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SEPTEMBER 2023

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SEAFLOOR ENGINEERING

FEATURING:

International Submarine Races

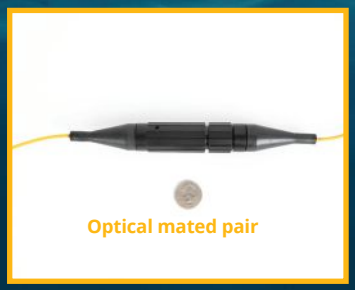
3D Subsea Asset Management

Q&A: Jim Cairns

Finally.

Compact Wet Mate connector technology has arrived.

Optical wet mate



Optical mated pair

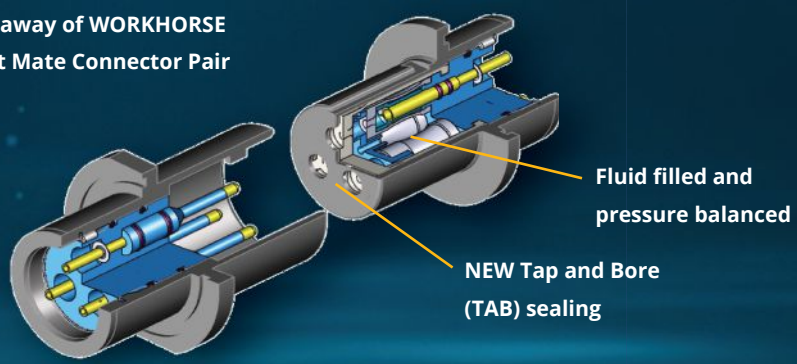
4-way electrical wet mate

Ready to disrupt an industry that's been virtually unchanged for the past 30 years?

Miniature, lightweight wet mateable connectivity is now a reality, thanks to a breakthrough sealing technology. Developed by the inventor of the first fluid-filled wet mate connector, complex spring-and-stopper mechanisms are replaced with a simple, one-piece seal for the highest reliability in a compact package.

Be the first to acquire the technology and launch a new class of compact electrical, fiber optic and hybrid (electrical / optical) wet mate connectors.

Cutaway of WORKHORSE Wet Mate Connector Pair



PONTUS SUBSEA CONNECTORS

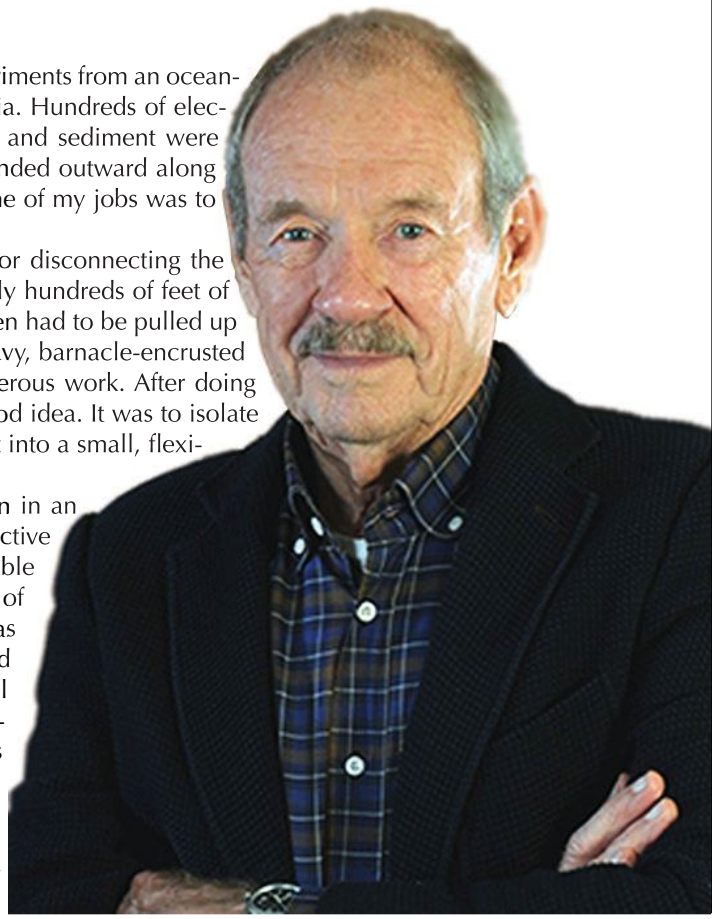
Learn More pontus-subsea.com

Read more about this technology on page 26.

