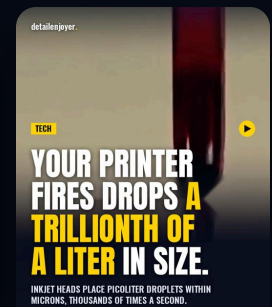




COLLECTION · COL-05

ENGINEERING ODDITIES

Clever machines that solve small problems in surprising ways, from spinning LED 'hologram' fans to tubs that melt a city's snow, new pipes cured inside old ones, pumps that squeeze fluid through a tube, trailer floors that walk their load out, air-held domes over building sites, wire that springs back to shape when heated, farm sprinklers that strike themselves to turn, rocket test stands flooded with water, a calculator that never finishes dividing by zero, train couplers that lock on contact and the awning that shaded the Colosseum.



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ABOUT THIS COLLECTION

29 case files on inventions that are stranger, smaller or smarter than they look, including fan blades that paint floating pictures, the machines New York uses to melt its snow, sewer pipes relined without digging, pumps whose fluid touches nothing but a tube, trailer floors whose slats walk a load out the back, fan-held domes that keep a building site's dust inside, metal that remembers its shape, the spring-loaded arm that steps an impact sprinkler around, the water deluge under a rocket test stand, a robot that files 200 bikes under the sidewalk, a mechanical calculator, a railroad knuckle coupler and the Colosseum's velarium. Giken's ECO Cycle stores about 200 bicycles in an underground silo beneath a booth the size of a parked car. **DD-009** Mahjong tiles for automatic tables contain magnets, so the machine can turn every tile face-down before stacking the walls. **DD-017**

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DD-009 · Tech · This robot parks 200 bikes underground.

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Probe IV

DD-002 · Tech / Cars · Ford's 1983 Probe IV concept car (built with Ghia) had a drag coefficient of about 0.15.

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Print Precision

DD-005 · Tech / Science · Your printer fires drops a trillionth of a liter in size.

06



Torque Conversion

DD-075 · Cars / Tech · How an automatic moves without a clutch pedal.

07



Piston Pumps

DD-072 · Tech / Science · A pump whose piston never touches the fluid.

08



Gas Blasting

DD-070 · Tech / Science · Breaking rock with liquid CO₂.

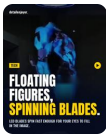
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HoloFans

DD-630 · Tech / Science · Pictures painted in midair.

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HoloFans II

DD-700 · Tech / Science · Floating figures, spinning blades.

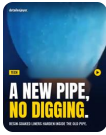
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New York Hot Tub

DD-702 · Tech / Locations · Where city snow goes to melt.

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CIPP

DD-676 · Tech · A new pipe, no digging.

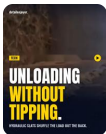
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Peristaltic Pumps

DD-689 · Tech / Science · Squeeze, roll, repeat.

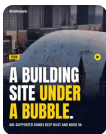
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Walking Floors

DD-665 · Tech / Cars · Unloading without tipping.

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Construction Covers

DD-631 · Tech / Locations · A building site under a bubble.

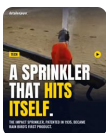
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DD-616 · Science / Tech · Bend it, heat it, it's back.

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Sprinkle Of Truth

DD-581 · Tech · A sprinkler that hits itself.

18



Deluge Days

DD-594 · Space / Tech · Rocket tests run on rivers of water.

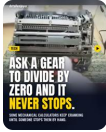
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Vertical Parking

DD-755 · Tech · Part I: why Japan put its bike racks underground, and the round, quake-ready shaft that made it work.

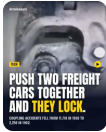
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OVER 0

DD-284 · Tech / History · Ask a gear to divide by zero and it never stops.

21



Knuckle Coupling

DD-303 · Tech / History · Push two freight cars together and they lock themselves.

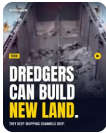
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The Colosseum

DD-121 · Locations / History · Rome's Colosseum had a retractable roof made of fabric.

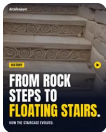
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Dredging Up the...Ground?

DD-323 · Tech / Locations · Dredgers suck sediment from the seabed and can build new land.

24



A Step Up

DD-341 · History / Tech · Spiral stairs in castles helped defenders.

25



The Googol Gears

DD-327 · Tech / Science · Each gear turns ten times slower than the one before it.

26



Earth Movers I

DD-359 · Tech · A Caterpillar 793F hauls about 250 short tons per load.

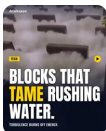
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Quarrels With Quarrying?

DD-376 · Tech · Marble and onyx are sliced out in clean blocks.

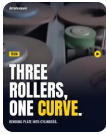
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Baffling

DD-410 · Tech / Nature · Rows of concrete blocks slow water rushing down a spillway.

29



Rolling Steel

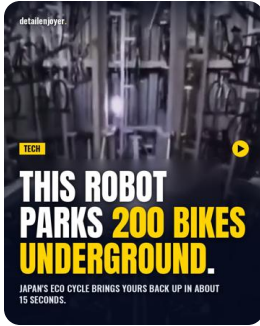
DD-423 · Tech · Three rollers can curl a flat steel plate into a tube.



Collection Quiz and Answer Key

58 questions from every case file

Every quick fact has a stable ID (for example DD-009-F01) and comes from a case file with its sources listed. Online edition with videos and slides: <https://detailenjoyer.com/collections/engineering-oddities/>



DD-009 TECH · 1 OF 29

VERTICAL PARKING II

Giken's ECO Cycle is a robotic bike park buried in a cylinder under the pavement. Above ground there's only a small entrance booth. You push your bike onto a slot and press a button, and a rotating elevator stores it in a ring of racks underground. A standard unit holds about 200 bikes. To get your bike back, you tap an IC card, and it returns in about 13–15 seconds on average. The first unit opened in 1998, and they now sit beside busy stations in Tokyo and other Japanese cities.

QUICK FACTS

DD-009-F01

Giken's ECO Cycle stores about 200 bicycles in an underground silo beneath a booth the size of a parked car.

DD-009-F02

A bike parked in an ECO Cycle comes back up in about 13–15 seconds on average after the owner taps an IC card.

THE WRITE-UP

Culture above ground, function underground. ECO Cycle is Giken's automated bicycle park. A small entrance booth sits on the pavement, and the parking spaces are buried below it.

About 200 bikes per unit. A standard ECO Cycle holds 200 bicycles. The upgraded model introduced at JR Chiba Station in 2009 holds 204, up from 144 in earlier units.

A rotating elevator. Bikes are stored by an elevator that rotates as it moves, filing each bike into the racks around it.

Button in, card out. Users push a button to store a bike and swipe an IC card or tag to get it back. Transit IC cards work too.

Back in seconds. Giken quotes an average retrieval time of 15 seconds, with the fastest at 10 seconds. Other sources give an average of about 13 seconds.

Built for crowded stations. ECO Cycles were designed to clear illegally parked bikes from station pavements. By about 2016, 36 units at 13 sites stored 6,605 bikes, at places such as Roppongi, Shinagawa and Kyoto stations.

Earthquake-proof. The structure is built to withstand an earthquake of Japanese seismic intensity 6-upper.

