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EXPERIMENTAL ANALYSIS AND INVESTIGATION OF COPPER ALLOY BASED LEAF SPRING WITH VARIOUS COMPOSITIONS

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Abstract

The aim of this project is to compare the structure and weight savings of alloy leaf spring with that of steel leaf spring. These alloys have been improved copper nickel white metal alloys which exhibit an excellent combination of mechanical strength, including tensile and yield strength, and formability, as measured by the radius to thickness ratios in bending. The alloys also have very good electrical and thermal conductivity and high resistance to thermal stress relaxation. The alloy described in this project addresses the growing demand of the automobile industry for cost-effective high performance alloys. In order to conserve natural resources and economize energy, weight reduction has been the main focus of automobile manufacturers in the present scenario. Weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes. This project describes the latest and strongest alloy automobile leaf spring. The new alloy, containing 60% copper 30% nickel and 10% white metal (3% tin and approx. 7% zinc).The casted leaf spring will be x ray, tensile and hardness testing to find its character.Casting of this alloy with different composition such as 40% copper 30% nickel and 30% white metal (10% tin, 10% antimony 7% zinc and 3% Lead). This paper presents comparative data of the new alloy with other leaf spring material commonly and radiography test also be carried out considered by design engineers for high performance applications. The alloy described in this paper addresses the growing demand of the connector industry for cost-effective high performance alloys. The subject gives a brief look on the suitability of copper white metal alloy material and their advantages. Efforts have been made to reduce the cost of copper white metal alloy material to that of steel material. The achievement of weight reduction with adequate improvement of mechanical properties has made copper white metal alloy a very replacement material for convectional steel. Material and manufacturing process are selected upon on the cost and strength factor. The design method is selected on the basis of mass production.

Index Terms—copper alloy, casting, experimentation, comparison

Introduction

A leaf spring is a simple form of spring commonly used for the suspension in wheeled vehicles. Originally called a laminated or carriage spring, and sometimes referred to as a semi-elliptical spring or cart spring, it is one of the oldest forms of springing, dating back to medieval times.

A leaf spring takes the form of a slender arc-shaped length of spring steel of rectangular cross-section. The center of the arc provides location for the axle, while tie holes are provided at either end for attaching to the vehicle body. For very heavy vehicles, a leaf spring can be made from several leaves stacked on top of each other in several layers, often with progressively shorter leaves. Leaf springs can serve locating and to some extent damping as well as springing functions

A leaf spring can either be attached directly to the frame at both ends or attached directly at one end, usually the front, with the other end attached through a shackle, a short swinging arm. The shackle takes up the tendency of the leaf spring to elongate when compressed and thus makes for softer springiness. Some springs terminated in a concave end, called a spoon end (seldom used now), to carry a swiveling member.Leaf springs were very common on automobiles, right up to the 1970s in Europe and Japan and late 70's in America when the move to front-wheel drive, and more sophisticated suspension designs saw automobile manufacturers use coil springs instead. Today leaf springs are still used in heavy commercial vehicles such as vans, trucks, and railway carriages. For heavy vehicles, they have the advantage of spreading the load more widely over the vehicle's chassis, whereas coil springs transfer it to a single point. Unlike coil springs, leaf springs also locate the rear axle, eliminating the need for trailing arms and a Panhard rod, thereby saving cost and weight in a simple live axle rear suspension. A further advantage of a leaf spring over a helical spring is that the end of the leaf spring may be guided along a definite path. A more modern implementation is the parabolic leaf spring. This design is characterized by fewer leaves whose thickness varies from center to ends following a parabolic curve. In this design, inter-leaf friction is unwanted, and therefore there is only contact between the springs at the ends and at the center where the axle is connected. Spacers prevent contact at other points. Aside from a weight saving, the main advantage of parabolic springs is their greater flexibility, which translates into vehicle ride quality that approaches that of coil springs. There is a trade-off in the form of reduced load carrying capability, however. The characteristic of parabolic springs is better riding comfort and not as "stiff" as conventional "multi-leaf springs". It is widely used on buses for better comfort. A further development by the British company and by Chevrolet with the Corvette amongst others is the move to composite plastic leaf springs.

Typically when used in automobile suspension the leaf supports an axle and locates/ partially locates the axle. This can lead to handling issues (such as 'axle tramp'), as the flexible nature of the spring makes precise control of the unsprung mass of the axle difficult. Some suspension designs use a Watts link (or a Panhard rod) and radius arms to locate the axle and do not have this drawback. Such designs can use softer springs, resulting in better ride.

