Product Knowledge Document

Gear Shifter

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INTRODUCTION

A gear stick, gearshift or shifter is a metal lever attached to the shift assembly in a manual transmission equipped automobile and is used to change gears. In an automatic transmission equipped vehicle, a similar device is known as a gear selector.

The gear shifter is normally located between the two front seats of the vehicle on a manual transmission. The gear knob is the top of the gear shifter, and includes a shift pattern that guides the gear selection. The shift pattern indicates which way the gear shifter should be moved when selecting a certain gear.

A gear stick will normally be used to change gear whilst depressing the clutch pedal with the left foot to disengage the engine from the drive train and wheels. Automatic transmission vehicles, semi-automatic transmission, and those with continuously variable transmission gearboxes do not require a clutch pedal.

STANDARDS FOR GEAR

- **ANSI/AGMA 6123-C16** - 09-29-16
- Design Manual for Enclosed Epicyclic Gear Drives -
- This standard is a design manual for drives employing epicyclic gear arrangements. It includes descriptions of epicyclic drives, nomenclature, application information and design guidelines with reference to other AGMA standards. This standard is applicable to enclosed epicyclic speed reducers and increasers which use spur and helical gears. This new standard replaces ANSI/AGMA 6123-B06
- **ISO 6336-5:2016 - 09-29-16**
  Calculation of load capacity of spur and helical gears Part 5: Strength and quality of materials -
- This standard describes contact and tooth-root stresses and gives numerical values for both limit stress numbers. It specifies requirements for material quality and heat treatment and comments on their influences on both limit stress numbers.
- This new standard replaces ISO 6336-5:2003

STANDARDS FOR GEAR

- **ANSI/AGMA 2002-C16** - 06-08-16
  Tooth Thickness and Backlash Measurement of Cylindrical Involute Gearing -
- This standard establishes the procedures for determining the specification limits for tooth thickness of external and internal cylindrical involute gearing. It includes equations and calculation procedures for the commonly used measuring methods. A specific tooth thickness specification limit can be established from the design thickness or from another tooth thickness measurement. The procedures can be used with an established design tooth thickness, or with actual tooth thickness dimensions. The effect of tooth geometric quality variations on tooth thickness dimensions is discussed. Calculations for backlash are included, and are based on the specified tooth thickness, center distance, and tolerances.

Gear Shifter System

Basic Working Principle

A knob, variously called gear knob, shift knob, gear shift knob or stick shift knob, forms the handle for the gear stick. Typically the gear knob includes a diagram of the shift pattern of the gear selection system, i.e. the positions to which the gear stick should be moved when selecting a gear. In some older manual transmission vehicles, the knob may incorporate a switch to engage an overdrive;

A knob showing the driver the position of each gear.

in some automatic transmission vehicles it may incorporate a switch to engage a special mode such as a sports mode or to disengage overdrive. Both of the above-mentioned switches may also be found on the console or on steering column stalks instead.