Q&A: Dr. Jim Cairns

Jim Cairns has had a long and distinguished career as an inventor and entrepreneur in the field of oceanographic research. He studied under the late, legendary Walter Munk, one of the world's greatest oceanographers. Oceanographic research led Cairns to introduce underwater connector technology that has enabled critical programs throughout the world's oceans. His work continues with a new company to create his latest connector technology. He spoke with *Sea Technology* about his work in the industry over the decades and his most recent startup venture.

You patented the world's first oil-filled, pressure-balanced underwater connectors in 1968, followed eventually by 60 U.S. patents on subsea electrical and fiber-optic interconnect devices. What spurred the idea for your first patented invention?

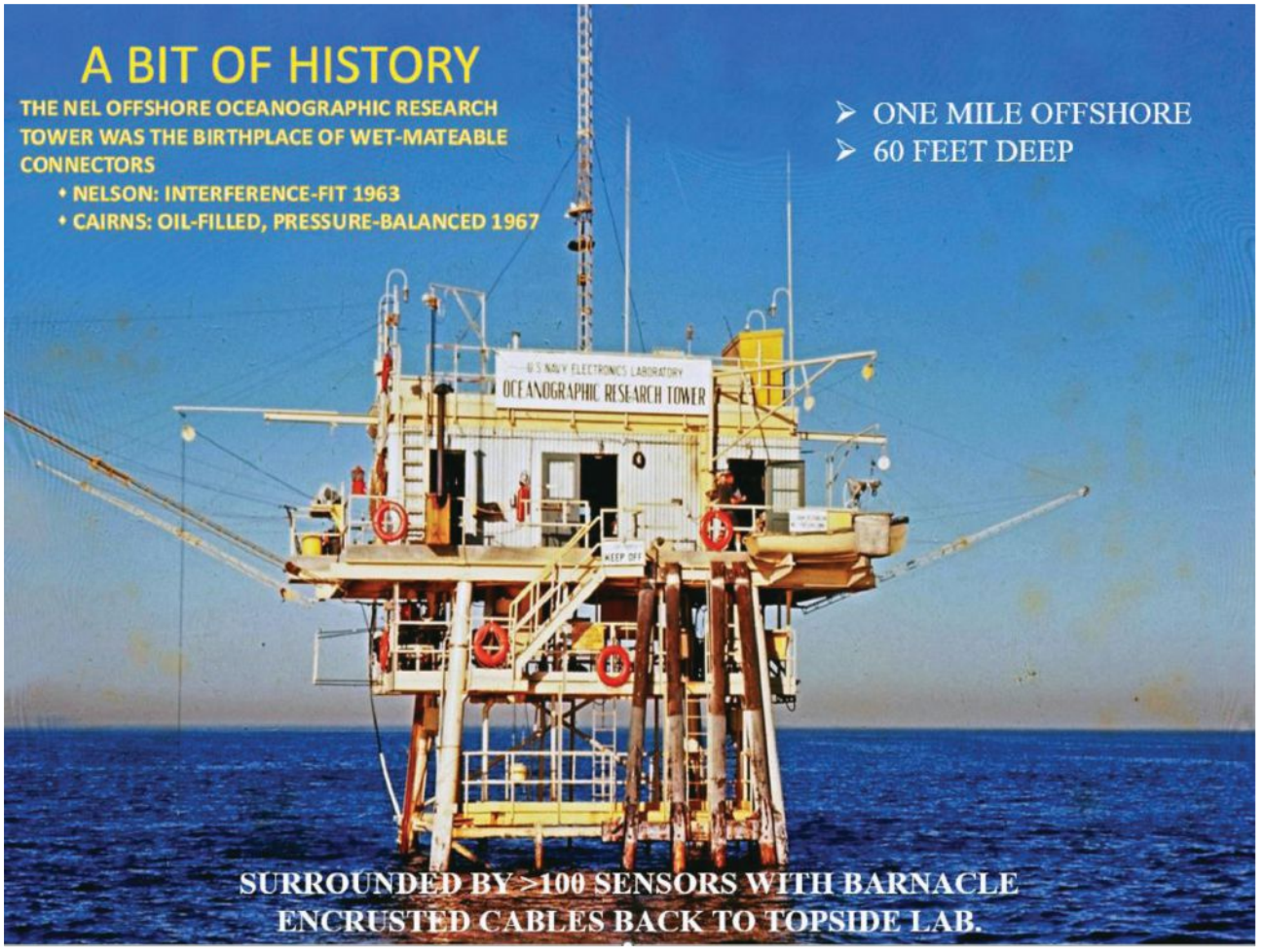


As a young oceanographer in the 1960s, I conducted experiments from an oceanographic research tower offshore of Mission Beach, California. Hundreds of electronic sensors measuring various properties of the seawater and sediment were arrayed on cables that ran down the tower's 60-ft. legs, extended outward along the seafloor, then were buoyed upward in vertical arrays. One of my jobs was to keep them all working.