REEL VS. RECORD

- **Nuance:** 'retrieval takes only seconds' means about 13–15 seconds on average (the fastest is 8–10 s). That's fair, but it isn't instant. [Giken brochure; Giken how-to; JSME; FUN! JAPAN]
- **Nuance:** 'widely used in cities like Tokyo'. There were dozens of units rather than hundreds (36 units at 13 sites by about 2016), mostly next to busy stations. [JSME; FUN! JAPAN]
- **Name:** Giken styles it 'ECO Cycle' (エコサイクル), not 'Ecocycle'. Confirmed: it's automated, underground, vertical, space-saving and made by Giken Ltd. [Giken]
- **Series:** this Reel is part II. I haven't found a part I ('Vertical Parking') in my files, so I list it as a series stub to link once part I turns up.

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Permalink: <https://detailenjoyer.com/case/vertical-parking-ii/> · Last updated May 5, 2026



DD-017 TECH · 2 OF 29

MODERN MAHJONG

Automatic mahjong tables hide a rotating drum under the felt. Players push the used tiles in, and the machine shuffles them, uses magnets to turn each tile face-down, and stacks the four walls. The real trick is that they use two sets of tiles: one is shuffled and stacked inside while the other is in play, so the next hand rises up almost instantly. Fully automatic tables appeared in Japan around 1980, replacing the hand 'washing' and wall-building that went before.

QUICK FACTS

DD-017-F01

Automatic mahjong tables use two sets of tiles: the machine shuffles and stacks one set inside while players use the other.

DD-017-F02

Mahjong tiles for automatic tables contain magnets, so the machine can turn every tile face-down before stacking the walls.

THE WRITE-UP

The old way: by hand, every round. Traditionally, players mixed the tiles by stirring them with their fingers after every round. They then built two-tier rows face-down along all four sides of the table to start the next game.

A spinning drum under the felt. An automatic table hides a chamber with a rotating 'floor' under the playing surface. Tiles pushed in through the table are churned around and fed into ramps in four slots.

Magnets keep tiles face-down. Each tile has a magnet or iron piece inside. The machine's magnets use it to orient every tile face-down before stacking the walls.

Two sets of tiles. The tables come with two sets of tiles in different back colours. While players use one set, the machine shuffles and stacks the other, so the next game can start without interruption.

Walls rise at the push of a button. When a hand ends, the old tiles go into the shuffler and a button raises the ready-built walls up to the table surface. More advanced tables also deal out the starting hands.

Born in Japan around 1980. A semi-automatic table that only flipped tiles appeared in Japan in 1974. Fully automatic tables that shuffle and build the walls arrived around 1980. Takahashi's US patent for a self-assembling table was granted that year.

Fairness and quiet, too. Besides saving time, automatic stacking prevents players from rigging the walls. The 1978 patent also notes that it keeps the clatter of mahjong inside the table.

REEL VS. RECORD

- **Imprecise:** 'shuffle and stack an entire set of tiles in seconds'. The next hand is ready in seconds because the table works on a second set while the current hand is played. The shuffle-and-stack cycle itself runs in the background during play. [US 4,219,200; Japanese Mahjong Wiki; The Men's Cave]
- **Unverified:** 'a process that could take several minutes and added physical wear to the tiles'. No reliable source found for a typical time or for tile wear from hand shuffling. The sources only say manual shuffling and wall-building were done by hand every round. Treat this as the Reel's claim.
- **Confirmed:** the hidden rotating mechanism under the playing surface, and manual mixing and four-wall building in traditional play. [US 4,219,200; Japanese Mahjong Wiki]

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4. History of automatic mahjong tables (Mahjong Goods Lab / 麻雀グッズ研究所, in Japanese): <https://mahjong-item.jp/post-3716/>

Permalink: <https://detailenjoyer.com/case/modern-mahjong/> · Last updated Aug 14, 2026



DD-014 TECH · 3 OF 29

FOOTSTEP POWER

Starting in 2006, JR East tested a 'power-generating floor' at Tokyo Station's ticket gates. Piezoelectric discs inside the floor turn the pressure and vibration of passengers' footsteps into electricity. The best trials made up to about 940 kilowatt-seconds a day. That's only about a quarter of a kilowatt-hour, enough for displays or a ticket gate but not for the station. In 2008 Soundpower tested a similar mat at Shibuya Station that lit a holiday display. The Reel's glowing tiles look like Pavegen's, which work differently: they use electromagnetic generators, not piezo crystals.

QUICK FACTS

DD-014-F01

JR East's power-generating floor at Tokyo Station turns passengers' footsteps into electricity using piezoelectric discs, about 600 per square meter.

DD-014-F02

Footstep-power floors make only small amounts of energy. Tokyo Station's best day was about 940 kW·s, roughly a quarter of a kilowatt-hour.

THE WRITE-UP

Tokyo Station's power floor. JR East has tested a 'power-generating floor' at Tokyo Station since 2006. The 2008 trial at the Yaesu North gates covered about 90 m² of ticket gates and stairs.

Piezo discs underfoot. The floor holds piezoelectric elements, 35 mm discs like those in loudspeakers, about 600 per square meter. They turn the pressure and vibration of footsteps into voltage.

How much power?. The 2008 trial made over 500 kW·s a day on weekdays, peaking at 766 kW·s. A later test peaked at about 940 kW·s a day, or 4.3 W·s per person passing through. A full day's output is roughly a quarter of a kilowatt-hour.

What it's for. JR East wants to use the power for station equipment such as automatic ticket gates and electronic displays. It estimated the output could light a 100 W bulb for about 80 minutes a day.

Shibuya's holiday mat. In 2008 Soundpower Corp. installed a piezoelectric mat at Shibuya Station. A 60 kg person makes about 0.1 W in the second it takes to step across it, and the mat lit a holiday light display.

Not all 'footstep tiles' are piezo. Pavegen's glowing tiles, like those in the footage, compress 5–10 mm. They drive small electromagnetic generators that make about 3–5 W·s per step, which Pavegen says scales better than piezo.

REEL VS. RECORD

- **Mislabeled visuals:** the glowing triangular and square tiles in the footage look like Pavegen tiles. Pavegen uses electromagnetic induction, not piezoelectric materials. The narration's piezo description fits Japan's JR East and Soundpower floors, not the tiles shown. [Pavegen; JR East]
- **Nuance:** 'installed in train stations' should read 'trialled'. JR East ran time-limited demonstration experiments (2006, 2008, 2008–09) and has not rolled out a permanent system. [JR East; NIES/J-GLOBAL; Takefuji]
- **Confirmed:** piezo charge under compression, small amounts of power, and use for LED/electronic displays and low-power devices. [JR East; Japan for Sustainability; Telegraph; WIRED]

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6. Power Generating Floor in Train Stations Light Up Holiday Displays (WIRED, Dec 2008): <https://www.wired.com/2008/12/power-generatin/>
7. How Pavegen works: electromagnetic vs piezoelectric (Pavegen): <https://www.pavegen.com/blog/how-pavegen-works-the-science-behind-every-step-kinetic-energy-flooring-explained>

Permalink: <https://detailenjoyer.com/case/footstep-power/> · Last updated Jun 20, 2026



DD-002 TECH / CARS · 4 OF 29

PROBE IV

Ford's 1983 Probe IV concept car (built with Ghia) had a drag coefficient of about 0.15.

QUICK FACTS

DD-002-F01

The Probe IV was a 1983 concept car built by Ford with the design house Ghia.

DD-002-F02

Ford's 1983 Probe IV concept car had a drag coefficient of about 0.15.

DD-002-F03

The Probe IV was created to showcase futuristic automotive design and advanced aerodynamics, using lightweight materials and a smooth, wide tunnel-shaped body.

