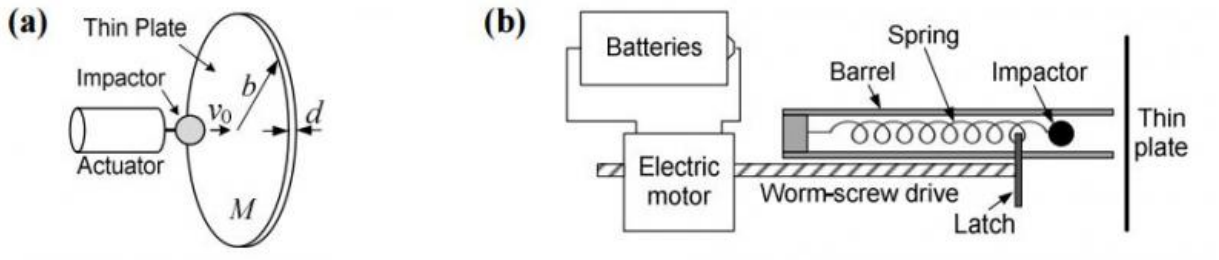
High-power acoustic sensor developed to detect stowaways

July 13 2015, by Nancy Owano



Conceptual sketches of: (a) impact transmitter; and (b) electromechanical pull-type actuator. Credit: arXiv:1507.01479 [physics.ins-det]

New technology has been developed to address the illegal movement across borders of people hidden in containers. SPIE, the international society for optics and photonics, in comments about today's technology efforts, said the ability to see inside sealed cargo was important. "With 200 million shipping containers being moved around the world annually, fast and effective ways of scanning the cargo are needed." They said that "Sensing through the walls of metal cargo containers can be done with gamma rays, however this is not safe when considering the possibility of people being stowed away inside these containers as a means of travel." They said that "The only current technology that can safely sense people behind the metal walls is acoustic."

Franklin Felber of California-based Starmark, a company that does

research and development for the defense and health-science industries, has written a paper that indicates success in that direction. The paper, posted on the arXiv server, is about a high-power acoustic through-the-wall sensor that can detect people through steel walls of cargo containers, trailer truck bodies and train cars. Translation: it can spot stowaways. He said the sensor has been developed and demonstrated.

The paper is titled, "Demonstration of novel high-power acoustic through-the-wall sensor." The technology presented, said Felber, who is co-founder of Starmark, offers the potential for rapid nonintrusive detection of stowaways inside closed steel cargo containers, truck bodies, and train cars.

Felber's approach involves a mechanical transmitter that is compact, lightweight, low-cost, can operate on battery power and produces acoustic pulses in dense media at one or more frequencies "orders of magnitude more powerful" than those produced by other transmitters of comparable scale; a resonant receiver matched to the transmitter; and methods of signal processing.

MIT Technology Review said passive millimeter wave sensors require a source of illumination to see though walls. Microwave radar systems do not pass through metal walls; systems based on the detection gamma rays , designed primarily to detect nuclear materials, are not suitable for use on humans; acoustic sensors can work in sending signals through metal walls but a drawback has been their lack of power to detect humans.

The acoustic sensor that Felber developed, said *MIT Technology Review*, "is both powerful and sensitive enough to detect the breathing motion of an otherwise stationary human on the other side of a cargo container wall ."

Felber said the device is capable of nonintrusively scanning steel cargo

containers for stowaways at a rate of two containers per minute.

MIT Technology Review discussed how his system works. Felber's acoustic transducer operates with a nine-volt battery. "His new machine is essentially a hammer or, as he calls it, a mechanical impact transmitter," said the review.

"This produces a powerful acoustic signal by repeatedly banging on a metal disc, which then resonates at a specific frequency. When attached to a container wall, the signal passes through into the air on the other side. An acoustic receiver picks up any reflections from each pulse and a signal processor then subtracts these from the reflections from the previous pulse. Reflections that haven't changed, ones from stationary objects, cancel out. That leaves only the reflections from moving objects, such as people."

Device tests showed it could detect a person on the other side of a wall either moving or stationary, from breathing action. The author said that "Lives could even be saved of those trying to escape detection by remaining motionless, like stowaways inside cargo containers, who are at risk of death by dehydration on long voyages, if undiscovered beforehand."

More information: Demonstration of novel high-power acoustic through-the-wall sensor, arXiv:1507.01479 [physics.ins-det] arxiv.org/abs/1507.01479

Abstract
A high-power acoustic sensor, capable of detecting and tracking persons through steel walls of cargo containers, trailer truck bodies, and train cars, has been developed and demonstrated. The sensor is based on a new concept for narrowband mechanical-impact acoustic transmitters and matched resonant receivers. The lightweight, compact, and low-cost

transmitters produce high-power acoustic pulses at one or more discrete frequencies with little input power. The energy for each pulse is accumulated over long times at low powers, like a mousetrap, and therefore can be operated with ordinary batteries and no power conditioning. A breadboard impact-transmitter and matched-receiver system that detected human motion through thick walls with only rudimentary signal processing is described, and results are presented. A conceptual design is presented of an acoustic through-the-wall sensor, costing about $10,000 per unit and capable of remotely and non-intrusively scanning steel cargo containers for stowaways at a rate of two containers per minute. Advantages of acoustic through-the-wall sensors over radar are: Sound penetrates metal walls; and acoustic sensors are sensitive to small and slow motions, and so can detect stationary persons by breathing motion alone. Other attractive features include: high-resolution locating and tracking; portability; low cost; quick and easy preparation and deployment; and near-real-time data processing and display. These features provide a robust stand-alone through-the-wall surveillance capability or an excellent complement to a radar sensor.

Citation: High-power acoustic sensor developed to detect stowaways (2015, July 13) retrieved 17 April 2024 from https://techxplore.com/news/2015-07-high-power-acoustic-sensor-stowaways.html