No reliable electrical connectors existed for connecting or disconnecting the sensors underwater. To replace a faulty sensor, it, and possibly hundreds of feet of cable joining it back to the topside instrument laboratory, often had to be pulled up for repairs. Diving under and around the tower, dragging heavy, barnacle-encrusted cables in murky, sometimes frigid water was grueling, dangerous work. After doing that hundreds of times, misery led me to a fundamentally good idea. It was to isolate the point of electrical contact from the seawater by moving it into a small, flexible chamber of benign, insulating fluid.

Its basic elements were to make the electrical connection in an electrically insulating fluid of choice, not corrosive, conductive seawater; provide that fluid in a flexible, sealed, penetrable chamber; and balance the chamber's interior pressure to that of the outside seawater to avoid pressure-induced leakage. I was able to secure the first patent ever filed on the oil-filled and pressure-balanced concept: U.S. 3,522,576. It contained all the basic elements of fluid-filled underwater mateable connectors that some years later revolutionized subsea operations worldwide.

Tell us about your relationship with the legendary oceanographer Walter Munk when you were a grad student at Scripps Institution of Oceanography. How did he influence



your work? What were the most important lessons you learned from him?

In 1969, I was accepted as a Ph.D. candidate at the Institute of Geophysics and Planetary Physics [IGPP] at Scripps Institution of Oceanography [SIO] at the University of California San Diego. Professor Walter Munk established IGPP on the SIO campus and for most of his later life conducted his research there. He became my thesis adviser and mentor. I worked in Walter's group from 1969 through 1976 both as a student and later as a post-doctorate researcher.

In late 1976, I accepted a three-year research position with NATO in La Spezia, Italy. Walter and I continued to work together long distance the whole time I was there. Those years in Italy changed my outlook on life, and when my NATO contract ended I decided to take some time off from research to see if I could make a living as an inventor.

I was nervous about telling Walter of my decision because we had worked together for so long and he had devoted so much time educating me as an oceanographer. I went to stay with him and his wife Judith to explain my plans. Instead of being upset, he urged me to follow my passion. He and Judith invested in my first startup business and in my other businesses that followed.

Walter taught me by example how to think clearly about complex problems. He had a wonderful mind capable of parsing the most daunting issues into a few basic, solvable elements. He always led the way for others.

His curiosity never wavered. Several days before his death I visited him in the hospital in intensive care. He asked me to bring some prototypes of a small invention which I was working on. Semi-reclined on his bed and adorned with tubes and sensors, he listened as I explained the parts laid out on his chest and, as usual, he asked pertinent questions. That was the last time I saw him.

You are not just an inventor. You're also an entrepreneur. What companies have you founded, and why did you start those businesses?

As a research scientist I seemed as far away from being an entrepreneur as one could imagine, but it was the only way to get my ideas into public use.

Independent inventors have two main paths open to them. One is to license or sell rights to their patented products. Early in my inventing career I took that path, licensing my patents many times to others. It was not very satisfying because I couldn't get my hands into the works, but it allowed me to accumulate enough funds to take bigger risks.

The independent inventor's other path is to set up a business to develop, produce and sell his invention. He becomes an entrepreneur.

In 1981, my friend John Folvig, who has a financial background, and I started our first business, Challenger Marine Connectors Ltd. Our financial investors were a few family and friends, including Walter and Judith Munk. Sectioned off by a low wall in part of an auto mechanic's garage and benefiting from all their fumes, loud music and cursing, we set up to manufacture underwater connectors. We purchased a mailing list from *Sea Technology* magazine and sent out a flier describing our only product. Within weeks, we received calls from several defense contractors. Soon after, Lockheed Corporation executives came to our shop. Almost immediately, they set us up in a proper facility, guided us technically and, two years later, purchased Challenger Marine for just under $4 million.

In 1988, John, I, and the same close-knit investors started Ocean Design Inc. [ODI] based on new inventions. ODI grew steadily over the next two decades and was purchased by Teledyne Technologies in 2009 for approximately $110 million.

Had I not become an entrepreneur, none of that would have happened.

What have been the greatest challenges you've faced in developing technology and in developing a business, and how did you resolve those issues?