DD-002-F04

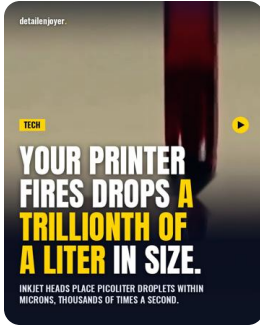
The Probe IV's extremely low drag emphasized fuel efficiency during an era of rising energy concerns.

THE WRITE-UP

1983 Ford concept. The Probe IV was a 1983 concept car from Ford, built with Ghia.

Cd $\approx$ 0.15. Its drag coefficient was about 0.15.

Permalink: <https://detailenjoyer.com/case/probe-iv/> · Last updated Apr 13, 2026



PRINT PRECISION

An inkjet printhead fires drops measured in picoliters, trillionths of a liter. Home printers go down to about 1–1.5 pL, and some lab heads go below 1. Thermal ('bubble jet') heads flash-boil a speck of ink so that a vapor bubble kicks a drop out. Piezo heads flex a crystal to squeeze it out. Drops fly at roughly 5–15 m/s, and Epson heads can fire up to 50,000 times a second. The best industrial heads land each drop within about a micron of its target.

QUICK FACTS

DD-005-F01

The smallest drops from modern inkjet printheads measure about 1–3 picoliters (trillionths of a liter).

DD-005-F02

Inkjet drops typically leave the printhead at roughly 5–15 meters per second (about 14 m/s for HP's thermal heads).

DD-005-F03

Inkjet resolutions like 4800×1200 dpi describe the finest grid a printer can address, not the size of a single dot.

DD-005-F04

Inkjet drops are measured in picoliters (trillionths of a liter). Home printers fire drops as small as about 1.3–1.5 pL.

DD-005-F05

The best industrial inkjet heads land each drop within about ± 1 –2 microns of its target.

THE WRITE-UP

Two ways to fire a drop. Thermal (bubble-jet) heads use a heater to make a vapor bubble that pushes ink out of the nozzle. Piezo heads apply a voltage to a piezoelectric element, which flexes and squeezes the drop out.

Measured in trillionths of a liter. Epson's piezo heads can deposit drops as small as 1.5 picoliters, one-and-a-half trillionths of a liter. HP's low-cost thermal cartridges fire 1.3 pL and 4.7 pL drops from nozzles 8.5 and 14 μm wide.

Even smaller in the lab. Canon's FINE research head ejected drops as small as 0.1 pL from a 2-micron orifice. Industrial heads like the Xaar 1003 AMP jet 1–3 pL sub-drops.

A microsecond boil. In an HP head, a 2.5-microsecond pulse heats a tiny resistor past the superheat point of water. That makes an almost explosive vapor bubble that launches the drop at about 50 km/h (14 m/s).

Speed and frequency. Drop speeds are typically about 5–15 m/s: about 14 m/s for HP's thermal drops, 7 m/s for the Xaar 1003, and 8–12 m/s for Canon's sub-picoliter drops. Epson heads can fire up to 50,000 drops per second.

Within microns. Placement is where the precision shows. A 1 pL head built for printing OLED displays achieved $\pm 1.35\text{ }\mu\text{m}$ landing repeatability. Canon sped up its drops by 1.5 times so that air currents from the moving head push them off target less.

What '4800 dpi' means. Consumer printers advertise figures like 4800×1200 dpi. That's the finest grid the printer can address in its best mode, often combining two drop sizes. It isn't the size of a single dot.

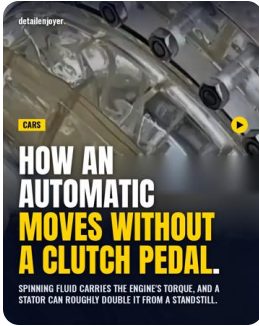
REEL VS. RECORD

- **Confirmed:** droplets are measured in picoliters and placed within microns, and printheads use thermal or piezoelectric actuators. [Epson; Canon; SID Digest; Semiconductor Digest]
- **Correction · earlier version of this page:** '~20 m/s' is high for typical printheads. Sourced values are about 14 m/s (HP thermal), 7 m/s (Xaar 1003) and 8–12 m/s (Canon sub-pL). This page now says 'roughly 5–15 m/s'. [Semiconductor Digest; Xaar; Canon FINE paper]
- **Clarification · earlier version of this page:** 'land at up to 4800 dpi'. 4800×1200 dpi is an advertised addressable resolution in the best mode, not a single dot size or a placement accuracy. [Philstar/HP; Canon]
- **Nuance · earlier version of this page:** '1–3 picoliters' fits the smallest drops of modern home and industrial heads (1.3–1.5 pL consumer, 1–3 pL Xaar sub-drops). Many heads also fire larger 4–12 pL drops for speed. [HP; Epson; Xaar]
- **Nuance:** 'within microns' is achieved by industrial and display heads ($\pm 1.35\text{ }\mu\text{m}$). Desktop printers on paper are looser, because ink spreads and the head moves. [SID Digest; Canon]

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Permalink: <https://detailenjoyer.com/case/print-precision/> · Last updated Oct 17, 2026



TORQUE CONVERSION

A torque converter sits between the engine and an automatic transmission and lets the car idle in gear without stalling. The engine-driven impeller (pump) flings automatic transmission fluid outward into the turbine, which turns the transmission input shaft. The stator sits between them on a one-way clutch. When the turbine is turning much slower than the impeller, as when pulling away from a stop, the stator turns the returning fluid so it helps the impeller instead of fighting it. That multiplies torque by up to about 2.5:1 at stall. As speeds even out, the stator freewheels and the unit acts like a plain fluid coupling. Because constant slip wastes energy as heat, virtually all modern automotive converters add a lock-up clutch that mechanically joins the impeller and turbine at cruise.

QUICK FACTS

DD-075-F01

At a standstill, a car's torque converter can multiply engine torque by about 2 to 2.5 times, thanks to a part called the stator.

DD-075-F02

Most modern torque converters still contain a mechanical clutch, which locks up at cruising speed to stop fluid slip.

THE WRITE-UP

Why automatics need one. The torque converter replaces the clutch in most automatic cars. Because it allows slip between input and output, the car can sit still in gear with the engine running.

Pump and turbine. The impeller, bolted to the engine, pumps fluid into the turbine, which drives the transmission input shaft. Together with the stator, these parts form the 'torus' that the fluid circulates through.

What the stator adds. A plain fluid coupling has no stator. Without one, fluid leaving the turbine would hit the impeller against its rotation and brake it. The stator reverses that flow so it helps instead.

Torque multiplication. The effect is strongest at stall, when the turbine is barely turning. Typical converters multiply torque by about 1.8 to 2.5 times there, and the effect fades as the turbine catches up.

The one-way clutch. The stator sits on an overrunning clutch. It's held still during multiplication and freewheels near the coupling point, so it doesn't get in the way.

Lock-up. Slip turns some power into heat, so modern converters include a lock-up clutch that mechanically links the impeller and turbine above roughly a 0.9 speed ratio.

