TECHNICAL CALENDAR

August 25-27
SME WORKSHOP:
International EDM
Lake Geneva, WI

Sept. 22-24
SME WORKSHOP:
Modern Grinding Technology
Detroit, MI

Call For Papers

SME Gear Processing & Manufacturing Clinic
Nov. 17-19, 1987
Detroit, MI

Proposals for papers must be submitted to the SME prior to **June 19, 1987**. They should be in the form of a title and an abstract of 100 words or less.

Suggested topics include, but are not limited to:

CNC and gear manufacturing, Gear grinding techniques, Gear tool design, Gear tooth scoring, Gear tooth honing, High speed gearing, CNC and gear manufacturing, Hob sharpening, Hard gear finishing, Gear shaping, Gear grinding, Gear measuring, Broaching gears, Inspection techniques

Tabletop Exhibits

An additional feature of the Gear Processing and Manufacturing Clinic will be a series of tabletop exhibits scheduled for the first evening of the program. Gear designers and gear manufacturers and equipment suppliers are invited to display company products and literature at these exhibits.

For more information on SME events contact Joe Franchini at SME, 1 SME Dr., P.O. Box 930, Dearborn, MI 48121, (312) 271-1500.

Tour of Belgium, Switzerland & Germany

A trip to visit gear manufacturing and machine tool plants in Switzerland, Germany and Belgium is currently being planned by AGMA for **September 12-26,** providing the opportunity to see first hand the operation of these high-tech companies. There will be a visit to two Gear Research Institutes: one in Munich with Dr. Winter and a second in Aachen with Dr. Wech. The visit will include time at the October Fest in Munich and plenty of time for sightseeing. The trip is open to anyone who is interested. AGMA membership is not a requirement.

If you are interested or wish further information, contact Joe Arvin, Arrow Gear Co., 2301 Curtiss St., Downers Grove, IL 60515, (312) 969-7640.

VIEWPOINT

Editors Note: As this issue of GEAR TECHNOLOGY was almost ready to go to press, we received a copy of AGMA's March newsletter. It contained the following item by Mr. Joe Arvin, V.P. — Product Division of AGMA and Executive Vice President and General Manager of Arrow Gear. Because it provides another perspective on the subject of our editorial, we are reprinting it in entirety.

Touring Scandinavian Gear Plants

Joe Arvin
Arrow Gear
Downers Grove, IL

As I reflect back on my trip to Denmark, Finland, Norway and Sweden, the first thought that comes to mind is the excellent caliber of the dozen manufacturing companies that we visited. Most of them were very clean and well managed with the latest machine tools that are available anywhere in the world. The vast majority of their machining centers were Japanese built equipment.

The average top hourly wage at plants I visited was $8.00/hr. with an additional $4.00 for fringe benefits. In Finland, the government-owned companies have a depreciation write-off of one-half of the book value per year on new capital equipment. Privately held companies have an investment write-off of 30% per year up to seven years. There are extremely low interest rate loans available from the government for new manufacturing facilities and government subsidies for new manufacturing companies in rural areas.

During our visit to the ASEA Robotics plant in Sweden, we all were astonished by the money that is being put into research and development in what ASEA feels is one of the "up and coming" technologies. They sold 19 robots in 1974, whereas in 1985, over 2,200 were sold. And management proudly boasted that by 1990, they will be the leading robot manufacturer in the world.

Upon arrival at the Stockholm Sheraton in Sweden, I was contacted by Goran Lundstrom, Technical Editor of the Stockholm Press. He said that he had heard that I was V.P. of the American Gear Manufacturers Association, that he wanted very much to interview me and so I agreed. During my listing of the countries

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and companies that we were visiting in Scandinavia, he periodically kept asking why I was there. I kept giving him the same answer: that I have visited gear and machine tool manufacturers in over a dozen countries during the past five years, and that I always found it interesting to see how other people were doing the same type of work that we do at Arrow Gear. I told him we also reciprocated by permitting foreign visitors to tour our plant, and that it was no longer an Asian/European/USA economy, but a worldwide economy that we are living in, and that we all have to get along together in this environment. I also told him that I was trying to help the AGMA to get its standards accepted in the world marketplace.

After the inverview was over, I asked Mr. Lundstrom why he kept questioning me as to why I was there. He said with a smile, the question wasn't why were we in Scandinavia and why did we visit these specific companies, but why weren't we also visiting their universities and their technical centers as the Japanese visitors do. Not only are the Japanese the No. 1 visitors to Scandinavia, but they spend literally months there visiting all the companies they can and spending weeks at their universities and tech centers. He also said that he and most Scandinavians thought America was a wonderful country, and that it was a shame that the U.S. manufacturing people were not spending more time in Sweden and in other corners of the world, absorbing their intellectual knowledge and bringing it back to the United States as the Japanese do for Japan.

