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## Based on Big Data Management Research Automobile Clutch Release Bearing Bdevelopment System

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**Abstract:** Vehicle clutch release bearings working at high speed, strong vibration, high temperature, damp and easy pollution conditions. Fatigue life analysis is based on the release bearing rings or rolling body began to appear fatigue spalling, in which this kind of phenomenon is under cyclic is under. Clutch release bearings are an important vehicle powertrain components. Collaborative design automotive clutch release bearings, making the regional formation of enterprises dynamic virtual design team, through a combination of scattered in various technological advantage, the talent to play all engineers, technicians can not subject to geographical restrictions, by Computer Supported Collaborative Design (CSCD), is a collaborative model of human and computer technology convergence of new technologies. The contact stress distribution is not uniform, the contact stress is mainly concentrated near the surface; influenced by the geometry and physical properties and lubrication of the surface significantly. Contact between the two types of fatigue crack extension methods: fatigue crack surface under expansion and surface fatigue crack propagation. By numerical calculation and the C# language on the separation of the axial load bearing capacity of the design process is developed. It is established on separate static analysis of the proposed bearing model.

**Key words:** Big data, release bearing, mathematical model

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### INTRODUCTION

Clutch release bearings are important vehicle powertrain components. Auto clutch bearings in high speed, strong vibration, high temperature, humidity and easy to work under conditions of pollution, required bearings with good strength and toughness, impact resistance, wear resistance and excellent contact fatigue performance.

Computer network technology and the rapid development of database technology to modern bearing design has injected new vigor, bearing design gradually to the digital and network direction. Web-based remote mechanical design is produced under these conditions, making the machinery manufacturing enterprises can make full use of resources sharing, particularly in the formation of inter-enterprise cross-regional dynamic virtual design team, scattered in various enterprises through a combination of technology advantage of the expertise to play various enterprises and various professional technical personnel

can not subject to geographical constraints, a unified platform for the development of off-site design, implementation, information sharing and then quickly develop new products and improve product design success rate.

### CLUTCH RELEASE BEARINGS

Release bearing (Fig. 1, 2) in the clutch separation process mainly bear axial force. Because the separation of rotary bearings, under the action of centrifugal force, it also bear radial force (Flaissier and Regazzoni, 1978). There are provisions for maximum separation force clutch catalogue with different sizes, in research and development of automobile clutch bearings, the primary research content is to be able to meet the requirements on the contact fatigue life under the condition of maximum separation force.

Because most modern engine speed exceeds  $6000 \text{ r min}^{-1}$ , the radial force caused by centrifugal force is very large, therefore, automobile clutch bearings are widely used in radial thrust angle contact ball bearing type. There are provisions for maximum separation force clutch samples with different sizes, in research and development of automobile clutch bearings, the primary research content is to be able to meet the requirements of the maximum axial separation force. Alfares and AEIsharkawy (2003) If clutch bearings only bear axial force, influence the separation bearing axial main bearing capacity factor formula (1, 2): the original contact angle ( $\alpha$ ) the actual contact angle ( $\alpha'$ ) cosine ratio; average value of the inner groove curvature