Basic Working Principle

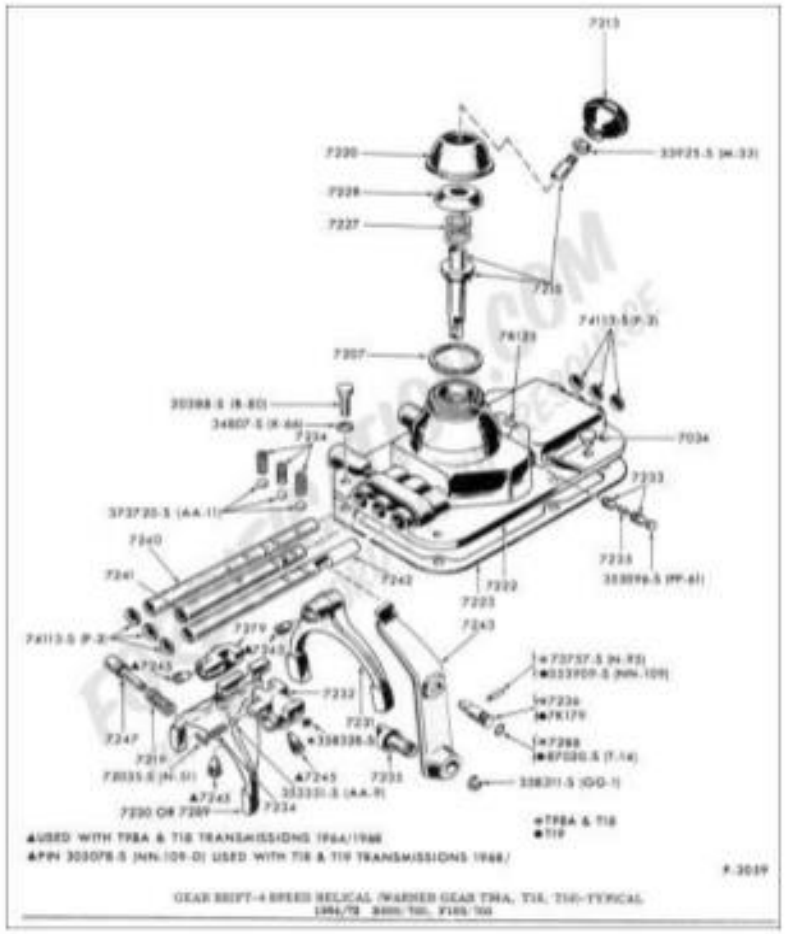
Starting the car in gear with the clutch engaged causes it to lurch forwards or backwards, since the starter motor by itself produces sufficient torque to move the whole vehicle; this can be highly dangerous, especially if the parking brake is not firmly applied and can be injurious to the starter and drive train.

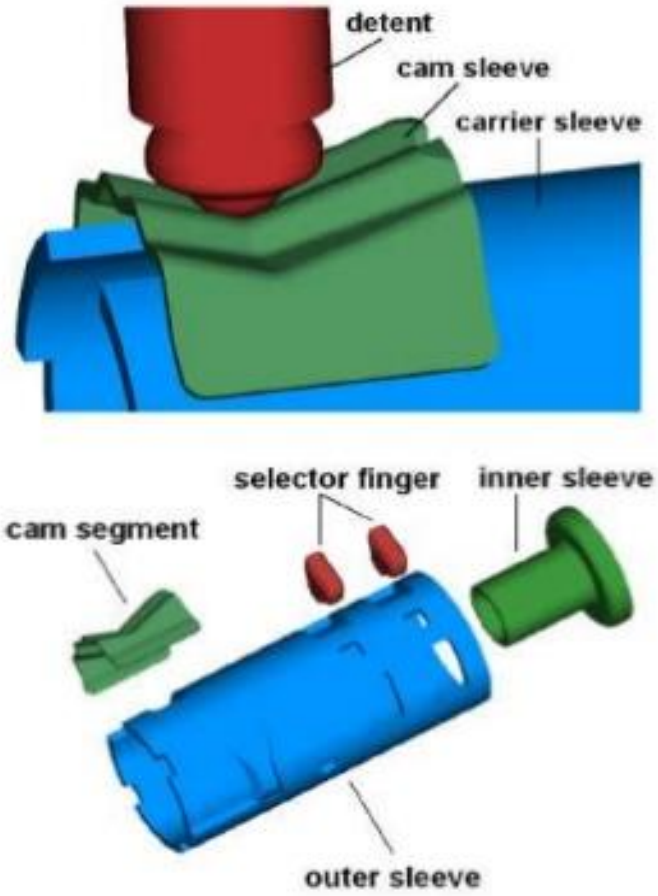
Therefore, novice drivers are taught to rock the knob of a manual gearbox from side to side before starting the engine to confirm that the gearbox is in neutral.

For the same reason, modern cars require the clutch pedal to be depressed before the starter will engage. The latter practice is also useful in extremely cold conditions or with a weak battery, as it avoids the starter motor also having to turn over a gearbox full of cold and highly viscous oil.