One of the things that has continued to bother me a great deal in my numerous travels around the world, is the number of consumer products, complete assemblies, or component parts that are being made by foreign comanies and end up being sold in the United States. This is not only due to commercial overseas joint ventures by major U.S. corporations, but also by the U.S. government and branches of the Armed Forces buying foreign components and products.

For example, I discovered during this Scandinavian trip alone that the U.S. government buys component parts from Kongsburg Vaapenfabrik, Norway, for the F-16 fighter, ASN Pentagon missile, and that the U.S. Air Force gave them $8 million dollars for the development of an automated machining cell for jet engine rotors. When there are so many U.S. manufacturing companies going out of business daily, we should at least enjoy the business of our own government.

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FROM THE

Give Your Gears a Break — Select the Right Coupling!

Stan Jakuba,
S.R. Jakub Associates
West Hartford, CT

How important is the right choice of coupling in determining successful machine design? Consider the following example. A transmission of appropriate size was needed to transfer the speed of the engine driver to that of the driven generator. The transmission was properly selected and sized to endure the rated power requirements indefinitely, but after only a short time in operation, it failed anyway. What happened? The culprit in the case was a coupling. It provided the necessary power and protection against misalignment, but it lacked the ability to isolate the gears from the torque peaks of the diesel engine.

All reciprocating engines produce uneven torque with peaks much higher than the value of the rated torque. The torque fluctuations are caused by the variations in the tangential forces acting on the crankpins. The engine flywheel smooths the fluctuations to some extent; the more inertia it has, the better job it does. Unfortunately, the more inertia a flywheel has, the heavier it usually is, and therefore, invariably, the light and powerful engines of today are "jerky" in this respect. Their flywheels are light to keep the engine mass down. On the other hand, they often drive relatively heavier equipment. The rotating components of the driven equipment may very well have more inertia than the engine flywheel. We will explore the negative effects these features have on the load imposed on the gears in transmissions, power take-offs, step-up gears, and similar mechanisms and discuss possible countermeasures.

Torque Fluctuations at the Prime Mover Output

One of the highest torque fluctuations is present in diesel engines. The size of the fluctuations depends on many fac-

AUTHOR:

MR. STAN JAKUBA *has over twenty years experience in the gear industry in the United States and overseas. President of S.R. Jakub Associates, Engineering and Training Consultants, Mr. Jakuba was educated in Czechoslovakia and holds a masters degree in mechanical engineering from MIT. He is the holder of several patents for engineering products and is a member of ASME and SAE. He is also secretary of the U.S. Metric Association.*

is not easily predictable, and several resonant speeds may be present in the desired operating range.

The most common type of stiff coupling is the ordinary universal joint drive shaft. This type of coupling is often noisy. The noise is usually an indication of the operation in a resonant region. A backlash in the driveline makes the noise, and the stresses in the transmission are further increased with the backlash.

Generally speaking, the use of a torsionally stiff coupling requires that the coupling and the transmission are oversized in comparison to the case when the soft coupling is used. They have to withstand torque values much higher than the values predicted from the power absorbed by the equipment. How much higher depends largely on the relative sizes of the polar moments of inertia of the equipment rotating components with respect to the prime mover rotating components.

Conclusion

For maximum protection of the transmission preference should always be given to the use of a torsionally soft coupling. When selecting a soft coupling, the objective is to find one of the desired physical configuration, torque capacity and allowable speed, which also exhibits the lowest torsional spring rate in its class, and is designed to fail at a load safe for the transmission.

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Dear Editor:

The article by Mr. Dale on "Gear Noise and the Sideband Phenomenon" contains some interesting test results, but may have given a slightly deceptive idea of what is currently possible.

The interaction of amplitude and frequency modification with resonances has been recognized for some time, although it is not the only possible way of obtaining highly asymmetric sidebands especially in epicyclic gears.[1] In the case quoted, the effects of pitch errors which only repeat every 559 teeth will give modulation at a vast range of frequencies, all multiples of the basic mesh cycle frequency.

Single flank testing is normally carried out slowly, and the article suggests that it is not possible to carry out transmission error checks at speed; this is, however, done at full speed and full torque on gearboxes. When testing under these conditions, it is easy to use time averaging techniques[2] which are more powerful than simple frequency analysis and have the advantages of separating out pitch errors on the two gears and increasing the accuracy of the results.

J. D. Smith
University of Cambridge
England

1. P. D. McFadden and J. D. Smith, "An Explanation for the Asymmetry of the Modulation Sidebands About Tooth Meshing Frequency in Epicyclic Gear Vibration." *Proc. Inst. Mech. Eng. 1985, 199* (C1), pp. 65-70.
2. J. D. Smith, *Gears and Their Vibration*. Marcel Dekker, New York and MacMillan, London. 1983.

Letters for this column should be addressed to Letters to the Editor, GEAR TECHNOLOGY, P.O. Box 1426, Elk Grove Village, IL 60007. Letters submitted to this column become the property of GEAR TECHNOLOGY. Names will be withheld upon request; however, no anonymous letters will be published. Opinions expressed by contributors are not necessarily those of the editor or publishing staff.