Invention-based companies often begin with nothing more tangible than an idea or two. Simultaneously developing an invention and setting up all other aspects of a business is a formidable challenge. If you take it on, don't overestimate your own business talents. I got help in my weak areas, trying to leave as little to chance as possible. Others often eagerly identified my own shortcomings, for which I am indebted to them.

Another challenge is to convince the marketplace to accept new technology. People are reluctant to put aside old technology that works, no matter how limiting it is, and switch to something better but unknown. Oil-filled connector technology was not fully embraced by the offshore oil industry until 15 years after its introduction. Persistence finally overcame the acceptance challenge.

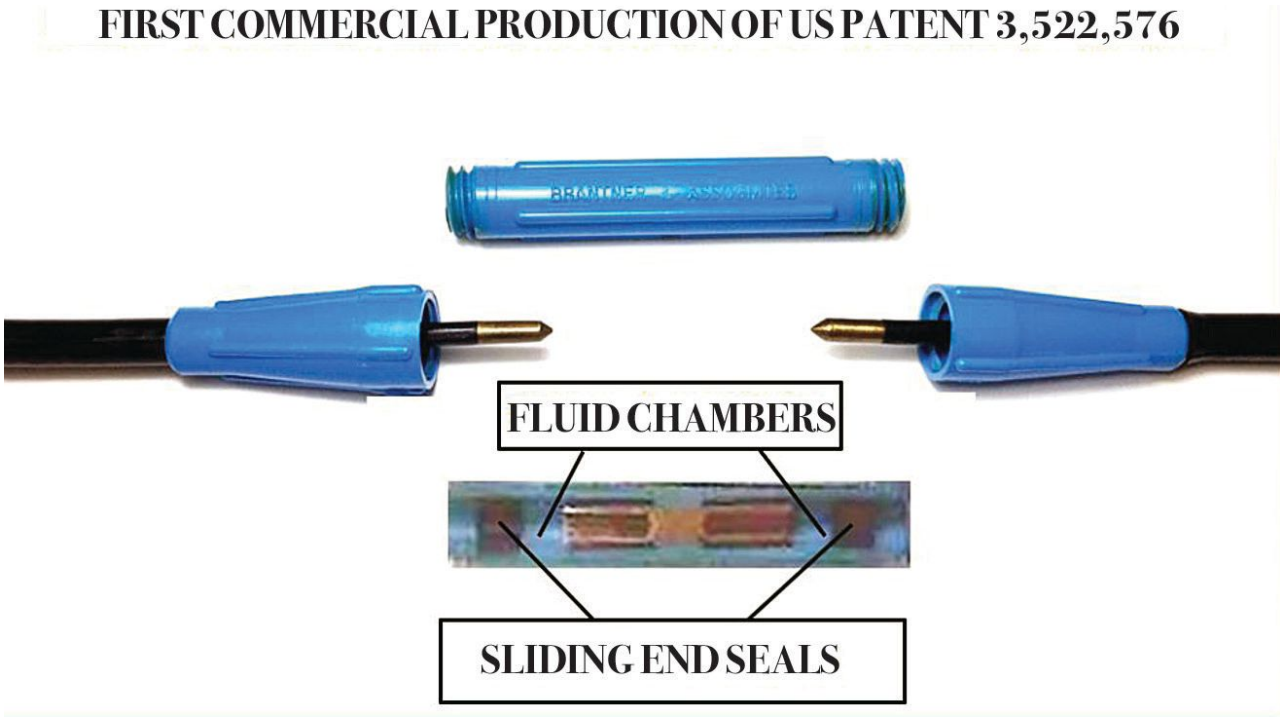
Surprisingly, rapid success is another threat. Once fluid-filled connectors were accepted, orders came in faster than revenues. Money was needed to fill the orders before payments arrived from sales of shipped products. The best way around it is to have solid banking relationships in place beforehand, but that's not easy for a startup business. We almost lost our rapidly growing company because of it.

Finally, it's painful to let employees go who have been essential to the startup company but are no longer competent in the same role in a much larger company, but it must be done. Finding new roles for them in the growing organization was rarely possible.

You set up the Cairns Foundation to support the next generation of innovators. What made you decide to establish that charity? What philosophy/principles do you seek to impart to those students?

The Cairns Foundation was established in 2003 to encourage young people to develop their creative potential through mentoring and financial help. In its early years, it funded scholarships at Bethune Cookman University, a historical black institution.

