance characteristics. With relatively

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good impact properties at low temperatures, EN24 is also suitable for a variety of elevated temperature applications. The chemical composition of EN 24 Steel is listed in Table 1. The salient features for this material selection include very high strength steel alloy, easy to heat treat and temper, supplied hardened & tempered, and a good combination of strength, ductility and wear resistance features.

Table 1. Chemical Composition of EN 24 Material

	Manganese	Silicon	Phosphorous	Sulphur	Molybdenum	Chromium	Nickel	Carbon
Min.	0.45	0.10	-	-	0.20	1.00	1.30	0.36
Max.	0.70	0.35	0.035	0.04	0.35	1.40	1.70	0.44

4. DESIGN AND FABRICATION

4.1 Design

Computer-aided design (CAD) is the use of computers (or workstations) to aid in the creation, modification, analysis, or optimization of a design. It is possible to reduce considerably the costs involved in the design of molds and the establishment of ideal molding conditions by using modern computer-aided design (CAD) developed specifically for injection and transfer molding tools.

- CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database Example: 3D CAD model for manufacturing.
- CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term CADD (for Computer-Aided Design and Drafting) is also used.
- Its use in designing electronic systems is known as electronic design automation (EDA). In mechanical design it is known as mechanical design automation (MDA) or computer-aided drafting (CAD), which includes the process of creating a technical drawing with the use of computer software.
- CAD software for mechanical design uses either vector-based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects. However, it involves more than just shapes. As in the manual drafting of technical and engineering drawings, the output of CAD must convey information, such as materials, processes, dimensions, and tolerances, according to application-specific conventions. CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three dimensional (3D) space.
- CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising, and technical manuals, often called DCC digital content creation. The modern ubiquity and power of computers mean that even perfume bottles and shampoo dispensers are designed using techniques unheard of by engineers of the 1960s. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry, computer graphics (both hardware and software), and discrete differential geometry.
- The design of geometric models for object shapes, in particular, is occasionally called computer-aided geometric design (CAGD).

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Work in an intuitive environment to create and try out different forming shape options. Select your preferred forming shapes to compose our strip layout. Perform automated blank calculation or user-controlled flattening on the entire part or specific sections of it. Eliminate hours of manual work using Auto Blank on Binder to unfold freeform shapes onto a 3D geometry. Utilize special geometric tools incorporating spring back compensation calculations for straight lines, edge cuttings, circles, extrude parts, the distance between the angle of gear teeth, and other forming operations. Work the way that best fits your needs with powerful solid, surface, and wireframe functions. Use built-in Finite Element Analysis tools to perform real-time thinning and safety zone analysis; on-screen indicators provide real-time curvature maps, draft angle analysis, and other input required for force calculation. Save time and eliminate errors by automatically transferring the information created in the forming phase to the die tool design environment. The front view (FV) of the designed key chain is shown in Figure 4.