The similarity in external appearance of the various alloys, along with the different combinations of elements used when making each alloy, can lead to confusion when categorizing the different compositions. There are as many as 400 different copper and copper-alloy compositions loosely grouped into the categories: copper, high copper alloy, brasses, bronzes, copper nickels, copper–nickel–zinc (nickel silver), leaded copper, and special alloys. The following table shows the different composition of copper alloy.

Nickel was first isolated and classified as a chemical element in 1751 by Axel Fredrik Cronstedt, who initially mistook its ore for a copper mineral. The element's name comes from a mischievous sprite of German miner mythology, Nickel (similar to Old Nick), that personified the fact that copper-nickel ores resisted refinement into copper. An economically important source of nickel is the iron ore limonite, which often contains 1-2% nickel. Nickel's other important ore minerals include garnierite, and pentlandite. Major production sites include the Sudbury region in Canada (which is thought to be of meteoric origin), New Caledonia in the Pacific, and Norilsk in Russia.

Because of nickel's slow rate of oxidation at room temperature, it is considered corrosion-resistant. Historically, this has led to its use for plating metals such as iron and brass, in chemical apparatus, and in certain alloys that retain a high silvery polish, such as German silver. Alnico permanent magnets based partly on nickel are of intermediate strength between iron-based permanent magnets and rare-earth magnets.

The metal is chiefly valuable in the modern world for the alloys it forms; about 60% of world production is used in nickel-steels (particularly stainless steel). Other common alloys, as well as some new super alloys, make up most of the remainder of world nickel use, with chemical uses for nickel compounds consuming less than 3% of production

In this paper we propose a ranked search which greatly enhances system usability by returning the matching files in a ranked order regarding to certain relevance criteria (e.g., keyword frequency), thus making one step closer toward practical deployment of privacy-preserving data hosting services in the context of Cloud Computing. To achieve the design goals on both system security and usability, we propose to bring together the advance of both crypto and IR community to design the rankedsearchable

Literature survey

Miravete et al (1990) Analysis and Prediction of large copper white metal alloy Structures. Material properties and design of copper white metal alloy structures are reported in many literatures. Very little information is available in connection with finite element analysis of material in the literature, than too in 2D analysis of material. At the same time, the literature available regarding experimental stress analysis more. The experimental procedures are described in national and international standards. Recent emphasis on mass reduction and developments in materials synthesis and processing technology has led to proven production worthy vehicle equipment.

Fuentes et al (1998) In the paper Premature fracture in automobile leaf springs' by the origin of Premature fracture in materials used in Venezuelan buses is studied. To this end, common failure analysis procedures, including examining the leaf spring history, visual inspection of fractured specimens, characterization of various properties and simulation tests on real components, were used. It is concluded that fracture occurred by a mechanism of mechanic tensile, initiated at the region of the central hole, which suffered the highest tensile stress levels. Several factors (poor design, low quality material and defected fabrication) have combined to facilitate failure. Preventive measures to lengthen the service life of materials are suggested.

Clarke et al (1997) this paper by on Evaluation of a Material Failure gives the determination of the point of failure during an accident sequence of a rear material in a sport utility vehicle is presented in terms of fracture surface analysis and residual-strength estimates. Marks at the scene of the accident pointed to two possibilities for the point of failure: marks in the roadway at the start of the accident sequence and a rock strike near the end of the sequen**III) Casting**

Green sand molding

AlloyCasting is a manufacturing process by which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various cold setting materials that cure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods

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Sand casting, also known as sand molded casting, is a metal casting process characterized by using sand as the mold material. The term "sand casting" can also refer to an object produced via the sand casting process. Sand castings are produced in specialized factories called foundries. Over 70% of all metal castings are produced via a sand casting process. Sand casting is relatively cheap and sufficiently refractory even for steel foundry use. In addition to the sand, a suitable bonding agent (usually clay) is mixed or occurs with the sand. contained in a system of frames

After casting, the cores are broken up by rods or shot and removed from the casting. The metal from the sprue and risers is cut from the rough casting. Various heat treatments may be applied to relieve stresses from the initial cooling and to add hardness—in the case of steel or iron, by quenching in water or oil. The casting may be further strengthened by surface compression treatment—like shot peening—that adds resistance to tensile cracking and smooths the rough surface.