Then from 2013 through 2022, in cooperation with local schools and government, the foundation hosted an annual Innovation Challenge to identify eager student entrepreneurs. Students applied for the opportunity to pitch their ideas to a large group of potential investors. Of the many applications received each year, six individ-



Pontus Foxhole wet-mate connector pair.

uals or teams were chosen for the pitch competition. The first, second and third place winners received significant cash prizes totaling $15,000. The first-place winner also received a one-year residency valued at $5,000 at the University of Central Florida's Daytona Beach Business Incubator. The students were coached on how to set up nascent commercial activities; how to define, protect and mature their inventions; how to fund their operations; and how to avoid pitfalls along the way. I often had the opportunity to mentor those with invention-based business plans.

The prize money helped the winners get started, and participating in the challenge gave all pitch competitors a bit of much-needed public speaking experience. Several successful ongoing companies were hatched through the Innovation Challenge.

The foundation tries to impart to students that becoming an entrepreneur, even as an inventor, can be a viable career choice. As it did with me, it can start out as an avocation and mature into a full-time activity.

Your creations have enabled tech systems at offshore depths for diverse purposes. How do you see your tech fitting into the energy transition?

Alternate energy sources such as floating and fixed wind farms and ocean current and wave energy generators are proliferating, as are the devices to install and service them. Inspection and maintenance of the new submerged systems, as well as monitoring their security, all require flexible, easily deployed work vehicles such as drones. Lightweight, inexpensive cable and connector hardware for both electrical and optical systems will be needed. Not all have to be connected and disconnected subsea or in splash zones, but many do. Putting a 3-kilogram, $100,000 wet-mateable optical connector on a small drone makes no sense. New connector options are required.

Optical contacts must be immaculate at the moment of engagement in order to function. That is often daunting in a dry laboratory, and a much greater challenge in field use. That's one of the challenges we've addressed at my new company, Pontus. Pontus optical and hybrid electro-optical connectors can be connected and disconnected repeatedly subsea, or nearly anywhere else, without cleaning. They are small, lightweight and relatively inexpensive. They should address many of the connector industry's growing needs.

What are you working on now?

I've been working with a company I started, Pontus Subsea Connectors, to address the growing need for smaller, less expensive and more versatile harsh-environment connectors. Commercially available fluid-filled connectors and ancillary components have primarily been developed for rugged subsea use. Highest-quality electrical connectors and rolling-seal optical connectors are superbly reliable. They've been designed to withstand extremely rough handling and up to 30-year immersion at full ocean depths. But fluid-filled connectors currently on the market are limited. Unfortunately, none of them can be downsized appreciably due to several factors, including their complex chamber-sealing mechanisms.

The most crucial element of fluid-filled connectors is the penetrable end-seal that allows a plug pin to sealably enter and subsequently be withdrawn from a fluid chamber housing a receptacle socket.

Pontus has developed a remarkable new end-seal that does away with the springs, pistons, actuator rods and other mechanisms used to operate the end-seals in existing fluid-filled connectors. The new seal consists simply of an elastomeric end-wall with a crescent-shaped axial perforation. The uncut portion of the crescentic cut serves as a substantial elastic force to return the seal to its unperforated, sealed position when the pin is withdrawn. It's hard to imagine anything simpler.

The new sealing technique allows fluid-filled connectors to be much smaller, lighter, with reduced part count, and less expensive than current products. It should open up new markets for use with modern, lightweight systems.

"I've been working with a company I started, Pontus Subsea Connectors, to address the growing need for smaller, less expensive and more versatile harsh-environment connectors."

Pontus connectors with the new one-piece end-seals can be connected and disconnected in almost any environment without further cleaning. Shipboard or terrestrial battle zones come to mind, as well as commercial outdoor and urban subterranean fiber-optic networks.

Anything you'd like to add or emphasize?

Before the availability of oil-filled connectors, the intervention of complex subsea systems was practically limited to diver zones. Now, nearly 60 years later, modularized assemblies can be constructed and repaired worldwide at full ocean depths. The ability to operate throughout the oceans has led to rapid development of manned and autonomous underwater work vehicles. As that technology continues to grow, so will the opportunities to build things on the seafloor. We can begin to do 'normal' sorts of work on much of our planet's surface that heretofore has been inaccessible.

That's going to put a lot of pressure on the underwater connector industry. Current high-reliability, fluid-filled products for heavy-duty use are not suitable for many of the new applications. Connector manufacturers I've talked to recently say they are struggling to fulfill customer orders for their existing products and don't have the bandwidth in their organizations to take on new development projects. They're not taking up the challenge.

Where's the new technology coming from? The manufacturer who is able to introduce it should already have a commanding industry position lasting for decades.

For more information, visit www.pontus-subsea.com. **ST**