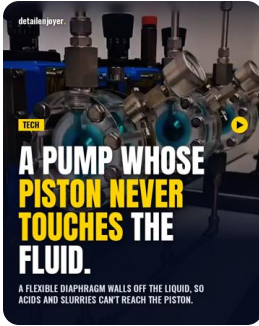
REEL VS. RECORD

- **Confirmed from the frames:** the Reel is about an automatic transmission's torque converter (captions at 0.8–8.4 s). It has three parts: an engine-driven impeller, a turbine on the transmission input shaft, and a stator that multiplies torque at low speed. [IEEE; Wikipedia]
- **Imprecise:** 'a torque converter is a fluid coupling.' It's a fluid coupling plus a stator. A plain fluid coupling can transmit torque but can't multiply it. [IDC; Wikipedia]
- **Outdated:** 'instead of a mechanical clutch.' Virtually all modern automotive converters include a lock-up clutch that mechanically joins the impeller and turbine at cruise to eliminate slip. [IEEE; IDC]
- **Missing detail:** the stator works only at low speed ratios. It sits on a one-way clutch, multiplies torque by up to about 2.5:1 at stall, and freewheels near the coupling point. [IEEE; Wikipedia]
- **Footage note:** the clip shows a converter-style unit in a transparent housing filled with fluid, apparently a demonstration piece. The Reel doesn't say what model it is. [frames]

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Permalink: <https://detailenjoyer.com/case/torque-conversion/> · Last updated Feb 26, 2026



PISTON PUMPS

A piston diaphragm (membrane) pump is a reciprocating positive-displacement pump. In most designs a crank-driven piston doesn't push the diaphragm directly: it moves a sealed hydraulic fluid, and that fluid flexes the diaphragm. On the suction stroke the pump chamber expands, the inlet check valve opens and liquid flows in. On the discharge stroke the diaphragm pushes into the chamber, the inlet valve closes and the outlet valve opens. Only the diaphragm, chamber and check valves touch the pumped liquid, so the pumps are used for slurries, acids and shear-sensitive products. Large mining models handle slurries of up to 85% solids at up to 250 °C.

QUICK FACTS

DD-072-F01

In most piston diaphragm pumps, the piston pushes hydraulic oil, and the oil flexes the diaphragm.

DD-072-F02

In a piston diaphragm pump, only the chamber, the diaphragm and the check valves touch the pumped liquid.

THE WRITE-UP

Positive displacement. A piston diaphragm pump moves a fixed volume of liquid with each stroke, like a piston pump. The difference is that a flexible diaphragm, also called a membrane, separates the pumped liquid from the piston.

Piston, oil, diaphragm. In most designs the piston doesn't push the diaphragm directly. It moves a hydraulic fluid, and the fluid flexes the diaphragm.

Suction and discharge. On the suction stroke the chamber expands, the inlet check valve opens and liquid flows in. On the discharge stroke the diaphragm presses into the chamber, the inlet valve closes and the outlet valve opens.

What touches the liquid. Only the inside of the pump chamber, the diaphragm and the check valves touch the pumped liquid. That protects the piston and seals, and it leaves the valves as the main wear parts.

What they pump. The pumps are used for abrasive slurries, acids, toxic media and shear-sensitive products. Weir's GEHO mining pumps handle slurries of up to 85% solids at temperatures up to 250 °C.

Leak detection. Diaphragms are often built in two layers with a sensing port between them. A pressure switch on that port can detect a rupture and shut the pump down.

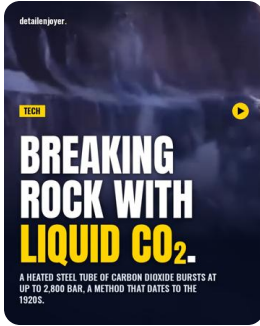
REEL VS. RECORD

- **Nuance:** in most piston diaphragm pumps the piston doesn't drive the membrane directly. It moves a hydraulic fluid, and that fluid flexes the diaphragm. [Emmerich; ABEL; Universal Pumping]
- **Missing context:** the inlet and outlet check valves are what make the flow one-way. They touch the liquid too, so they, not the piston, are the main wear parts. [Star Pump Alliance; Weir]
- **Terminology:** in English the part is usually called a diaphragm, so the pump is usually called a piston diaphragm pump. Manufacturers also use 'membrane'. [Star Pump Alliance; Emmerich]
- **Confirmed:** it is a positive-displacement pump with suction and discharge strokes, and the pumped liquid doesn't touch the piston or drive. 'Sensitive' liquids include shear-sensitive products. [ABEL; Star Pump Alliance]
- **Context on scale:** big mining versions, such as Weir's GEHO pumps, move slurries of up to 85% solids at up to 250 °C, for example through ore pipelines and tailings lines. [Weir]

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Permalink: <https://detailenjoyer.com/case/piston-pumps/> · Last updated Feb 2, 2026



GAS BLASTING

Carbon dioxide blasting was conceived around 1924–25 by three southern Illinois coal men, a chemist, an electrical engineer and a mine operator. They wanted a non-explosive way to break coal that would be at least as safe as permissible explosives and produce less fine coal. The Safety Mining Company took over the patents in 1927 under the trade name Cardox. A reusable high-strength steel tube is filled with liquid CO₂ at a charging plant and then placed in a drill hole. An electrically fired chemical heater turns the CO₂ supercritical almost instantly, and a rupture disc bursts at a set pressure, adjustable from about 1,200 to 2,800 bar. Mechanized mining made it rare in coal mines, but it's used again where explosives are restricted: in some coal mines, urban construction, frozen ground and concrete demolition.

QUICK FACTS

DD-070-F01

CO₂ rock blasting was conceived around 1924–25 by coal men in southern Illinois and sold under the name Cardox.

DD-070-F02

A Cardox tube's rupture disc can be set to burst at pressures from about 1,200 to 2,800 bar.

THE WRITE-UP

Origins. Around 1924–25, a chemist, an electrical engineer and a mine operator from southern Illinois conceived a non-explosive cartridge that used expanding CO₂ to break coal. In 1927 the Safety Mining Company took over the patents under the trade name Cardox.

Regulated in Britain. Britain regulated Cardox cartridges in coal mines under Explosives in Coal Mines (Cardox) Orders in 1932, consolidated in 1933.

The tube. A reusable high-strength steel tube is filled with liquid CO₂ at a charging plant, then placed in a drill hole. Inside is a chemical heater fired by a small electric charge.

The burst. The heater turns the CO₂ supercritical almost instantly. A rupture disc shears at a set pressure, adjustable from about 1,200 to 2,800 bar by disc thickness, and the gas escapes through angled ports.

How fast. The pressure rises over about 0.026–0.086 seconds, and the release lasts about 0.2 milliseconds.

Then and now. Mechanized mining made Cardox rare in coal mines. Concerns over mine safety and explosives control have brought it back for some coal mines, urban construction, frozen soil and concrete demolition. It's labor-intensive and less efficient for large-scale mining.