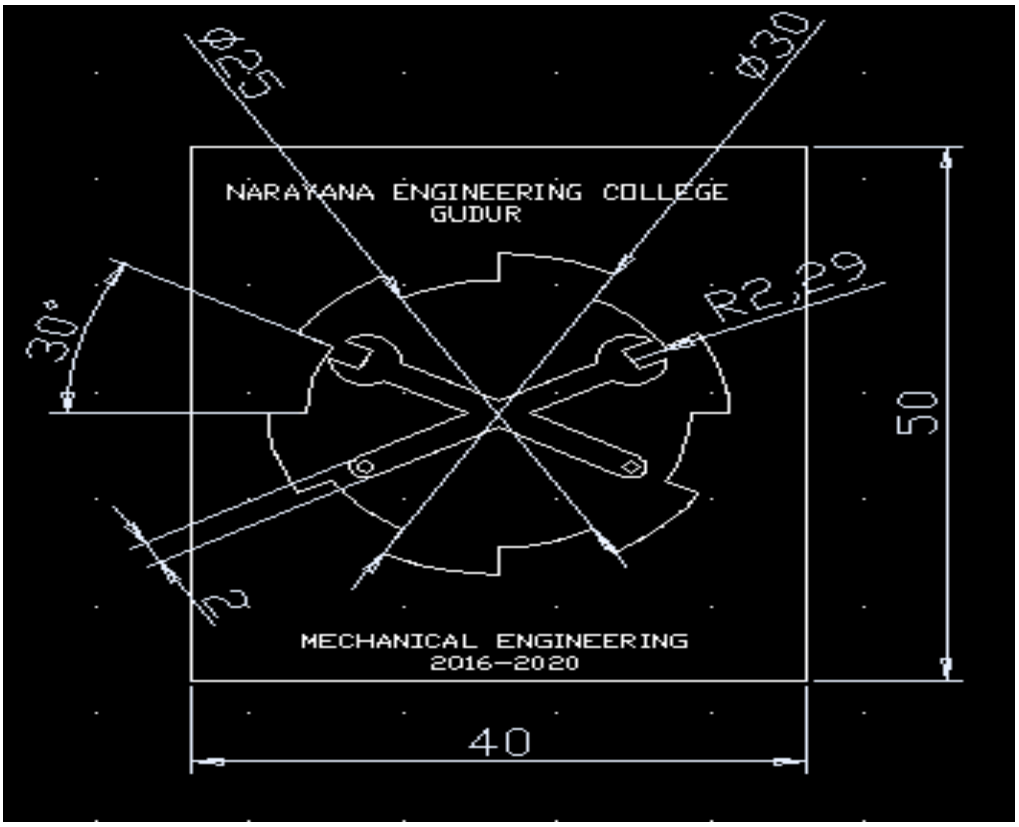

Fig. 4. Front view of key chain Designed.

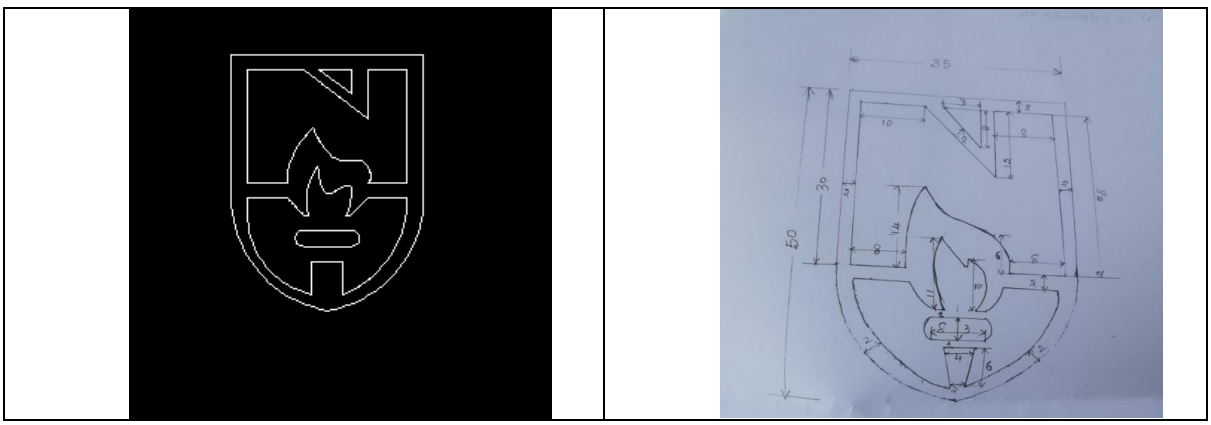

Fig. 5.1 (a). Key Chain Rear View in 2D	**Fig. 5.1 (b).** Key Chain Rear View in 2D (Art

Fig. 5. Key chain Rear View Design

Designers used to work in 2D will enjoy the layout Design environment, offering a similar 2D working experience with additional productivity-enhancing features. This also Creates and relocate radius, angels, spline curves, and arcs it may two or three-point arcs are required.

5. CONCLUSIONS

We have concluded that the usage of the designing component in the injection molding machine is very simple, fast, accurate, and easy to use. The machines are primarily meant for the lowest energy cost, extreme reproducibility, narrow processing window for the thin-walled component in engineering polymers, prolonged accuracy, and instant repeatability, high uptime, smaller short size utilization, low emission, etc. As the injection molding technology is now living it is the most rapid development time. The process in the production of plastic items involving intricate shapes and vast production of identical items.

- The problem of the design of the key chain layout in multiple die injection molds has received relatively little attention in the computer-aided design support system for injection molding. A computer-based design system will offer great savings in time and cost in arriving at the possible layout from several alternatives.
- The development of a key chain Layout Design System is believed to be the first attempt in this direction using a knowledge-based approach. The key chain Layout Design System for injection molding is accomplished using CLIPS, and the designed mold is modeled in AUTOCAD.

Injection molding is an extraordinary innovation for completed creation for a monstrous scope. It is additionally valuable for finished models that are utilized for shoppers as well as item testing. Infusion forming is an amazingly helpful instrument for mass-delivering polymer parts once the parameters for its optimal activity have been found out.

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