**Introduction**

- Gears are wheels having on its periphery, equal spaced teeth which are so designed that those wheels transmit, without slip, rotary motion smoothly and uniformly with minimum friction and wear at the mating tooth-profiles.
- Designing is done prior to manufacturing and includes calculation of the gear geometry, taking into account gear, strength, wear, characteristics of the gear teeth, material selection, gear alignment and provision for lubrication.
- The melting, pouring and solidification calculations have been considered. The material for the production has been selected to be Grey cast iron, and the casting process employed is sand casting.
- Inspection methods have also been included to check for possible defects after the casting process. These have been elaborated in details.
- The target structure after the production process should be as in the figure below;

**Aims and Objectives**

The aim of the design is to produce a part (gear) that can withstand mechanical wear and provide rotary motion with limited slip and friction at the mating tooth profiles. The cast part should have minimum defects and be machineable at the end of the casting process.

**Objectives**

1. To design a pattern for the part (camshaft timing gear).
2. To specify a mold appropriate for the production of the part.
3. To specify the casting process to be used.
4. To identify the possible defects and appropriate prevention and remedies for the defects.

**Cast Part – Applications and Design goals**

The areas where where gear systems are applicable are:

- Speed gear box,
- Feed gear box and some other kinetic units of machine tools,
- Gear boxes of automobiles,
- Timing and idler gears in automobiles and in several other machanised systems and tools.

**Design Goals**

The camshaft timing gear is to be used to transmit rotary motion with limited wear and friction. The cast part must therefore have the following properties;

- The material for the production should be castable with minimum defects.
- The mold should take minimum time in the production.
- The part must have high compressive strength and machineable after production.
- The part should have high strength to weight ratio.
- It should take a maximum of 5 hours to complete production from melting to finished product.
- The possible defects should be able to be remedied.

**Charge Calculation**

- Material.
  - The material selected is Grey cast iron. A material for a gear production should be hard, with good thermal and mechanical properties with minimum elongation and high compressive strength. A material for a gear should be machineable and castable.
  - The composition of the Grey cast Iron should fall within the following range of composition: Carbon, C=2.7% - 4%. Manganese, Mn=0.8% max, Silicon, Si=1.8% - 3%. Sulphur, S=0.07% max, Phosphorus, P=0.2% max. W=1.357kg

**Defects Discussions**

- a. Sand blow
- b. Pin holes
- c. Sand wash
- d. Scabs
- e. Penetration
- f. Mold shift
- g. Core shift
- h. Mold Crack
- i. Misrun

**Conclusions / Recommendations**

- The material chosen for the production of the timing gear was grey cast iron because it is machineable, castable and has high compressive strength.
- A horizontal gating system was designed to produce a gear blank using green sand mold and a non-pressurized gating system with a gating ratio of 1:3:3.
- One defect which can render the whole process nil is mold shift, it is recommended that proper alignment of cope and drag must be ensured.
- The heat for melting and total solidification of the part was calculated and determined. These calculations were done to ensure the production of a cast part meeting the required dimensions and accuracy.
- During the annealing process, it must be heated and soaked at about 50°C above the austenitic region. This is done to prevent overheating and burning.
- Since the component will be used, it is recommended that only NDT methods are used to determine flaws.

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