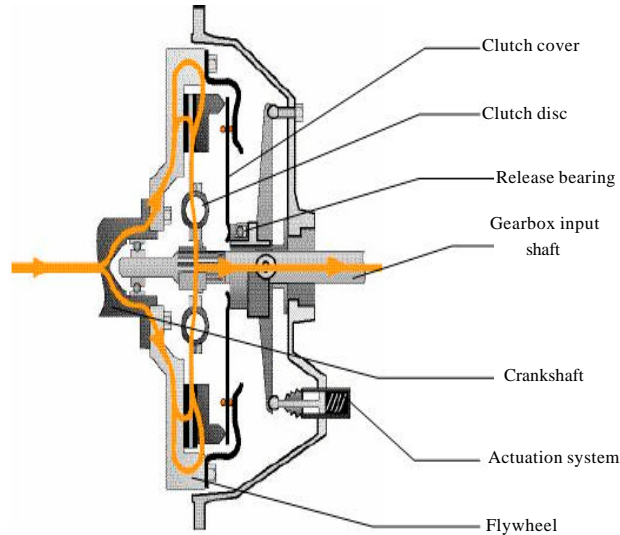


Fig. 1: Schematic diagram of clutch structure design

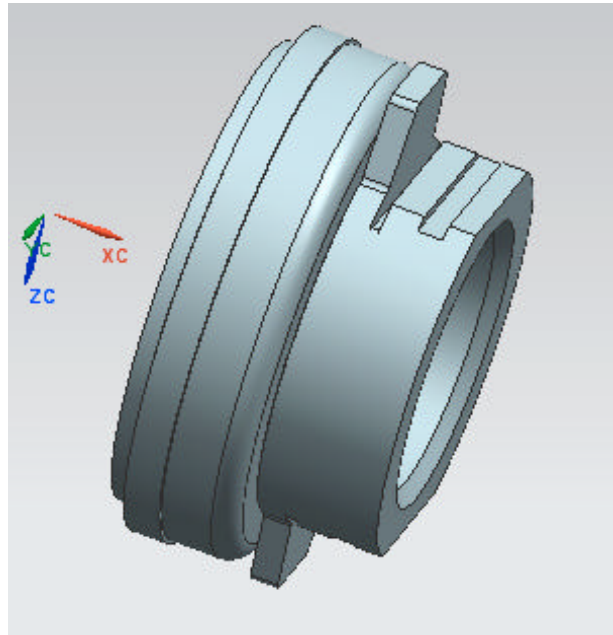


Fig. 2: Vehicle clutch release bearing outside view

radius coefficient ( $f_m$ ); contact deformation coefficient ( $C$ ); the number of steel balls ( $Z$ ); the ball diameter ( $D_w$ ); the actual contact angle ( $\alpha'$ ) sinusoidal; the Herze contact coefficient ( $e_a$ ); the inner and outer raceway curvature center angle and inner and outer ring raceway center line ( $\theta$ ); The principal curvature and function ( $\Sigma\rho$ ):

$$\sin(\theta - \alpha') = \frac{2e_a}{(D_w \Sigma\rho)^{1/2}} \left[ \left( \frac{2f_m - 1}{C} \right) \cdot \left( \frac{\cos\theta}{\cos\alpha'} - 1 \right) \right]^{1/2} \quad (1)$$

$$F_{am\ ax} = \left[ \left( \frac{2f_m - 1}{C} \right) \left( \frac{\cos\theta}{\cos\alpha'} - 1 \right) \right]^{3/2} Z D_w^2 \cdot \sin \alpha' \quad (2)$$

Proposed bearing surface defects proposed lifetime distribution of Nd expression (Tallian,1996):

$$-\ln S(N) = 2 \left( N^{-1/\zeta} A^{1/\zeta} + \tau_0 \right)^{-\beta} Z_s^{-h\beta} \int_0^{Z_0} \int_0^{l} m t_{crit}^{\beta} P_{max}^{\beta} a dZ dl \quad (3)$$

where,  $S(N)$ : Containing bearing survival probability volume defects;  $A$  defect life factor;  $\tau_0$ : The ultimate fatigue constants (MPa);  $\zeta$ : Stress index;  $\beta$ : Life discrete index;  $Z_s$ : Stress measuring depth (usually: Surface) (mm);  $h$ : Value constant;  $m$ : Defect density;  $t_{crit}$ : Dimensionless critical stress;  $P_{max}$ : The maximum Hertzian pressure (M Pa);  $l$ : Raceway length;  $Z_0$ : The maximum Hertzian shear stress range in depth (mm);  $a$ : Hertz contact half length (in the direction perpendicular to the rolling) (mm).

**FEASIBILITY ANALYSIS**

Applied C# language program to optimize the design of bearings, automotive bearings are numerical range for the object determine the overall structure to the most simple and easiest way to use C# to make it a primary system software. Determine the feasibility of the main factors: The mathematical model is correct and the operator skill level. Analysis of existing systems, increasing the amount of bearing design, the experience has clearly can not meet existing current technology. Expenditure: In view of the technical content of the original system is relatively low, so the number of high-tech workers do not need to operate only because of the increasing amount of bearing design, the required number of operators is increasing (Vlcek *et al.*, 2003). This is no longer adapt to the pace of the current information age. Limitations, after analysis, we can see the original method of bearing design limitations, such as the technology is too old and personnel work load, low-tech personnel and equipment, so a series of shortcomings, all of which are clearly the need for a new adaptation The new high-tech system. Therefore, the development of such a software is still very necessary (Norton and Leonard, 2000).

**SYSTEM DESIGN**

For automobile release bearing optimal design software system overall structure, shown in Fig. 3. Pillars of the system layer and function layer is divided into two levels. Functional layers include: Bearing type selection; determine the structural and material parameters; working conditions and the transmission parameters; design variables and optimization goals in four parts. Mainly to provide friendly information exchange mechanism. Pillar for the database layer, the functional layer of bearing products to provide data and design guidelines.