Basic Working Principle

Detail components of product



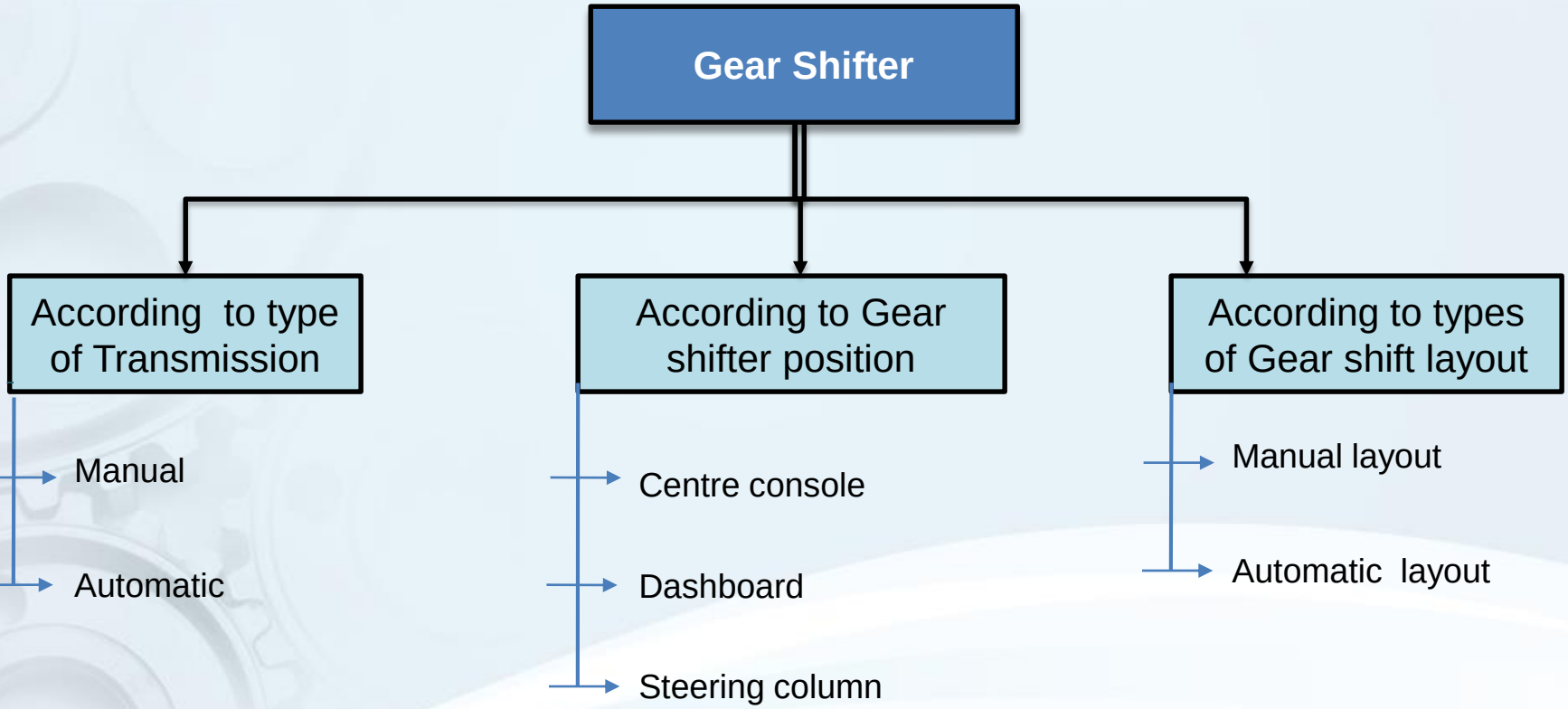


Requirements of Gear Shifter

Some of the major requirements

1. **Gears :** Steel grades - 20MnCr5A , SAE 8620, SAE 1045 etc
2. **Shafts :** Steel grade – END8
3. **Shifter Forks :** EN8D, Polymer, Investment casting
4. **Rails :** Bright bars – EN1A
5. **Transmission Casting :** Grey or S.G Iron casting
6. **To** manufacture these iron, Coke & CRCA scrap & alloying elements are used as raw materials.
7. **High** carbon steel such as 45C8, 50C4, 55C8 which are stronger, tougher and respond to heat treatment are, therefore used for gears.
8. **In** Automotive sector, gears are designed for heavy duty application and are thus made from alloy steels such as 16Mn5Cr4, 30Ni16Cr5 etc.