REEL VS. RECORD

- **Nuance:** the liquid CO₂ isn't injected in the hole. A reusable steel tube is filled at a charging plant beforehand and then placed in the drill hole. [Cardox patent; Energies 2019]
- **Note:** Missing context on 'when triggered': an electrically fired chemical heater inside the tube turns the CO₂ supercritical, and a rupture disc bursts at a set pressure of about 1,200–2,800 bar. [Cardox patent; Energies 2019]
- **Note:** Nuance on 'instantly': the pressure builds over about 0.03–0.09 seconds before the disc bursts, and the release then takes about 0.2 milliseconds. [Energies 2019]
- **Missing context:** it isn't new. It was conceived around 1924–25 in southern Illinois coal mines and sold as Cardox from 1927. Britain regulated it under Explosives in Coal Mines (Cardox) Orders in 1932–33. [Schooler thesis; London Gazette]
- **Note:** Context on 'instead of explosives': it causes less vibration and pollution, but it's labor-intensive and less efficient, so it isn't suited to large-scale mining. Today it's used where explosives are restricted. [Energies 2019]

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Permalink: <https://detailenjoyer.com/case/gas-blasting/> · Last updated Jan 29, 2026



HOLOFANS

'Holographic fans' are rotating LED displays. Each blade, or 'ray', carries a strip of LEDs. As the rotor spins, a controller switches every LED on and off at exact angles, so each sweep paints the picture one slice at a time, and the eye blends the flashes into a steady image. In a dark room the blur of the blades nearly disappears, so the picture seems to float. Single fans use hundreds of LEDs rather than thousands. HYPERVSN's Solo M has four rays of 168 LEDs each (672 in all) spinning at about 670 rpm, and its newer SmartV Solo M lists 216 LEDs per ray and a 1080 × 1080 picture. Displays only reach thousands of LEDs when several fans are synced into a wall. Despite the name, these aren't holograms. Holography, which Dennis Gabor invented in 1947 and won the 1971 Nobel Prize in Physics for, records and rebuilds light waves using interference. A fan draws a flat image on the plane of its blades, and the 3D look comes from the artwork's shading. This Reel is Part I of a pair. HoloFans II (DD-700) explains the same mechanism, so this case focuses on hardware numbers and the holography history.

QUICK FACTS

DD-630-F01

A HYPERVSN Solo M fan has 672 LEDs on four rays.

DD-630-F02

Holography was invented by Dennis Gabor in 1947.

THE WRITE-UP

One slice at a time. LED strips on a spinning rotor are switched at exact angles, so each turn paints the image slice by slice.

Hundreds, not thousands. A HYPERVSN Solo M carries 672 LEDs on four rays spinning at about 670 rpm.

Sharper models. The newer SmartV Solo M lists 216 LEDs per ray and a 1080 × 1080 picture.

Walls of fans. Several units can be synced into one big display, which is when LED counts reach the thousands.

Not holography. Dennis Gabor invented holography in 1947 and won the 1971 Nobel Prize in Physics. Fans don't use interference at all.

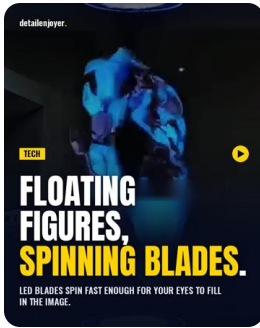
REEL VS. RECORD

- **Note:** 'Thousands of LEDs': a single commercial fan uses hundreds. HYPERVSN's Solo M has 672 (4×168), and the SmartV Solo M has 864 (4×216). Only multi-fan walls reach thousands.
- **Note:** 'Holographic': these are rotating LED (persistence-of-vision) displays, not holograms. Real holography rebuilds light waves using interference, a method Dennis Gabor invented in 1947.
- **Note:** '3D images': a single fan draws a flat image on the plane of its blades. The depth comes from shaded artwork and a dark background.
- **Note:** 'Precisely timed': the timing comes from the controller tracking the rotor's angle and firing each LED at set positions, many times per second (about 670 rpm on HYPERVSN units).
- **Note:** 'Persistence of vision' is the popular name. Vision scientists usually describe the blending as flicker fusion, the eye merging flashes too fast to separate. (HoloFans II makes the same point.)

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Permalink: <https://detailenjoyer.com/case/holofans/> · Last updated Aug 2, 2025



HOLOFANS II

'Hologram fans' are persistence-of-vision (POV) displays. A rotor carrying strips of LEDs spins fast while a controller switches each LED on and off at exact angles, painting one slice of the picture at a time. Because the eye blends these rapid flashes, the viewer sees a steady image that seems to float, especially against a dark background where the blur of the blades disappears. They aren't holograms in the physics sense. True holography records and rebuilds light waves using interference, usually with lasers. A fan draws a flat (2D) image, and the 3D look comes from the artwork's shading and the invisible frame. HYPERVSN, the brand formerly known as Kino-mo, describes its units as four LED rays spinning at about 670 rpm, and several units can be synced into a larger 'wall'.

QUICK FACTS

DD-700-F01

A HYPERVSN fan spins four LED rays at about 670 rpm.

DD-700-F02

'Hologram fans' draw a flat image and aren't true holograms.

THE WRITE-UP

Painting with a spinning line. A POV display has one or more LED strips on a rotor. A sensor tracks the rotor's angle, and the controller lights each LED at exactly the right moment to draw one 'slice' of the image per position.

The eye does the rest. The visual system blends flashes that arrive faster than it can separate them, so the slices merge into one continuous picture.

Why it looks like it floats. Against a dark background, the spinning blades are almost invisible, so the bright image seems to hang in the air. Shaded 3D-style artwork adds to the effect.

Not a real hologram. Holography records the interference pattern of light and rebuilds the light field, so you can look around the object. A fan draws a flat image on the plane of its blades.

Commercial units. HYPERVSN's manual describes four LED rays spinning at about 670 rpm. Units can be tiled and synced into larger displays for shops and events.

REEL VS. RECORD

- **Not a hologram:** the image is drawn by LEDs on the plane of the blades. True holography rebuilds light waves using interference.
- **Note:** Not truly 3D: a single fan makes a flat image that only looks 3D because of the artwork's shading and the invisible blades.
- **Mechanism:** a sensor tracks the blade angle, and the controller fires each LED at exact angular positions, which is how the 'precise sequences' are timed.
- **Wording:** 'persistence of vision' is the popular term. Perception researchers describe the effect as flicker fusion and the eye's temporal integration.
- **Missing safety note:** commercial units spin fast and are usually mounted high or behind a guard, because the blades are a contact hazard.

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Permalink: <https://detailenjoyer.com/case/holofans-ii/> · Last updated Feb 20, 2026



DD-702 TECH / LOCATIONS · 11 OF 29

NEW YORK HOT TUB

After the January 25, 2026 winter storm and days of below-freezing temperatures, the NYC Department of Sanitation (DSNY) started eight snow melters on January 27, 2026, its first use of them since 2021. Officials call the machines 'hot tubs'. Dump trucks haul piled snow to fixed melter sites in all five boroughs, where front-end loaders tip it in half-ton buckets into heated water. DSNY says each machine melts 60 to 120 tons an hour. The water is kept at about 38 °F, enough to melt snow while controlling flow, and drains into sewers the city's Department of Environmental Protection approved. In DSNY's own words: 'We bring snow to the melters – NOT the melters to the snow.'

QUICK FACTS

DD-702-F01

Each DSNY snow melter melts 60 to 120 tons of snow an hour.

DD-702-F02

The water in the 'hot tubs' is kept at about 38 °F.

THE WRITE-UP

Why melt it. After the January 25, 2026 storm, temperatures stayed below freezing for days, so piled snow wasn't going anywhere and was blocking bus stops, sidewalks and bike lanes.

Snow comes to the tubs. DSNY parks the melters at fixed sites, one or more in each borough, and dump trucks bring the snow to them. Front-end loaders tip it in half-ton buckets.

How fast. Officials say each of the eight machines melts 60 to 120 tons an hour, and they planned to run them for a couple of weeks.

Not so hot. The 'hot tub' is more like a cold plunge. CBS reported the water is held at about 38 °F, warm enough to melt snow while controlling the water flow.

Down the drain. The meltwater goes into specific sewers approved by the Department of Environmental Protection. NBC reported it was the first use of the melters since 2021.