III. Testing

Nondestructive testing or Non-destructive testing is a wide group of analysis techniques used in science and industry to evaluate the properties of a material, component or system without causing damage. The terms Nondestructive examination, Nondestructive inspection, and Nondestructive evaluation are also commonly used to describe this technology. Because Nondestructive Test does not permanently alter the article being inspected, it is a highly valuable technique that can save both money and time in product evaluation, troubleshooting, and research. Common Nondestructive Test methods include ultrasonic, magnetic-particle, liquid penetrant, radiographic, Remote Visual Inspection eddy-current testing, and low coherence interferometry. Nondestructive Test is commonly used in forensic engineering, mechanical engineering, electrical engineering, civil engineering systems engineering, aeronautical engineering, medicine and art.

In manufacturing, there is a chance that they may fail if not created to proper specification. For example, the base metal must reach a certain temperature during the welding process, must cool at a specific rate, and must be welded with compatible materials or the joint may not be strong enough to hold the parts together, or cracks may form in the weld causing it to fail. The typical welding defects (lack of fusion of the weld to the base metal, cracks or porosity inside the weld, and variations in weld density) could cause a structure to break or a pipeline to rupture.

Dye penetrant test is one of the important test to check the casting defects in a material. The following figure shows the process of dye penetrant test.

- Section of material with a surface-breaking crack that is not visible to the naked eye.
- Penetrant is applied to the surface.
- Excess penetrant is removed.
- Developer is applied, rendering the crack visible.

Casting may be tested using Nondestructive Techniques such as industrial radiography or industrial scanning using X-rays or gamma rays, ultrasonic testing, liquid penetrant testing, magnetic particle inspection or via eddy current. In a proper weld, these tests would indicate a lack of cracks in the radiograph, show clear passage of sound through the weld and back, or indicate a clear surface without penetrant captured in cracks.

Welding techniques may also be actively monitored with acoustic emission techniques before production to design the best set of parameters to use to properly join two materials. In the case of high stress or safety critical welds, weld monitoring will be employed to confirm the specified welding parameters (arc current, arc voltage, travel speed, heat input etc.) are being adhered to those stated in the welding procedure. This verifies the weld as correct to procedure prior to nondestructive evaluation and metallurgy tests.

As a system, the human body is difficult to model as a complete transfer function. Elements of the body, however, such as bones or molecules, have a known response to certain radiographic inputs, such as x-rays or magnetic resonance. Coupled with the controlled introduction of a known element, such as digested barium, radiography can be used to image parts or functions of the body by measuring and interpreting the response to the radiographic input. In this manner, many bone and diseases may be detected and localized in preparation for treatment. X-rays may also be used to examine the interior of mechanical systems in manufacturing using Nondestructive Techniques as well.

Structure can be complex systems that undergo different loads during their lifetime. Some complex structures, such as the turbo machinery in anliquid-fuel rocket, can also cost millions of dollars. Engineers will commonly model these structures as coupled second-order systems, approximating dynamic structure components with springs, masses, and dampers. The resulting sets of differential equations are then used to derive a transfer function that models the behavior of the system.

In Nondestructive Techniques, the structure undergoes a dynamic input, such as the tap of a hammer or a controlled impulse. Key properties, such as displacement or acceleration at different points of the structure, are measured as the corresponding output. This output is recorded and compared to the corresponding output given by the transfer function and the known input. Differences may indicate an inappropriate model (which may alert engineers to unpredicted instabilities or performance outside of tolerances), failed components, or an inadequate control.

The impact test, also known as the V-notch test, is a standardized high strain-rate test which determines the amount of energy absorbed by a material during fracture. This absorbed energy is a measure of a given material's notch toughness and acts as a tool to study temperature-dependent ductile-brittle transition. It is widely applied in industry, since it is easy to prepare and conduct and results can be obtained quickly and cheaply.