GEAR SHIFTER CLASSIFICATION



Gear Shifter Classification – Based on transmission

Gear Shifter Classification – Based on transmission

Manual – A typical manual transmission vehicle, with (for example) five forward gears, will thus have seven possible positions: the five forwards gears, reverse gear, and a central "neutral" position. Some vehicles have a special button to prevent accidental engagement of reverse. Others require that the lever be lifted, pressed down, or moved with extra force to engage reverse. In transmissions with reverse directly below fifth, there may be a mechanical lock-out preventing selection of reverse other than from neutral, thus preventing a driver used to a six-speed transmission from engaging reverse while trying to select sixth.

Cross Section – Manual gear shifter with 5 gear speeds

Gear Shifter Classification – Based on transmission

Automatic – Automatic transmissions traditionally have had a straight pattern, adopting the classic P-R-N-D gate, with "P" being to the front, topmost position (or "P" all the way to the left on a column mounted shifter); the corresponding shift positions being:

P = Park - transmission is mechanically locked in position for parking.

R = Reverse - reverse motion

N = Neutral - no drive applied to the wheels with the engine running

D = Drive - forward motion with full automatic operation in all gears.

More modern automatic transmissions have employed a "J-gate" (pioneered by Jaguar) where some gears are on the left-hand "arm", some on the right, and there is a sideways movement at the rear of the pattern.

Gear Shifter Classification – Based on transmission

The second generation Range Rover from 1995 used an "H-gate", with two parallel PRND gates on the opposing legs of the "H" for both high range and low range ratios, for normal and off-road driving, respectively.

Cross Section – Automatic gear shifter

Gear Shifter Classification – Based on position

Gear Shifter Classification – Based on position

Centre Console – The **center console** in an automobile refers to the control-bearing surfaces in the center of the front of the vehicle interior. The term is applied to the area beginning in the dashboard and continuing beneath it, and often merging with the transmission tunnel which runs between the front driver's and passenger's seats of many vehicles.

Traditionally, vehicles with a gear stick have placed this control where the two areas of console and tunnel merge, or at the rear-most end of the console in front-wheel-drive vehicles without transmission tunnels. In some modern vehicles – particularly vans – the gear stick is mounted in the front, more vertical part of the center console to be within better reach of the driver without requiring a long stalk mounted on the steering column.

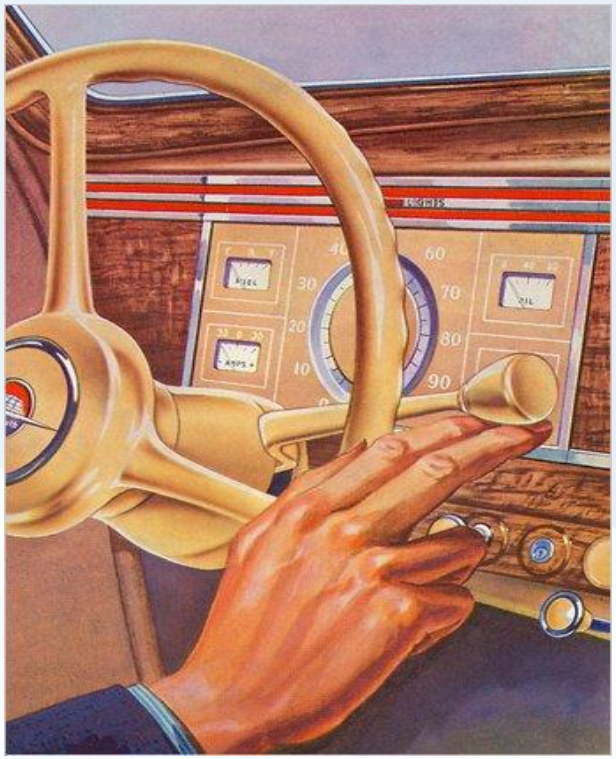
Gear Shifter Classification – Based on position

Dashboard – A **dashboard** (also called **dash**, **instrument panel (IP)**, or **fascia**) is a control panel located directly ahead of a vehicle's driver, displaying instrumentation and controls for the vehicle's operation.

