

Non-traditional Mechanical Connection Mode and Its Application in Lightweight of Automobile

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Abstract: With the intensification of China's modernization process, the automobile industry, as a fast industry which can show the characteristics of modern development, has a strong momentum of development, and its performance in the process of modernization is incisively and vividly. But in the process of the development of automobile industry, a series of problems have also been shown unreservedly. Among them, energy consumption, safety and environmental protection are particularly important. According to the statistics of the international authority, about 60% of the fuel used for automobiles is consumed by the automobile. Every 10% of the quality of the car can be reduced by 10%, and the fuel consumption can be reduced by 7%. In view of the above problems, whether it is national policy or industry rule, a series of methods, such as laws and regulations, the development of new energy technology and the development of automobile lightweight technology, have been actively explored for the three major problems. However, the automotive industry in all countries agree that the application of automotive lightweight technology is the most effective means and method for energy consumption, safety and environmental protection. Therefore, vehicle lightweight technology basically covers the entire automotive industry. As we all know, the development of technology needs to find the key to the problem. Based on the above problems, this paper puts forward three methods, which are realized from three aspects: material, design and process (non-traditional mechanical connection).

Keywords: lightweight technology, material, design, non-traditional mechanical connection.

1. INTRODUCTION

The realization of vehicle lightweight technology is generally optimized through three aspects: material, design and process.

2. MATERIAL

Material, the first part of the realization method of automobile lightweight technology: Nowadays many material of the automobile lightweight technology use of aluminum alloy,

magnesium alloy, titanium alloy, and other lightweight alloy or method of mixing material using the optimization of automotive lightweight technology material, with the high-speed development of material science, such as carbon fiber composite non-metallic materials are used in the automotive lightweight technology. In particular, the use of aluminum alloy due to the weight of aluminum alloy and energy saving effect is obvious, passengers comfort and safety improved, and aluminum alloy is easy to recycle. Firstly, the mechanical performance of aluminum is good, its density is only 1/3 of steel, it has good thermal conductivity, second only to copper, its processing performance is 4.5 times of iron, and the natural formation of the surface of the oxide film has good corrosion resistance, thus becoming the most ideal choice to realize lightweight materials for automobiles. Secondly the aluminum alloy car can reduce the weight of the car without reducing the capacity of the car. The weight of the car is reduced, and the car is more stable and comfortable. Because of its good energy absorption, aluminum has obvious advantages in collision safety. It will produce folds in the deformation area before the collision, and can absorb a lot of impact force to protect the back of the driver and passengers. This is the reason for the comfort and safety of passengers. At last, aluminum products are hardly corroded or lightly corroded during use. In the conventional materials used in industry, the recovery value of aluminum is the highest. In aluminum - aluminum - recycled aluminium ingots - recycled aluminum - the loss of aluminum is only about 5%, and its regeneration performance is higher than that of any other commonly used metal. It is based on the above advantages, many companies or research institutions are willing to use these lightweight alloy.

3. DESIGN

Design, the second part of the realization method of automobile lightweight technology: The main method of design optimization is finite element method and optimal design method. Using CAD technology, the body structure design and layout design can be accurately realized, and the shape, configuration and thickness of the plate are analyzed. And for the components of lightweight materials, the use of CAE technology can be used to analyze the layout of the parts and the analysis of motion interference, so that the lightweight materials can meet the requirements of body design. Topological optimization: Multi-application in the conceptual design stage of structure. The main idea is to transform the optimal topological problem of the seeking structure into the optimal material distribution in a given design area. The methods of topological optimization of continuous body structure are: variable thickness method, variable density method and homogenization method. Topographic optimization: the form, direction and depth of reinforcement can be optimized. Shape and size optimization: this kind of structural design method has been used in the design of automotive rear axle differential housing and semi-axle. This method of shape optimization based on the law of biological growth can receive the effect of reducing the quality of parts and avoiding the local stress peak. To store the materials at high load, remove materials that bear low load, and the shape of the parts will be designed according to avoid stress peaks and distribute stress distribution evenly.

4. NON-TRADITIONAL MECHANICAL CONNECTION

Mechanical connection, the last but not least part of the realization method of automobile lightweight technology: In the application of mechanical industry traditional connection is used in many areas. Generally speaking Traditional mode of connection include welding, riveting, bolted connection, key connection, pin connection, splice and profile shaft connection. Among the rest, it is the most widely used of welding, riveting and bolted connection.

Welding: also known as fusion and melting, is a manufacturing process and technology that USES heat, high temperature or high pressure to engage metal or other thermoplastic materials such as plastics. The joint purpose is achieved by welding and brazing. Traditional welding for sheet metal and sex or both for quality has a certain influence on the safety performance for some materials at the same time, the application of welding technology may be relatively narrow and can not be well adapted to the various materials, traditional welding technology insufficiency lies in its biggest produced a large number of harmful gas, for human health and ecological environment has a certain influence.