**PROGRAM FEATURES PROCESS**

System software running on the computing environment, C# and Microsoft SQL Server7.0 unified database platform. Information interactively through its input to the system requirements, the main features include: (A) Bearing type selection; press can bear the load direction can be divided into push and pull, etc.; (B) determine the structure and material parameters; different types of bearings with different diameter series, the same diameter, the diameter and width can be different; inner and outer ring may be made from different materials, related materials and therefore need to determine the mechanical properties ; (c) working conditions and transmission parameters; Consists mainly of automotive release bearings is the load and speed work ; (D) Design variables and optimization goals: Able to change the design variables as required and gives the required optimization goals. Such as minimum contact stress, or can withstand the maximum axial force. Figure 3, shows the system framework; Figure 4, shows the program implementation process.

**USER INTERFACE DESIGN**

Applied C# language program to optimize the design of bearings, automotive bearings are numerical range for the object Sequence development. Feature: the ability to quickly and accurately input, so can be easily operated by technical personnel. Performance: fast and stable, the input / output: English Chinese character input, in English

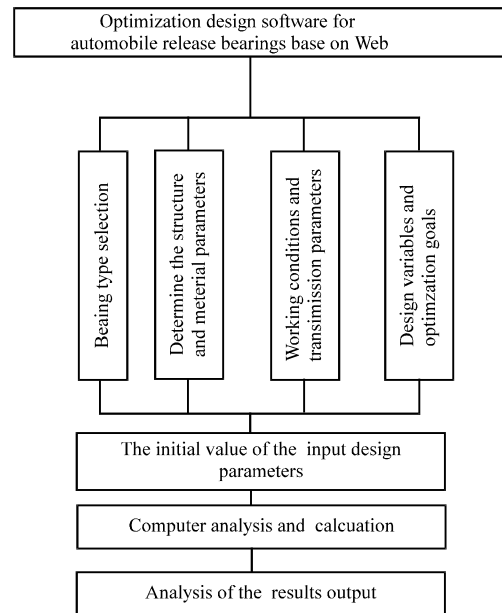


Fig. 3: System framework

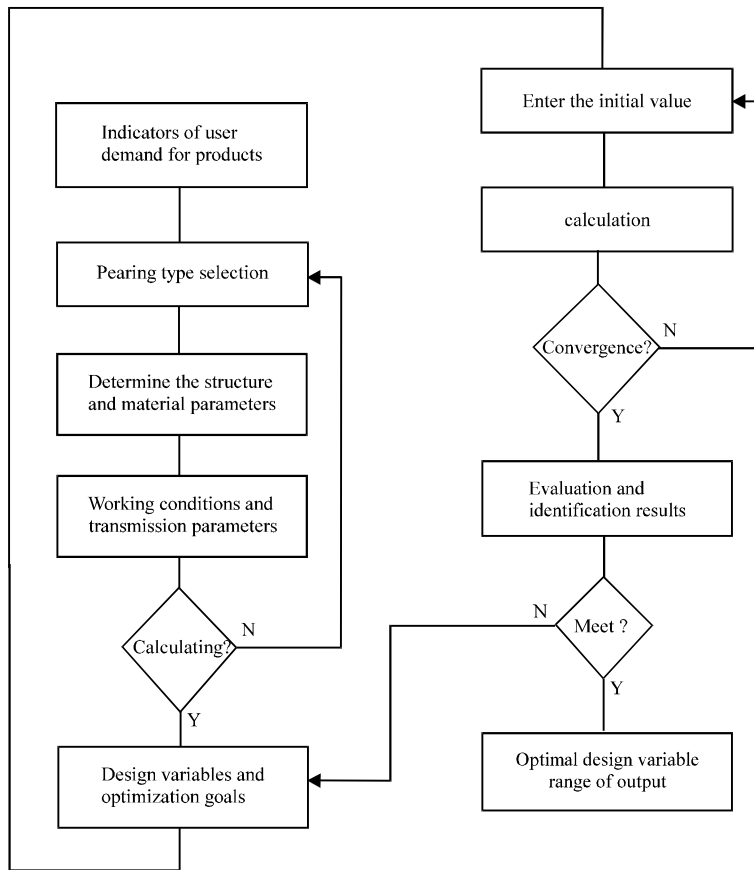


Fig. 4: Program implementation process

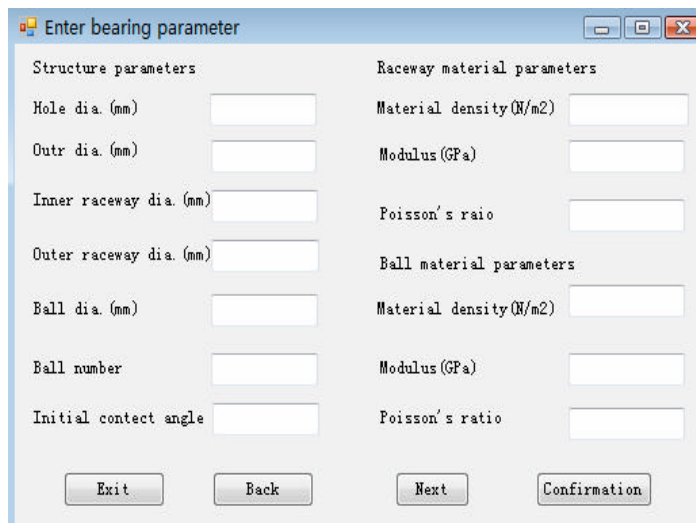


Fig. 5: Set properties of user interface objects

and Chinese output. Safety requirements: Can not easily be destroyed, can not let people outside professionals deletion of information on power outages, crashes,

system crashes and other issues have strong measures to protect data from loss. Figure 5, shows set the properties of user interface objects.

