National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

Superelastic Tire

A viable alternative to the pneumatic tire

Innovators at NASA's Glenn Research center have developed a game changing, non-pneumatic, compliant tire. This innovation, called the Superelastic Tire, was developed for future Moon and Mars missions, but is a viable alternative to pneumatic tires here on Earth. This technology represents the latest evolution of the Spring Tire which was invented by NASA Glenn and Goodyear, and inspired by the Apollo lunar tires. The novel use of shape memory alloys capable of undergoing high strain as load bearing components, instead of typical elastic materials, results in a tire that can withstand excessive deformation without permanent damage. Using shape memory alloy as radial stiffening elements can also increase the load carrying capacity of the tire. The Superelastic Tire offers traction equal or superior to conventional pneumatic tires and eliminates both the possibility of puncture failures and running "under-inflated", thereby improving automobile fuel efficiency and safety. Also, this tire design does not require an inner frame which both simplifies and lightens the tire/wheel assembly.

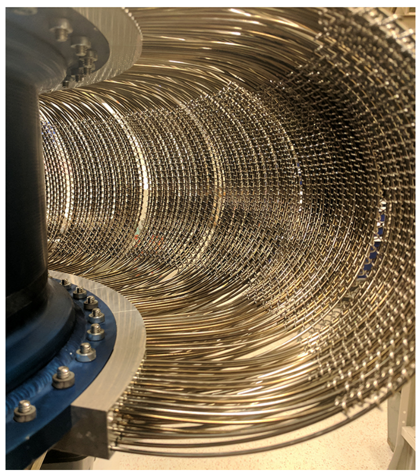
BENEFITS

- Safe: Eliminates the possibility of puncture failure
- Strong: Can withstand excessive deformation
- Robust: Can be configured for high traction on various terrains
- Simple: Eliminates the need for air
- Versatile: Tire stiffness can be designed to limit energy transferred to vehicle
- Lightweight: No inner frame needed for the tire/wheel assembly

THE TECHNOLOGY

This NASA Glenn innovation comprises a non-pneumatic, compliant tire utilizing shape memory alloys (mainly NiTi and its derivatives) as load bearing components. These shape memory alloys are capable of undergoing significant reversible strain (up to 10%), enabling the tire to withstand an order of magnitude more deformation than other non-pneumatic tires before undergoing permanent deformation. Commonly used elastic-plastic materials (e.g. spring steels, composites, etc.) can only be subjected to strains on the order of ~ 0.3-0.5% before yielding. Hence, the use of a NiTi shape memory alloy produces a superelastic tire that is virtually impervious to plastic deformation. In addition, the utilization of shape memory alloys provides enhanced control over the effective stiffness as a function of the deformation, providing increased design versatility. For instance, the Glenn Superelastic Tire can be made to soften with increased deflection, reducing the amount of energy transferred to the vehicle during high deformation events. In addition, the use of shape memory alloys in the form of radial stiffeners, as opposed to springs, provides even more load carrying potential and improved design flexibility. This type of compliant tire would allow for increased travel speeds in off-road applications.

NASA Glenn's Superelastic Tire is a viable alternative to the pneumatic tire. The tire shown here is all metal but could be encased in rubber for improved performance.



The use of shape memory alloys in the form of radial stiffeners provides even more load carrying potential

APPLICATIONS

The technology has several potential applications:

- Automotive (trucking, all-terrain, commercial, automobile tires)
- Military (Improvised Explosive Device (IED), ballistic resistant tires)
- Industrial machinery (heavy-duty construction, agriculture tires)
- Aerospace
- High-performance sports
- Search and rescue

PUBLICATIONS

Patent No: 10,449,804; 10,427,461

Patent Pending

More Information

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Agency Licensing Concierge

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LEW-18729-1, LEW-19444-1, LEW-19444-2, LEW-TOPS-99