Riveting is the rivet connection is a mechanical term, which is to use the axial force to roughen the hole of the part of the rivet hole and to form a nail head, so as to connect the various parts. Its technological process is: drilling - economic nest - debarring - the top die insert rivet - spin riveting machine (top) to resist rivet rivet forming (or manual block - pier coarse - riveting into - cover form). Popular speak riveting is refers to two small thickness of plate, through to make holes in its place, and then put in rivet, rivet riveting die with riveter, and connect the two board or objects together. The riveting connection is high and the sealing property is good, but the disassembly is not convenient and the hole precision is high, the operation is very difficult.

Bolted connection: is bolt with nut cylinder of threaded fasteners, by the head and the screw (with external thread of the cylinder) of two parts of fasteners, to cooperate with nut, used for fastening the two parts with hole. This form of connection is called bolted connection. If you screw the nut from the bolt, you can separate the two parts, so the bolt connection is a removable connection. The traditional bolt connection structure is simple, the type is varied, the connection is reliable, the installation is convenient, the cost is low. But under the alternating load, it is easy to loosen. The hole precision is higher. In addition, the operation process of drilling, drilling, tapping and other necessary operating procedures can be greatly affected by the operable and economy of bolted connections.

Based on these problems, non-traditional mechanical connection method is proposed. In this essay through no riveting connection, friction drill and friction stir welding to introduce the non-traditional mechanical connection mode.

4.1 No riveting connection

no riveting connection just as its name implies that it is a new-style riveting. It is compared with traditional riveting, it doesn't need rivets, A rivet connection technology using pressure welding machine and special connection plate mold, generally plank pressure welding machine and special connection mold using concave and convex mold as the main connection of abrasive, through a strong instantaneous high pressure processing, material of cold extrusion

deformation according to the panel itself, forming a certain tensile resistance and shear strength of stress concentration inside inlaid dot, can be different material thickness of two layer or multilayer board piece together. No rivet connection technology has no requirement on the surface of the plate, the original coating and coating on the surface of the joint are not damaged. The connection process is highly automated, can be connected at single point or multi point, and can be used to detect and monitor the whole process without damage, and the production efficiency is very high.

4.2 Friction drill

Friction drill technology is the last time the metal sheet or the pipe material has been processed the hole and the bushing of the shavings processing technology, completely replaces the process of welding (riveting) on the thin-wall work-piece. The hot melt drill is made of hard alloy materials with wear-resisting and high temperature resistance. When the cutting tool and work-piece contact, high speed (1000 ~ 3500), and appropriate axial thrust, the friction between the drill and metal, instantly at the temperature of 650 ° ~ 750 ° centigrade. The metal in the area near the drill is quickly softened, and the axial pressure is applied to quickly extrude the convex platform and bushing of about 3 times the thickness of the initial plate on the work-piece. The whole process takes only two to six seconds.

4.3 Friction stir welding(FSW)

Friction stir welding(FSW). The heat of friction and plastic deformation is used as the welding heat source. The process of FSW is made up of a cylinder or other shapes, such as cylinder with screws mixing needle (welding pin) into the seams of the work-piece, through high-speed welding head, make its and friction welding materials, so that the connection part of the material temperature to soften. At the same time, the material is stirred and rubbed to finish the welding.

5. APPLICATION OF NON-TRADITIONAL MECHANICAL CONNECTIONS IN VEHICLE LIGHTWEIGHT

Non-traditional connection methods have been applied to many aspects in vehicle lightweight: Some researches at home and abroad show that friction stir welding has achieved the same kind of processing. The most important research trend today is friction stir welding of dissimilar materials, which is not difficult to find copper, magnesium, aluminum, magnesium, titanium, aluminum and even some connections with non-metallic materials. Friction drill: hot melt drilling technology is widely used in bolt processing, because of its simple process and high economy, more and more R & D units and enterprises have attached great importance to it. The most famous one is the hot-melt self tapping bolted connection technology used on Cadillac CT6 body, with 745 connection points. No riveting connection connection: non- riveting connection is widely used in body, chassis and engine parts. Especially for the processing and using of some high strength steels, the riveting connection technology shows its strong feasibility and effectiveness.

6. CONCLUSION

With the progress of science and technology, energy, security and environmental protection have been paid more and more attention, and the development of automotive lightweight technology has a positive impact on energy, safety and environmental protection. Automobile lightweight technology is optimized from materials, processes and design methods, and it is highly possible to realize the positive characteristics of this technology for our development. It is very important for us to optimize the process, and the three kinds of non-traditional mechanical connection technologies mentioned in this report are developed on this basis. But due to a series of problems such as late start and slow development, process optimization has not been developed rapidly. It is believed that in the near future, the non-traditional mechanical connection will play a vital role in the process of automobile lightweight development and even the whole process of the development of the whole machinery industry.

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