REEL VS. RECORD

- **Not roaming trucks:** DSNY says it brings 'snow to the melters, NOT the melters to the snow'. The units sit at fixed sites and trucks bring the snow to them.
- **Missing scale:** in 2026 the city ran eight melters, each rated at 60 to 120 tons an hour (NY1, CBS).
- **Missing context:** they're rarely used. January 2026 was the first time since 2021, after a storm followed by a long freeze.
- **Precision:** the water is only about 38 °F. It's warm enough to melt snow, not hot (CBS New York).
- **Unverified detail:** I couldn't confirm 'diesel burners' or filtering from the 2026 coverage, which says only that meltwater drains into DEP-approved sewers.

SOURCES

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Permalink: <https://detailenjoyer.com/case/new-york-hot-tub/> · Last updated Feb 28, 2026



DD-676 TECH · 12 OF 29

CIPP

Cured-in-place pipe (CIPP) is a trenchless way to rehabilitate sewer, storm, water and other pipes. A flexible tube of felt or fiberglass is soaked in thermosetting resin (polyester, vinyl ester or epoxy). It's either inverted into the host pipe with water or air pressure, or pulled in and inflated. The resin is then cured with hot water, steam or, for glass-fiber liners, UV light. The result is a jointless pipe-within-a-pipe, usually a few millimeters to a few centimeters thick. Engineer Eric Wood first used the method in London in 1971, and it was commercialized as Insituform. A 2012 US EPA retrospective found sampled municipal sewer liners generally in good condition after years in service. Researchers at Purdue (2017) reported that steam-cured installations release a mix of chemical vapors, including styrene, which raised worker- and public-exposure concerns. Service connections have to be reopened from inside, usually by robotic cutters.

QUICK FACTS

DD-676-F01

CIPP was first used in London in 1971.

DD-676-F02

Steam-cured CIPP sites can release chemical vapors such as styrene (Purdue, 2017).

THE WRITE-UP

The idea. Instead of digging up a failing pipe, crews line it from inside through existing manholes or access pits. The liner becomes a new structural or semi-structural pipe.

The liner. A felt or fiberglass tube is impregnated with thermosetting resin and inserted by inversion (turned inside out by water or air pressure) or pulled in and inflated so it presses against the host pipe.

Curing. Hot water, steam, or UV light (used with translucent glass-fiber liners) cures the resin into a hard, jointless pipe. Robotic cutters then reopen the side connections.

Track record. First used by Eric Wood in London in 1971 and later commercialized as Insituform, CIPP is now one of the most widely used sewer rehabilitation methods. The EPA's 2012 retrospective found sampled liners generally performing well.

Emissions. A 2017 Purdue-led study measured chemical plumes, including styrene, at steam-cured worksites and called for more research on worker and public exposure.

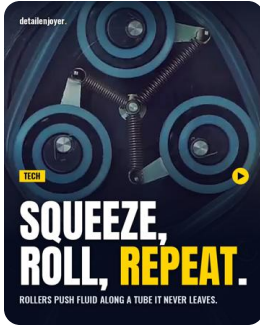
REEL VS. RECORD

- **Wording:** the standard term is 'cured-in-place pipe' (no hyphen before 'pipe'). The Reel's 'steam or, UV light' should read 'steam, or UV light'.
- **Not quite seamless:** the liner is jointless, but side connections have to be reopened from inside after curing, usually with robotic cutters.
- **Missing caveat:** curing can release chemical vapors. A 2017 Purdue-led study found styrene and other compounds in steam-curing plumes (ES&T Letters).
- **Detail:** UV curing generally needs translucent glass-fiber liners. Felt liners are usually cured with hot water or steam.
- **Missing history:** Eric Wood first used the method in London in 1971, and it was commercialized as Insituform.

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Permalink: <https://detailenjoyer.com/case/cipp/> · Last updated Dec 5, 2025



PERISTALTIC PUMPS

A peristaltic pump is a positive-displacement pump. Rollers or shoes on a rotating head squeeze a flexible tube against a curved track, trapping 'pillows' of fluid and pushing them forward, while the tube springs back behind them to draw in more. The fluid only touches the inside of the tube, so the pump suits sterile, corrosive, shear-sensitive or hygienic fluids, and changing the tube is all it takes to switch fluids. The Reel gets one thing backwards, though. Peristaltic flow naturally pulses as each roller lifts off the tube. Manufacturers reduce pulsation with more rollers, offset or out-of-phase tube channels, dampers or compliant tubing, but don't eliminate it. The tube itself is the part that wears out. The design dates back at least to an 1855 US patent, and roller pumps later became standard for moving blood in medical equipment.

QUICK FACTS

DD-689-F01

In a peristaltic pump, the fluid touches only the inside of the tube.

DD-689-F02

Peristaltic pump flow naturally pulses as rollers lift off the tube.

THE WRITE-UP

How it works. Rollers or shoes squeeze a flexible tube against a track, trapping pockets of fluid and pushing them forward as the head turns. The tube recovers behind them and draws in more fluid.

Tube-only contact. The fluid touches only the inside of the tube, which suits sterile, corrosive or hygienic fluids. Switching fluids just means changing the tube.

It pulses. Each roller lifting off the tube creates a pulse in flow and pressure, which can cause vibration and measurement errors.

Taming the pulse. More rollers, offset or out-of-phase tube channels, dampers and compliant tubing reduce pulsation but don't remove it.

History. The idea dates back at least to an 1855 US patent, and roller pumps were later adopted for moving blood in medical devices.

REEL VS. RECORD

- **Wrong:** peristaltic flow isn't 'pulseless'. It naturally pulses as each roller lifts off the tube, and designs can only reduce the pulsation.
- **Missing tradeoff:** the tube is a wear part that must be replaced regularly. The tube's material sets the pump's chemical compatibility and pressure limits.
- **Missing detail:** rollers versus shoes is a real design choice. Shoe pumps usually run tubes filled with lubricant and handle higher pressures.
- **Accurate:** the fluid touches only the tubing, which is why these pumps suit sterile and corrosive fluids, and switching fluids just means changing the tube.
- **Missing history:** the design dates back at least to an 1855 US patent, and roller pumps later became common in medical equipment for moving blood.

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Permalink: <https://detailenjoyer.com/case/peristaltic-pumps/> · Last updated Jan 5, 2026



WALKING FLOORS

A moving-floor trailer unloads itself through the back doors without tipping. The floor is made of long slats, usually aluminum, split into three interleaved groups and driven by hydraulic cylinders under the trailer. All the slats slide rearward together, carrying the load a short distance. Then the groups pull forward one at a time. Because two-thirds of the floor is always holding still, friction keeps the load from sliding forward with the moving third. Repeating the cycle 'walks' the cargo out the back. 'WALKING FLOOR' is a trademark of KEITH Manufacturing of Oregon. Its founder, Keith Foster, introduced the first commercially viable all-hydraulic moving floor for semi-trailers in 1973, and other makers sell similar 'moving floor' or 'live floor' systems. Because the trailer never tips, it can unload under low roofs or on uneven ground. It's widely used for wood chips, bark, biomass, waste, scrap, recycling and farm produce.

QUICK FACTS

DD-665-F01

A walking floor moves the load while two-thirds of the slats hold still.

DD-665-F02

KEITH introduced its WALKING FLOOR system in 1973.

THE WRITE-UP

The slats. The floor is long hydraulic slats, usually aluminum, split into three interleaved groups.

The cycle. All the slats slide rearward together, carrying the load. Then each third pulls forward on its own while the other two hold the load by friction.

No tipping. The trailer stays level, so it can unload under low roofs, indoors or on soft ground.

