DEATH STAR
P.78 Scientists Find the Mega-Supernova

REMOTE-CONTROL SPERM
P.42
The Future of Male Contraception

POPULAR SCIENCE

THE FUTURE NOW

28 HOT PRODUCTS

The Cellphone That Never Dies
P.18

INVENTIONS OF THE YEAR

The 40MPH Electric Unicycle

Low-Cost Rocket Engine

Living Air Filter

Super-Efficient Car Engine

Sewage-Proof Dive Suit

Personal Wind Farm

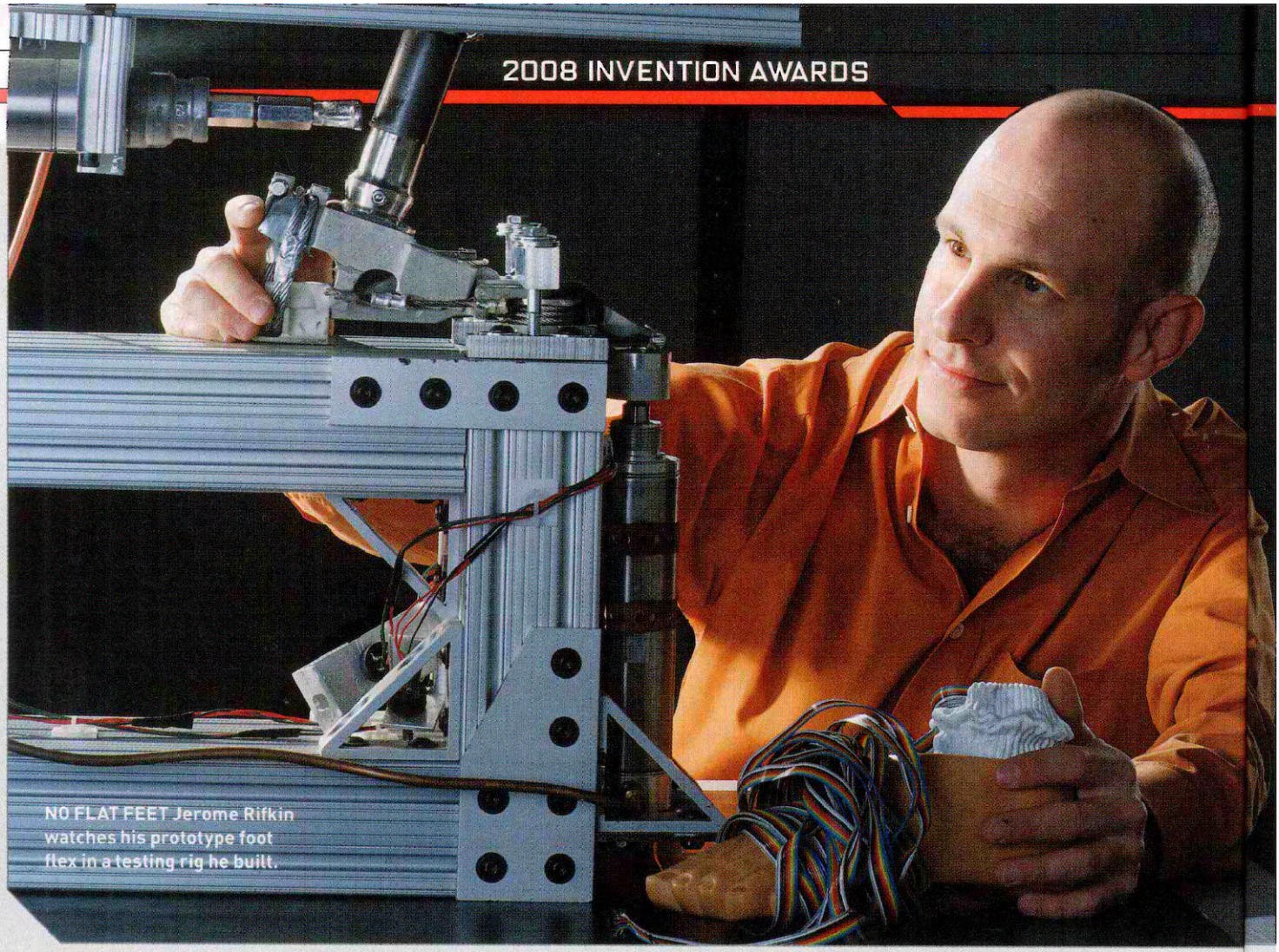
Trapped-Miner Finder

and...A New Cancer-Buster?

PLUS: Our 4-Step Guide to Launching Your Own Invention P.47

POPSCI.COM

JUNE 2008
US $4.99



NO FLAT FEET Jerome Rifkin watches his prototype foot flex in a testing rig he built.

THE IDEA

A MORE NATURAL ARTIFICIAL FOOT

DESCRIPTION
Mimics the jointed motion of a real foot for easier walking

NAME
K3 Promoter

INVENTOR
Jerome Rifkin

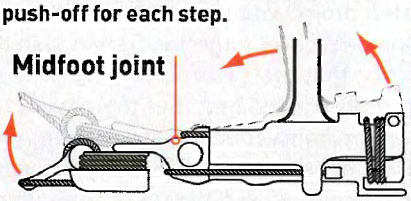
TIME
8 years

COST TO DEVELOP
$100,000

HORIZON
PROTOTYPE ■ ■ ■ ■ ■ PRODUCT

HOW IT WORKS

A flexible midfoot joint makes the prosthetic stable on uneven ground, and a spring-loaded toe provides push-off for each step.