A multi-part molding box (known as a casting flask, the top and bottom halves of which are known respectively as the cope and drag) is prepared to receive the pattern. Molding boxes are made in segments that may be latched to each other and to end closures. The sand is packed in through a vibratory process called ramming, and in this case, periodically screened level. The surface of the sand may then be stabilized with a sizing compound. The pattern is placed on the sand and another molding box segment is added. Additional sand is rammed over and around the pattern. Finally a cover is placed on the box and it is turned and unlatched, so that the halves of the mold may be parted and the pattern with its sprue and vent patterns removed. Additional sizing may be added and any defects introduced by the removal of the pattern are corrected. The box is closed again. This forms a "green" mold which must be dried to receive the hot metal. If the mold is not sufficiently dried a steam explosion can occur that can throw molten metal about. In some cases, the sand may be oiled instead of moistened, which makes possible casting without waiting for the sand to dry. Sand may also be bonded by chemical binders, such as furan resins or amine-hardened resins.

To control the solidification structure of the metal, it is possible to place metal plates, chills, in the mold. The associated rapid local cooling will form a finer-grained structure and may form a somewhat harder metal at these locations. In ferrous castings, the effect is similar to quenching metals in forge work. The inner diameter of an engine cylinder is made hard by a chilling core. In other metals, chills may be used to promote directional solidification of the casting. In controlling the way a casting freezes, it is possible to prevent internal voids or porosity inside castings.

With a completed mold at the appropriate moisture content, the box containing the sand mold is then positioned for filling with molten metal—typically iron, steel, bronze, brass, aluminium, magnesium alloys, or various pot metal alloys, which often include lead, tin, and zinc. After filling with liquid metal the box is set aside until the metal is sufficiently cool to be strong. The sand is then removed revealing a rough casting that, in the case of iron or steel, may still be glowing red. When casting with metals like iron or lead, which are significantly heavier than the casting sand, the casting flask is often covered with a heavy plate to prevent a problem known as floating the mold. Floating the mold occurs when the pressure of the metal pushes the sand above the mold cavity out of shape, causing the casting to fail.

After casting, the cores are broken up by rods or shot and removed from the casting. The metal from the sprue and risers is cut from the rough casting. Various heat treatments may be applied to relieve stresses from the initial cooling and to add hardness—in the case of steel or iron, by quenching in water or oil. The casting may be further strengthened by surface compression treatment—like shot peening—that adds resistance to tensile cracking and smooth the rough surface.

IV. Comparison

Tensile testing is a fundamental materials science test in which a sample is subjected to a controlled tension until failure. The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area. From these measurements the following properties can also be determined: Young's modulus, Poisson's ratio, yield strength, and strain-hardeningcharacteristics. Uniaxial tensile testing is the most commonly used for obtaining the mechanical characteristics of isotropic materials. For anisotropic materials, such as composite materials and textiles, biaxial tensile testing is required.

The size of the indent is determined optically by measuring two diagonals of the round indent using either a portable microscope or one that is integrated with the load application device.

The Brinell hardness number is a function of the test force divided by the curved surface area of the indent. The indentation is considered to be spherical with a radius equal to half the diameter of the ball. The average of the two diagonals is used in the following formula to calculate the Brinell hardness.

Normally Order preserving mapping is used to preserve the order. The order of mapped points on the two boundaries must be monotonically non-decreasing.
It is allowing different levels of detail like One-to-one, Many-to-one, One-to-many. Here the proposed method follows one-to-many order preserving mapping technique. The authorization between the data owner and users is appropriately done. To search the file collection for a given keyword, an authorized user generates and submits a search request in a secret form to the cloud server. Upon receiving the search request the cloud server is responsible to search the index and return the corresponding set of files to the user. This is considered as the secure ranked keyword search problem.

V. Conclusion

This study explains the various characteristics and properties of the copper white metal alloy fiber. By means the literature survey it is well clear that the copper white metal alloy fiber is best suitable for its properties. This project describes the latest and strongest alloy automobile leaf spring. The new alloy, containing 60% copper 30% nickel and 10% white metal (3% tin and approx. 7% zinc), is an inexpensive substitute for this alloys. Casting of this alloy with different composition such as 40% copper 30% nickel and 30% white metal (10% tin, 10% antimony 7% zinc and 3% Lead). This work will show that successful fabrication of a copper white metal alloy. Solid particle characteristics and strength of these will be analyzed using NDT method.

III. FUTURE ENHANCEMENT

In further objective of this study is to evaluate the applicability of a copper white metal alloy material in automobiles by considering cost-effectiveness and strength. The comparison between multi-material and mono-leaf copper white metal alloy spring is made for the same requirements and loading conditions. The comparison is based on four major aspects such as weight, riding comfort, cost and strength.

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