Where it came from. KEITH Manufacturing introduced the first commercially viable all-hydraulic moving floor for semi-trailers in 1973.

A brand name. 'WALKING FLOOR' is KEITH's trademark. Similar systems are sold as moving or live floors.

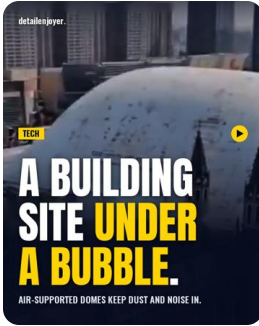
REEL VS. RECORD

- **Mechanism:** the slats don't move in one 'continuous sequence'. All of them push the load rearward together, then each third retracts on its own while the other two-thirds hold the load by friction.
- **Note:** 'Interlocking': the slats sit side by side in three alternating groups and are sealed against each other. They slide independently rather than locking together.
- **Power:** the slats are driven by hydraulic cylinders under the floor, which the Reel doesn't mention.
- **Name:** 'WALKING FLOOR' is a KEITH Manufacturing trademark (since 1973). Generic terms are moving floor or live floor.
- **Note:** Trailers, not truck beds: the system is mostly built into semi-trailers, though some rigid trucks use it too.

SOURCES

1. Commercial Motor (Sep 1, 2005): How they work, moving-floor trailers: <https://archive.commercialmotor.com/article/1st-september-2005/55/how-they-work-moving-floor-trailers-comprise-a-ser>
2. Trailer Magazine (Jun 1, 2023): Fifty years of innovation, KEITH Walking Floor: <https://www.trailermag.com.au/fifty-years-of-innovation-keith-walking-floor/>
3. KEITH Manufacturing Co.: WALKING FLOOR official site: <https://www.keithwalkingfloor.com/>

Permalink: <https://detailenjoyer.com/case/walking-floors/> · Last updated Oct 22, 2025



CONSTRUCTION COVERS

In crowded Chinese cities, some building and excavation sites are now covered by huge air-supported domes, sometimes called 'soft pillows' or 'giant airbags'. Fans on the ground keep pumping air in, so the slightly higher pressure inside holds up a membrane, often PVDF-coated fabric, usually reinforced with steel cables. The main goal is to keep dust and noise from reaching the neighbors. Local officials say a nearly 9,000 m² dome over a renovation site in Guangzhou's Yuexiu District blocks up to 99% of dust. CGTN reported that it keeps construction noise below 60 decibels. A dome in Shenzhen stands 40 m tall over more than 12,000 m². Officials say such domes can be reused and taken down without leaving construction waste. A related design is used on contaminated land. In 2016, a soil-cleanup project at Beijing's former Shougang steelworks built what researchers called China's first negative-pressure membrane yard. There the air pressure is kept slightly lower inside, so fumes and dust can't leak out, and exhaust is filtered before release. The footage shows a white dome between towers and a Gothic-style church, but the Reel doesn't name the site.

QUICK FACTS

DD-631-F01

Fans keep air-supported construction domes inflated.

DD-631-F02

A Guangzhou dome is reported to block up to 99% of dust.

THE WRITE-UP

Held up by air. Ground fans keep the inside pressure slightly higher than outside, which holds up a PVDF membrane over the site.

For the neighbors. A Guangzhou dome is reported to block up to 99% of dust, and CGTN says it keeps noise below 60 decibels.

Big ones. A Shenzhen dome stands 40 m tall and covers more than 12,000 m².

Reusable. Officials describe the domes as reusable and easy to take down, with no construction waste.

Negative pressure. For contaminated soil, a 2016 Beijing yard kept the air pressure lower inside so fumes couldn't escape.

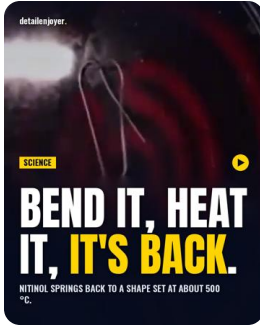
REEL VS. RECORD

- **Main purpose:** the domes are mostly about protecting the neighborhood, keeping dust and noise in, more than protecting the project from the weather.
- **Note:** 'Inflatable': they aren't sealed balloons. Fans run continuously to keep the inside air pressure slightly higher than outside. Membranes are often PVDF-coated fabric, usually with steel cables.
- **Note:** 'Cost savings compared to scaffolding': I found no cost comparison. A dome covers a whole site, while scaffolding does a different job, so the Reel's comparison is unsupported.
- **Note:** 'Quickly deployed and moved': officials describe the domes as reusable and easy to take down, but these are large engineered structures, not quick pop-ups.
- **Missing:** on contaminated land, some domes are kept at lower pressure inside so polluted air can't leak out, with exhaust filtered first (as at a 2016 Beijing soil-cleanup site).

SOURCES

1. Shenzhen Government Online: Giant 'soft pillows' reshape construction in Guangzhou and Shenzhen: https://www.sz.gov.cn/en_szgov/news/latest/content/post_12743452.html
2. CGTN (Mar 13, 2026): 9,000 m² 'giant airbag' installed at construction site in S. China: <https://news.cgtn.com/news/2026-03-13/9-000-m-giant-airbag-installed-at-construction-site-in-S-China-1LttOnwUtK8/p.html>
3. Application of technology of negative pressure membrane structure for soil remediation (2018), Advances in Environmental Protection: https://pdf.hanspub.org/aep20180200000_37887520.pdf

Permalink: <https://detailenjoyer.com/case/construction-covers/> · Last updated Aug 4, 2025



SHAPE MEMORY

Shape-memory alloys can be bent out of shape when cool and then spring back when warmed. The best known is nitinol, an alloy of roughly equal parts nickel and titanium. Its name comes from Nickel, Titanium and the Naval Ordnance Laboratory, where William J. Buehler's team discovered it in 1959. According to ASME, the team was looking for materials for tools to dismantle mines. Wikipedia recounts that, at a 1961 meeting, someone heated a folded strip of it with a pipe lighter and it snapped back to its original shape. The effect comes from a reversible change in crystal structure. Below its transformation temperature, nitinol is in a monoclinic martensite phase that deforms easily and holds its new shape. Heated above that temperature, it converts to a cubic austenite phase and returns to its original form. The remembered shape isn't automatic. ASME says the part must be shape-set by clamping it in a mold, heat-treating it at about 500 °C and cooling it quickly. Composition and heat treatment adjust the transformation temperature. Above that temperature, nitinol is also superelastic, recovering from strains of about 8%. The shape-memory effect was first seen in a gold-cadmium alloy in 1932 by the Swedish chemist Arne Ölander. Shape-memory polymers became commercially available in the late 1990s. Nitinol is now used in stents, orthodontic wires and eyeglass frames. The footage shows a bent wire and a coil over a red heating element, straightening and contracting as they warm.

QUICK FACTS

DD-616-F01

Nitinol is named for nickel, titanium and the Naval Ordnance Laboratory.

DD-616-F02

A nitinol part's remembered shape is set by heat-treating it at about 500 °C.

THE WRITE-UP

Two crystal forms. Cool nitinol is soft martensite; heated, it becomes austenite and returns to its set shape.

Shape-setting. The remembered shape is set by clamping the part and heat-treating it at about 500 °C.

Navy origins. Nitinol was discovered in 1959 at the Naval Ordnance Laboratory, which gives it its name.

First seen. The shape-memory effect was first seen in a gold-cadmium alloy in 1932.

In use. Nitinol is used in stents, orthodontic wires and eyeglass frames.

