

# 1992 Marks Important Gear Design Milestone: Lewis' Bending Strength Equations Now 100 Years Old



Columbus' first voyage to the Americas is not the only anniversary worthy of celebration this year. In 1892, on October 15, Wilfred Lewis gave an address to the Engineer's Club of Philadelphia, whose significance, while not as great as that of Columbus' voyage, had important results for the gearing community. In this address, Lewis first publicly outlined his formula for computing bending stress in gear teeth, a formula still in use today.

While the Lewis equations are taken for granted today, a hundred years ago, there were at least 48 known "rules" for calculating bending strength, yielding values which varied as much as 500%. Lewis brought some order to this chaotic situation when he found that the load stress on a gear tooth could be compared to applying that same load onto a parabola of the same general size as the gear tooth. While it is virtually impossible to compute the stress on an involute curved member, such as a gear tooth, it is possible to compute the stress of a load imposed onto a parabola. It was on the basis of this observation that he developed the Lewis bending strength formula.

At the time he delivered his paper, "The Investigation of the Strength of Gear Teeth," to the Engineers' Club of Philadelphia, Lewis was employed by William Sellers & Co., of Philadelphia. He began his work there as a mechanic after his graduation from the Massachusetts Institute of Technology and subsequently served as a draftsman, designer, assistant engineer, and finally, director of the plant. In 1900 he became president of Tabor Manufacturing Company, where he remained until his retirement.

Lewis was the author of numerous books, papers, and over 50 inventions. In 1927 he received the Medal of the American Society of Mechanical Engineers for his contributions in the field of gearing. He won the Franklin Institute's Longstreth Medal twice; in 1899 for his invention of an "inertia indicator" and in 1927 for a "shockless jarring machine." He died in 1929 on the return trip from Tokyo, where he had attended a convention of the World Engineering Conference, and was buried at sea.

*The editors wish to thank William R. Rollins for bringing the Wilfred Lewis paper to our attention and for his help with the research and preparation of the article. Mr. Rollins is the principal in Aerospace Planetary Gear Consultants, a gear research, design, and development firm in South Windsor, CT.*