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Design and Modification of Washer Die

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***Abstract*: A washer is a thin plate which is used to distribute the load of a threaded fastener, as a screw or nut. In automotive engine component is made up of split or spring lock washer in which washer is used. At a one-point ring split which bent into helical shape. The benefit of spring lock washers lies in the trapezoidal shape of the washer prevents from loosening. The steel washer is a critical safety component for automobile engine and its failure may cause severe safety issue. The washer undergoes different process lines Wire Rod, Drawing, Annealing, Pickling, Flattening, Spring Washer, Single Spring Washer before subjecting to manufacturing. To find out the metallurgical soundness and surface quality of the washer after manufacturing of washer toughness test is done.**

***Keywords*: Blanking, D2, Washer Special, Tool**

1. Introduction

A washer die performs a series of fundamental sheet metal operations at two or more stations during each press stroke in order to develop a work piece as the strip stock moves through the die. The work piece on progressive dies travels from one station to another, with separate operations being performed at each station. Usually the work piece is retained in the stroke until it reaches the final station, which cuts off the finished piece. At different points along the work strip, which advances on station at each stroke of ram all station work simultaneously. Thus a complete part is produced with each stroke. Generally progressive dies include blanking and piercing operations but a complicated progressive die can do the operation of bending, forming, curling and heading also. Each workstation performs one or more distinct die operation, but the scrip must move from the first through each succeeding station to produce a complete part. One or more idle station incorporated in the die, not to perform work on the metal but to locate the strip, to facilitate inter station strip travel, the operation performed in a progressive die could be done individual dies as separate operations but would require individual feeding and producing.

A. Problem statement

Following are some problems that's we find in a die operation.

The previous design for die and punch are less efficient. In previous manufacturing four strokes operations manufacturing one component three press machine required.

- For operating four machines four workers required.
- The cycle time for product increased.
- More space required in workshop.
- Required for final product.
- Due to this Electricity consumption increases.
- Because of this cost of product increases.

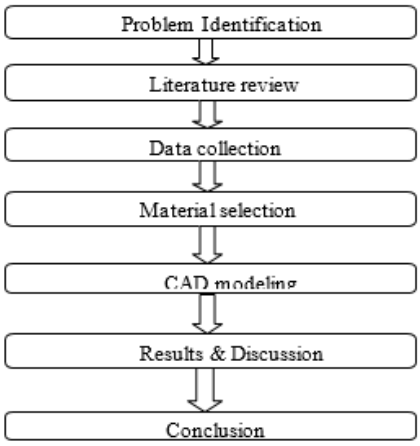
B. Objectives

- To reduce the cycle time for production.
- To use workspace more efficiently.
- To decrease no. of workers required hence reduce human error.
- To use press machine more effectively.
- To increase the production.
- To reduce the cost of the product.

C. Scope of project

- The technique of combining the two or more die effect in one die will very effective in producing compound or progressive dies in future.
- This technique is very easy to execute and more efficient in case of large production.
- It is very simple technique to reduce cost of product, time period and excessive man power used in production.
- By using such combination dies, we can have done more than operation at one press machine in one stroke results in energy consumption and extra press machines.

D. Methodology



2. Literature review

S. S. Chikshe [1] Manufacturing of Washer is accompanied by two types of press tool operation namely blanking, piercing. It is a metal stamping operation in which the sheet metal is punched to get the needed outer profile of the sheet metal component.

Dakshin Lakshmi [2] in this paper, a systematic method is presented for designing and analyzing Belleville spring washers. To model a Belleville spring washer, a slanted surface is first utilized to define the axial cross section. The solid model of the Belleville spring washer is then generated through rotating the slanted surface along its central axis.

Zhiqiang Xie [3] The paper presents an experimental investigation on the tensile behaviour and strength of self-piercing rivet (SPR) connections used in cold-formed thin-walled steel structures. The sheet thickness ratio, the sheet combination type, and the rivet length were analysed for their effects on the tensile performance of SPR connections. The research also studied the feasibility of the existing calculation method of SPR connections and the other design methods of self-tapping screw connections for the SPRs investigated herein. Based on the test results and analyses, a new design method for the tensile capacity was proposed. The test results showed that the sheet thickness ratio, the sheet combination type, and the rivet length were the key factors controlling the failure mode and the tensile capacity of SPR connections.

Pritam B. bhawar [4] At two or more workstations progressive die performs a series of operations in a single die. In sheet metal manufacturing Design and development of progressive die in important phase.

Kassahun Nigussie Asfew [5] work in a progressive press tool is designed using logo press 3 die design software for a part called receiver body which is produced in Gafat armament industry. the part is produced after passing through 22 separate working stations, 48 parts are made per day and it costs 102 birr per part in the existing system. the part is produced in one progressive die in the newly designed progressive press tool, 7200 parts are produced per day and it costs 12.23 birr per part.

Ketan Kapse, et.al. (2017) [6] This paper deals with the design of blanking die used for the manufacturing of stiffening rib. This research paper focuses on designing of various components of blanking tool, two dimensional and three dimensional modelling of components. The modelling of the components was carried out on CATIA V5. The design and selection of blanking die components is carried out by following standard die design approach. Closed die set is used for the manufacturing of stiffening rib. The guiding arrangement of plain bushing type is used for this blanking tool.

3. Calculation of die

Many variations of these formulas exits and readily available online. These variations' may often seem to be at odds with one another, but they are invariable the same formulas simplified or combined. What are presented here are the un-simplified formulas.

Punching force F= (shear stress) ×Area

Where,

F = punching force in N

C = constant (1 to 2).

t = thickness of the plate in mm.

Specification of the part

Area of blank = 17041.01mm^2

Thickness of the sheet = 2.3mm

Yield strength = 250 MPa

Young's modulus = 200 GPa

Percentage of elongation = 0.005 mm

Ultimate shear strength = 40 MPa

Factor of safety = 1.2

Hardness of mild steel = 130 HRP

A. Design calculations for blanking and piercing force

Blanking cutting load/force calculation

The blanking force or cutting force is the force required to punch a blank

This determines the capacity of the press to be used for the tool.

$F = P \times t \times \tau_{us}$

τ_{us} = ultimate shear strength of sheet (N/mm^2)

$F = P \times t \times \tau_{us}$

$F = \pi \times (32.18 \times 9) \times (7.90 \times 2) \times 2.3 \times 40$

$=1322584.218$ N/mm^2

= 135+10% of force

= 148.5 Tons

Blanking force/ cutting load = 148.5 tons

B. Press load is 160 ton selected Piercing force or cutting load calculation

The piercing is the operation of production of hole in a sheet metal by the punch and the die.

$F = P \times t \times \tau_{us}$

$F = P \times t \times f_{us}$

$F = \pi \times (10.5 \times 9) \times (7.90 \times 2) \times 2.3 \times 40$

F = 431545.50N/mm^2

F= 44 tons

F = 44+10% of force

F = 48.4 tons

C. Press load is 70 ton selected

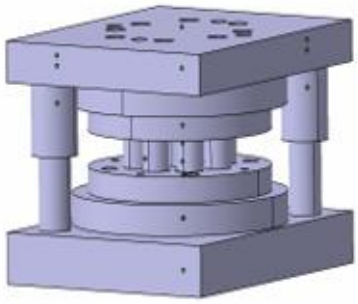


Fig. 2. Die assembly

4. Conclusion

This paper presents an overview on design and modification of washer die.

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