Vehicles with a gear stick placed on Dashboard. This control has gear shift placed on either side of the steering Wheel.

Gear Shifter Classification – Based on position

Steering column – The automotive **steering column** is a device intended primarily for connecting the steering wheel to the steering mechanism or transferring the driver's input torque from the steering wheel.



Among the first standard equipment column shifters were those used on the 1939 Plymouth, proclaimed in sales brochures as Perfected Remote Control Shifting. Column shifters became available on Chevrolets and Fords around the same time, soon joining the list of standard equipment.

Coupled to the transmission with levers and rods, column shifters retained the relative shift movements of their floor-mounted predecessors, and “three on the tree” became the industry standard. But the column shift really came in its own as automatic transmissions became common late in the 1940s, and remained the gear changer of choice for more than 20 years.

Gear Shifter Classification – Based on layout

Gear Shifter Classification – Based on layout

Manual type –

This shift pattern is the most common five-speed shift pattern. This layout is reasonably intuitive because it starts at the upper left and works left to right, top to bottom, with reverse at the end of the sequence and toward the rear of the car.

This shift pattern is another five-speed shift pattern which can be found in Saabs, BMWs, some Audis, Eagle, Volvos, Volkswagens, Skoda's, Opel's, Hyundai's, most Renaults, some diesel Fords, most Holden/Vauxhalls and more. The selection of the reverse gear is to prevent the reverse gear from being selected accidentally while the vehicle is in motion, causing catastrophic damage to the transmission.

Gear Shifter Classification – Based on layout

Manual type –

This shift pattern, sometimes called a Dog leg shift pattern is used on many race cars and on older road vehicles with three-speed transmissions. The name derives from the up-and-over path between first and second gears. Its use is common in race cars and sports cars, but is diminishing as six speed and sequential gearboxes are becoming more common. Having first gear across the dog leg is beneficial as first gear is traditionally only used for getting the car moving and hence it allows second and third gears to be aligned fore and aft of each other, which facilitates shifting between the two. As most racing gearboxes are non-synchromesh there is no appreciable delay when up shifting from first through the dog leg into second. This gear pattern can also be found on some heavy vehicles in which first gear is an extra-low ratio for use in extreme standing-start conditions, and would see little use in normal driving.

Gear Shifter Classification – Based on layout

Manual type –

This shift pattern is a typical pattern for a six-speed transmission. Six speeds is the maximum usually seen in single range transmissions, however many semi trucks and other large commercial vehicles have manual transmissions with 8, 16 or even 20 speeds, which is made possible due to multi-range gearboxes. In such a case, Reverse is placed outside of the "H," with a canted shift path, to prevent the shift lever from intruding too far into the driver's space (in left-hand drive cars) when reverse is selected. Higher number of speeds in automobiles are rare occurrences, although examples do exist, such as the Porsche 911, which is equipped with a seven-speed manual transmission.

Shift pattern for a 3-speed car.

Gear Shifter Classification – Based on layout

Manual type –

Shift pattern for a 4-speed column shifter.

Shift pattern for a 4-speed car.

Gear Shifter Classification – Based on layout

Automatic type –

Stick shifter - The most common shifter that can be found in cars in India and worldwide is the stick shifter. What stick shifter essentially Means is a gearbox with a regular stick like a manual gearbox, but a bit slick, that can be slotted to Reverse, Drive or Neutral gears by moving it in a linear direction or in gated format. Gated format consists of slots in a zigzag format that prevents the driver to accidentally move the gear level, a case most prominent in linear shifters.

Example - Maruti Suzuki Alto K10, Honda Jazz

Gear Shifter Classification – Based on layout

Automatic type –

Joystick / Monostable shifter - A joystick or a monostable shifter is a kind of the stick shifter, albeit with a refined functionality and rich looks. Expensive and luxury cars like BMW and Audi are famous for providing the monostable shifter. In a monostable shifter, the gear knob remains at the same position, even after you have slotted it in the desired gear. Sadly, this is also considered to be a design flaw of the shifter as the driver can't really tell the position of the gear selected.