### OPTIMIZATION DESIGN APPLICATION

Bearing internal structure parameters optimization. Bearing design for evaluating the merits of the indicators, the proposed objective function has many, such as fatigue life of the longest and the longest wear life, low friction torque, rotary roll than the minimum, maximum dynamic load rating and so on. Design is to choose which of the combination of one or even necessary for further analysis and testing. Need to determine the structural parameters are: The number of ball diameter and ball; inside and outside the ring contact angle; groove radius of curvature coefficient.

Point contact bearing the finite element method. Compared with the traditional theoretical analysis, contact problems using finite element analysis, high accuracy, wide and so on. Because the contact ball bearings problem is a combination of multi-body contact, friction, sliding, material nonlinearity, several other complex non-linear access charge issue, the issue of such contacts finite element analysis calculation and improved design can reduce blindness.

Most of the current engine speed exceeds  $6000 \text{ r min}^{-1}$ , a large radial force caused by centrifugal force, therefore, vehicles are widely used clutch bearings radial angular contact thrust bearings and put it into a

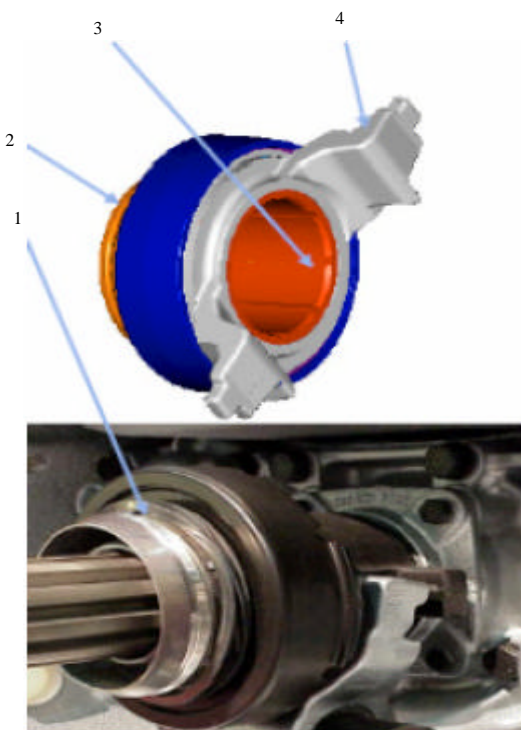


Fig. 6: Bearings and components of the struct

sealed, filled with high temperature lithium grease in the bearings and the traditional into the ground by the rotating outer ring rotating bearing inner ring, these structural measures to extend the service life and maintenance-free bearings. Figure 6 shows that bearings and components of the structure. 1.connection to clutch cover; 2.housing;3. sliding sleeve;4.interface for fork.

Release bearing Fig. 7 in the clutch separation process mainly bear axial force. Because the separation of rotary bearings, under the action of centrifugal force, it also bear radial force. There are provisions for maximum separation force clutch catalogue with different sizes, in research and development of automobile clutch bearings, the primary research content is to be able to meet the requirements on the contact fatigue life under the condition of maximum separation force.