GORDON LINK, A DIABETIC and foot amputee, is not looking to climb Mount Everest, run a marathon, or snowboard off a cliff. "I just want to walk without stumbling like I'm a drunk," he says. It may not sound like a tall order, but until he was fitted with a prototype prosthetic foot that simulates the body's natural movements, walking on uneven ground was like navigating an obstacle course. "Hitting a low spot of even one inch with my old foot was like a non-amputee stepping into a four-inch hole," he adds. "Not good."

Link has been testing the new foot for the past six months, but 36-year-old inventor Jerome Rifkin has been building and rebuilding the flexible mechanical foot for more than eight years—ever since he broke his hip in a bicycle accident and spent three years learning to walk again. The mechanical engineer had studied prosthetics as an undergrad, but his physical therapy was a crash course in the biomechanics of walking. "That's when I realized that prosthetic feet were nothing like natural feet," he says.

With 26 bones, 35 joints, and the awesome responsibilities of weight-bearing and propulsion, the foot is one of

SMOOTHER THAN IT LOOKS
Tensioned cables act like tendons in Rifkin's magnesium foot.

the trickiest body parts to mimic. Today, amputees must choose between mechanical models, which rely on flat carbon-fiber platforms that bend slightly with each step, or a computer-controlled motorized foot that better reproduces a natural gait but can cost up to $18,000 and often isn't covered by insurance.

Working by night in a Boulder, Colorado, cabin, Rifkin built something that combined the natural step of a bionic foot with the simplicity and low cost of a mechanical prosthetic. His jointed foot has a heel, a forefoot, a big toe—and no joint at the ankle. Instead, a novel midfoot joint, which connects the heel and forefoot, does the job of both the ankle and the arch. Like an ankle joint, it flexes up and down to give the wearer a more natural step. And, like a real midfoot joint, it creates a flexible arch in the middle of the foot. A spring and cable connect it to a second joint at the toe, to create extra push-off at the end of each step. Other tensioned steel cables serve as the tendons and ligaments that govern its range of motion—the user doesn't control it, it simply responds to the pressure of walking. Because the front and back of the foot can move independently, it can react to uneven terrain.

With input from 11 amputee test users like Link, Rifkin is refining his fifth (and, he hopes, final) prototype, made primarily of magnesium for its strength and low weight. Early results indicate that the one-pound foot reduces the amount of energy required for each step because it uses the force absorbed by the spring and joints to help propel the foot forward. "It's the equivalent of taking a 50-pound pack off your back," he explains. That's on par with the best bionic feet, without all the expensive motors and artificial intelligence.

Rifkin's main concern now is with durability; a spring keeps popping, mostly because he nicks and weakens its cables during the amputee fittings. "If he can work out the durability issues," says Stanford University prosthetist Gary Berke, "then it could be excellent for the active adult who wants to walk through the city or hike in the park." As for Link, he's moving on to tougher terrain. "It's so natural, I can walk on a golf course."—RENA MARIE PACELLA

CRASH COURSE

SECURING A PATENT

ROBERT KATZ, head of law firm Banner & Witcoff's design patent team and a former patent examiner, guides you through the maze of intellectual property.

- To see if someone has already patented an idea like yours, **use the U.S. Patent and Trademark Office's Web site (*uspto.gov*)**. If you know of a company that makes a similar product, start by searching its name under the "assignee" field. Use that to find your invention's class and subclass, and plug those into the search field along with key terms.

- **Is it novel? Is it non-obvious?** Those are the two requirements. To a patent examiner, "novel" is easy—it hasn't been done before. But "non-obvious" is subjective. If it builds off another product, is your modification the obvious next step? Could someone with "an ordinary skill level" have come up with it? If the answer to both questions is yes, it will probably be rejected.

- Unless you invented a chemical composition, **you'll need at least one drawing**, so hire a patent draftsman to render sketches. It will cost $300 to $600 but spare you delays later, since a draftsman will know the USPTO's requirements.

- **To prepare the application, hire a patent lawyer**, who will not only know how to increase your chance of receiving a patent but will also get you one with a wider scope. Expect to pay anywhere from $6,000 for a simple item like a pen cap to $15,000 for a jet engine.

- The best patent lawyer will be a member of the state bar *and* be registered to practice before the U.S. Patent and Trademark Office. Research who the lawyer has represented (look for big, reputable companies) and for how long (if clients come and go, watch out). **To find out what inventions a firm has handled, search its name in the "Attorney" field on the USPTO page.**

- **Skip any law firm that demands a percentage of your proceeds** in exchange for preparing the application—it's shady. Also, search for complaints against lawyers on the USPTO site.

- If you absolutely can't afford to hand it over to a pro, **find a patent application by a reputable law firm and follow it as a template.**

- Getting a patent granted **can take anywhere from two to five years**, and there's no way to predict how long yours will take.

- **Filing an application doesn't automatically protect your idea.** Eighteen months later, the patent office makes it public. At that point, you can write to people who have been infringing on your claim. You can't legally stop them, but when the patent is issued, you can collect damages starting from when you gave them notice. Provisional patent applications are valid for a year before you file a regular application but offer no real protection against infringement—they're just a placeholder to establish a date of invention.