Example - BMW 3 Series, Audi A4

Gear Shifter Classification – Based on layout

Automatic type –

Rotary shifter - Rotary shifters are not too common, yet the most fascinating looking form of the gear shifts. India got its taste of the rotary gearshifts with the arrival of Jaguar and Land Rover cars in the country, which offered a fancy pop-up kind of swivel wheel that can be rotated to shift a gear. While JLR's shift was all about technology and style, more recently, Renault offered the rotary dial in its Kwid 1.0L AMT version, but for a more Indian reason - to save the space in the car.

Example - Jaguar XE, Renault Kwid 1.0L AMT

Gear Shifter Classification – Based on layout

Automatic type –

Stalk shifter - Probably the only manufacturer in the world to offer this old school charm, the steering column mounted gear lever was common in cars like Fiat Padmini Premiere. All the Mercedes cars across the globe offers this stalk gear shift which remains in its positions and functions just like a monostable gear level. BMW tried its hand to offer the same type of column mounted lever in its 2002-2008 7-series sedan. This type of lever is installed below the wiper/ indicator stalk on the steering column.

Example - Mercedes Benz C-Class, Mercedes Benz GLA-Class

Gear Shifter Classification – Based on layout

Automatic type –

Push button shifter - Push button shifters are the most uncommon type of gear shifters available in the market today. Strangely, these are also one of the earliest form of automatic shifters found in any car, dating back as early as 1950s. The design of the gear shifters is simple - they have individual buttons to select the gear you want slot your car in - P,R, N, D etc. In India, the hot hatch Abarth 595 Competizione and super expensive Aston Martin Vanquish offer this kind of gear shifter.

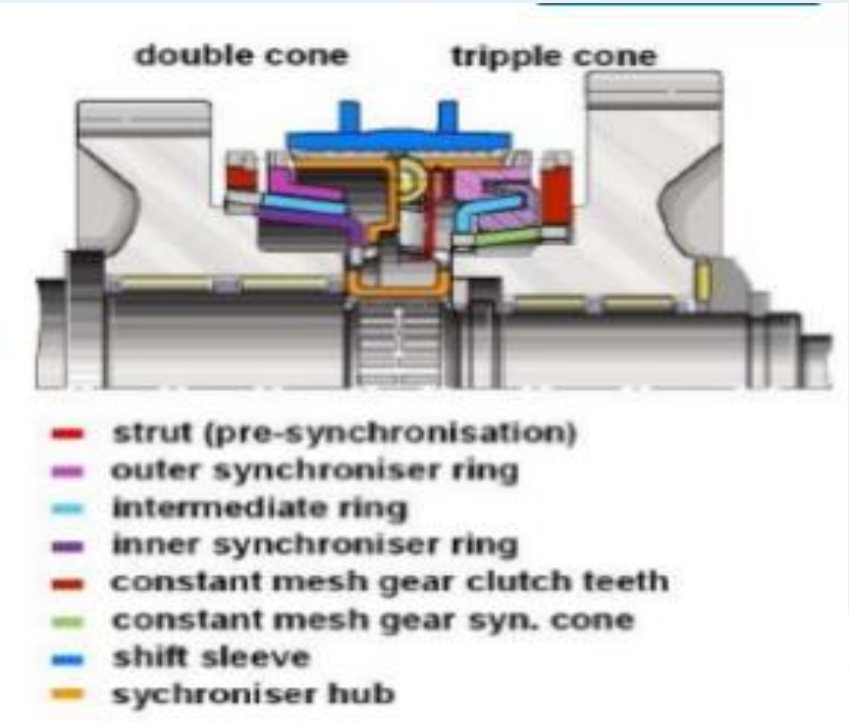
Example - Fiat Abarth 595 Competizione, Aston Martin Vanquish

Manufacturing Processes
Gear Shifter

Manufacturing processes –

- A shift lever is composed of a lower lever section connected to a control rod of a transmission, and a upper lever section formed with a hollow cylindrical portion and provided with a shift lever knob.