### MODEL SIMULATION TESTING DEVICE

#### Experimental Study of maintenance-free bearings:

Bearings in the engine shaft and transmission shaft has to work under conditions of axial displacement, the installation location and size limits by a car transmission, maintenance and troubleshooting requirements of highly expensive. In recent years, foreign countries has been launched within a certain mileage maintenance-free bearings, which bearing materials, lubricants, sealing structure and the fatigue life test failure under simulated working conditions data processing methods are put forward new research. The use of modern design theory of the dynamic performance of automotive bearings, contact stress, material properties, lubrication conditions and test equipment, to improve the bearing capacity of the axial bearings to extend life and increase its reliability.

Performance testing of new materials and processing technology. Of steel materials, life and reliability is

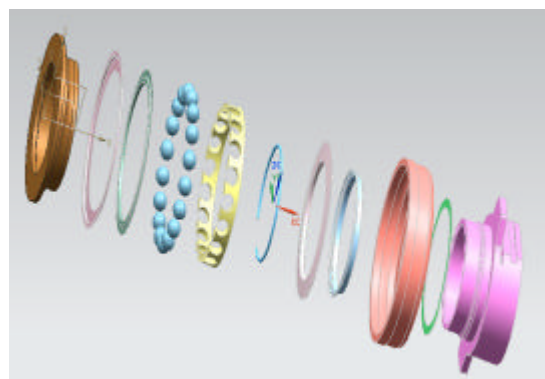


Fig. 7: Clutch bearings parts 3D blasting chart

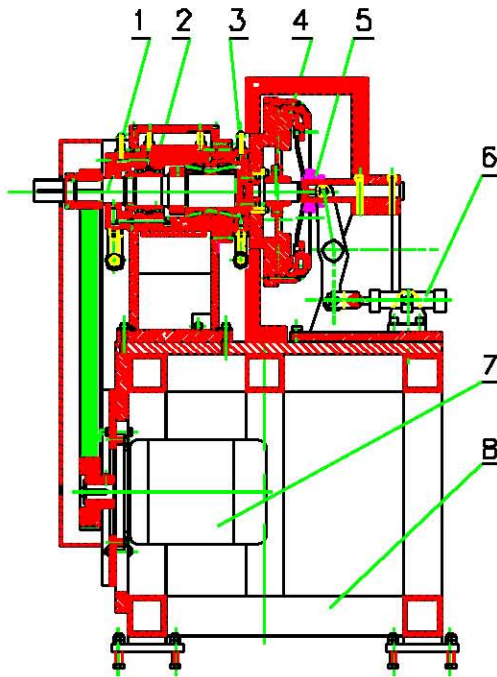


Fig. 8: Schematic diagram of new testing device

essential that the quality of steel and advanced heat treatment technology and equipment. Bearings in the machining process, grinding, lubrication, cooling, cleaning and processing of abrasives dimensional stability control and other issues need to be studied and proposed standards. The need for bearing raceway surface coating of laser quenching and Treatment. Maintenance-free bearings used in non-metallic materials such as: glass fiber reinforced PA (polyamide, silicon nitride (Si<sub>3</sub>N<sub>4</sub>), Silicon carbide (SiC), nitrile rubber, acrylonitrile, glass fiber reinforced nylon and grease. Test and measurement and control system. bearing test (Sochting *et al.*, 2006) and measurement and control system in the assessment and validation analysis results is essential in the key of off-road vehicle clutch bearings bear the load, displacement, clutch frequency, speed and temperature must be the main parameters of simulation test. Fig. 8: shows that Schematic diagram of new testing device of the structure. Where: (1) spindle; (2) spindle cooling systems; (3) spindle lubrication system; (4) clutch; (5) by testing the clutch release bearing; (6) cylinder (7) Electric motor; (8) Frame; Ball and the raceway is to calculate the contact stiffness between the contact stress and contact deformation is based on a separation of the design parameters of the internal structure of bearing a very important parameter (Hyun *et al.*, 2004), must as accurately as possible given its size, therefore, to

design test equipment and measurement and control system for verification for the theory and basic experiments.

## CONCLUSION

As the vehicle design to raise the level of the clutch bearings are increasingly high performance requirements. Computer network technology and the rapid development of database technology to modern bearing design has injected new vigor, bearing design gradually to the digital and network direction. Web-based remote mechanical design is produced under these conditions, making the machinery manufacturing enterprises can make full use of resources sharing, particularly in the formation of inter-enterprise cross-regional dynamic virtual design team, scattered in various enterprises through a combination of technology advantage of the expertise to play various enterprises and various professional technical personnel can not subject to geographical constraints, a unified platform for the development of off-site design, implementation, information sharing and then quickly develop new products and improve product design success rate.

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