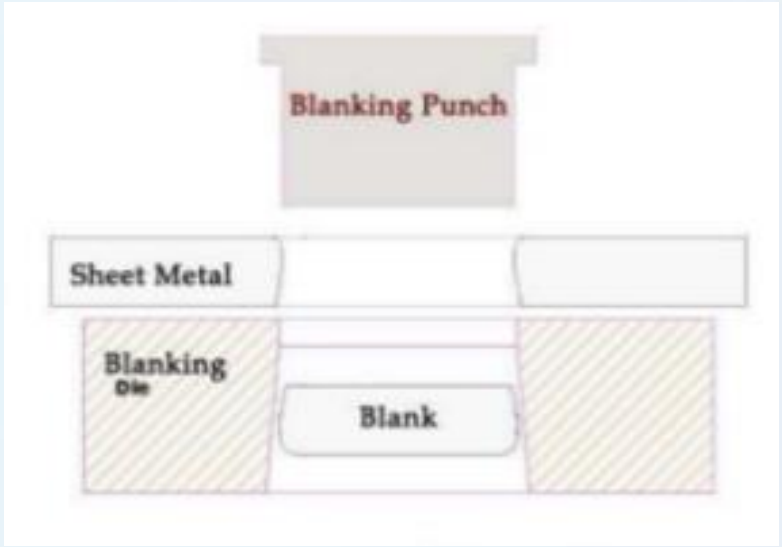
- The lower lever section is formed with an elongate end portion which is being inserted in the hollow cylindrical portion of the upper lever section.



Manufacturing processes –

Blanking :

- It is a rolling of a straight trapezoidal bar of a steel into a coiled form.
- Slitting the entire coil ay a point to separate each steel loop of the coil which in the form of ring but silt at point.



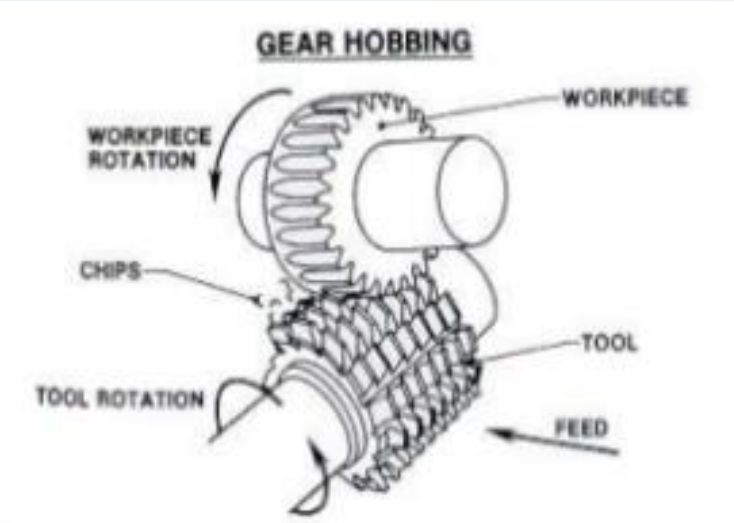
Machining :

- The processes involved is turning.
- The turning operation on a ring is done in two steps.
- In first and second step, the internal diameter is turned to a specific size and surface finish resp.

Manufacturing processes –

Hobbing :

❑ It is cutting of outer diameter of the machining ring into the shape of gear teeth by a specially designed cutting tool called as hob cutter.



Debarring, Washing & Punching :

❑ In this process loose chips of the metal which may have stuck on the ring are removed and the gears are washed using antirust oil.

❑ Punching of the batch code and supplier code is done after this process.

Induction hardening:

❑ This is the operation of raising the surface hardness of the gear teeth and depth of hardness to a specific level.

Additional information, References

Signs of problem with Gear Shifter :

If your vehicle hesitates or does not go into gear, this indicates a problem. This can happen in both automatic and manual transmissions. If you notice this problem in your vehicle, it may be time to get the clutch inspected or have the vehicle inspected by a mechanic.

While shifting gears, if you hear a grinding or feel shaking, this can indicate a problem with the gears. If the car will not go into gear, this could be an issue with the clutch or shift cables.

A mechanic can replace the shift selector cable so you can drive safely again. Sometimes a gear will slip, meaning it goes in and out of a certain gear. This is a huge safety risk and should be looked at by a professional right away.

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THANK YOU

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Are there any Questions?