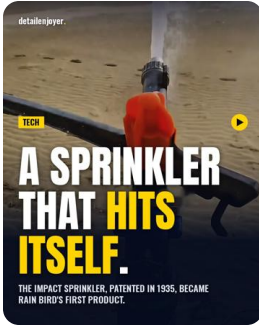
REEL VS. RECORD

- **Note:** 'A preset shape': the shape has to be set first, by holding the part in a mold while it's heat-treated at about 500 °C and then cooled quickly (ASME).
- **Note:** 'Heating triggers a change': it happens above the alloy's transformation temperature, which is tuned by composition and heat treatment. For some devices that's near body temperature.
- **Note:** 'Low-temperature martensitic phase where it's easily deformed': correct. Martensite is monoclinic and austenite is cubic.
- **Note:** 'Shape memory alloys and shape memory polymers': nitinol is the most common alloy. Copper-based alloys exist too, and shape-memory polymers became commercially available in the late 1990s.
- **Missing:** nitinol was discovered in 1959 at the US Naval Ordnance Laboratory. The shape-memory effect itself was first seen in a gold-cadmium alloy in 1932.

SOURCES

1. ASME: Metal That Remembers Its Shape: <https://www.asme.org/topics-resources/content/metal-that-remembers-its-shape>
2. Wikipedia: Nickel titanium: https://en.wikipedia.org/wiki/Nickel_titanium
3. Wikipedia: Shape-memory alloy: https://en.wikipedia.org/wiki/Shape-memory_alloy

Permalink: <https://detailenjoyer.com/case/shape-memory/> · Last updated Jul 17, 2025



DD-581 TECH · 17 OF 29

SPRINKLE OF TRUTH

The sprinkler in the footage is an impact sprinkler, the classic 'tick-tick-tick' design on farm risers. Water under pressure leaves the main nozzle as a jet. A spring-loaded drive arm sits in front of it with a small deflector, or spoon, that dips into the stream. The jet knocks the arm aside, the spring swings it back, and it strikes the sprinkler body. Each strike nudges the head around a few degrees, so the jet sweeps a circle (or an arc, with trip stops) in small, even steps. Breaking up the stream this way also spreads the water more evenly across the wetted area. Other rotary sprinklers use a turbine or gear drive instead, as the Reel says. Orton Englehart, a citrus grower in Glendora, California, built the horizontal-action impact drive sprinkler in his shed around 1932 to 1933. His neighbor Clem LaFetra urged him to patent it. The application was filed on December 18, 1933, and US Patent 1,997,901 was granted on April 16, 1935. Englehart preferred farming and sold the rights to Clem and Mary LaFetra, who began production in their family barn on October 13, 1935, under the name Rain Bird. In 1990, the American Society of Agricultural Engineers named the Rain Bird impact sprinkler a historic landmark of agricultural engineering, crediting it with helping sprinkler irrigation spread to more than 50 million acres worldwide. The footage shows an impact sprinkler on a tripod stand in a sandy field, its arm swinging as the jet sprays across the sand.

QUICK FACTS

DD-581-F01

In an impact sprinkler, a spring-loaded arm knocked aside by the jet strikes the body and turns the head in small steps.

DD-581-F02

Orton Englehart's impact sprinkler patent was granted on April 16, 1935.

THE WRITE-UP

Spring, spoon, strike. The jet knocks a spring-loaded arm aside. It swings back, strikes the body and turns the head a notch.

A citrus grower's idea. Glendora citrus grower Orton Englehart built the impact sprinkler in the early 1930s.

Patented in 1935. His patent was filed on December 18, 1933, and granted on April 16, 1935.

Rain Bird. The LaFetras bought the rights and began production in their barn on October 13, 1935.

A landmark. ASAE named the Rain Bird impact sprinkler a historic landmark of agricultural engineering in 1990.

REEL VS. RECORD

- **Note:** 'This stream hits a small turbine or hammer-like arm': both designs exist. The footage shows the hammer type, an impact sprinkler. The jet knocks the spring-loaded arm aside, and the arm swings back and strikes the body, turning the head a few degrees each time.
- **Note:** 'Deflects the flow and causes the sprinkler to spin': in an impact sprinkler, the head steps around in small increments rather than spinning continuously.
- **Missing:** citrus grower Orton Englehart invented the impact sprinkler in the early 1930s. His patent was granted on April 16, 1935, and it became the first product of Rain Bird.

SOURCES

1. ASABE: Rain Bird Impact Drive Sprinkler Head, historic landmark (1990): <https://asabe.org/About-Us/About-ASABE/History/ASABE-Historic-Landmarks/Rain-Bird-Impact-Drive-Sprinkler-Head-1990>
2. Irrigation Today: The invention that changed irrigation: <https://irrigationtoday.org/features/the-invention-that-changed-irrigation/>
3. Journal of Irrigation and Drainage Engineering: Seventy-Fifth Anniversary of Horizontal Action Impact Drive Sprinkler (2009): [https://doi.org/10.1061/\(ASCE\)0733-9437\(2009\)135:2\(133\)](https://doi.org/10.1061/(ASCE)0733-9437(2009)135:2(133))
4. Google Patents: US1997901A, Water sprinkler (Englehart, 1935): <https://patents.google.com/patent/US1997901A/en>

Permalink: <https://detailenjoyer.com/case/sprinkle-of-truth/> · Last updated May 26, 2025



DELUGE DAYS

NASA's Stennis Space Center in Mississippi tests rocket engines and stages by bolting them to giant stands and firing them in place. Because the hardware doesn't move, the exhaust, which NASA says can reach 6,000 degrees Fahrenheit (about 3,300 degrees Celsius), pours into the same flame deflector for the whole test. Water keeps it from melting. Stennis's high-pressure industrial water system draws on a 66-million-gallon reservoir. For the Space Launch System core stage's Green Run tests in 2020 and 2021, the B-2 stand could receive 335,000 gallons a minute at 300 psi, enough to fill an Olympic pool in about two minutes. Most of it cooled the exhaust through the deflector, and about 87,000 to 92,000 gallons a minute formed a curtain of water to damp noise and vibration. A typical 500-second RS-25 engine test uses about 5 million gallons. Launch pads use water too. At Kennedy Space Center's Pad 39B, the ignition overpressure and sound suppression system dumps about 400,000 gallons in under 30 seconds, peaking around 1.1 million gallons a minute. NASA says SLS produces about 176 decibels at liftoff. The footage looks like a pad water-flow test, with columns of water erupting in front of a steel launch structure.

QUICK FACTS

DD-594-F01

The B-2 test stand at Stennis can receive 335,000 gallons of water a minute.

DD-594-F02

A typical 500-second RS-25 test at Stennis uses about 5 million gallons of water.

THE WRITE-UP

Fired in place. Stennis bolts engines to test stands, so the exhaust hits the same deflector for the whole burn.

335,000 gallons a minute. The B-2 stand's water system can deliver 335,000 gallons a minute at 300 psi.

Curtains for sound. Part of the flow sprays a water curtain to damp noise and vibration.

5 million gallons a test. A typical 500-second RS-25 test uses about 5 million gallons of water.

At the launch pad. Pad 39B's sound suppression system releases about 400,000 gallons in under 30 seconds.

REEL VS. RECORD

- **Note:** 'Acoustic energy exceeding 300 decibels': I can't support that. NASA puts SLS at about 176 decibels at liftoff, and sound in air can't really go much past about 194 decibels before it stops behaving like a normal sound wave. 300 decibels isn't physically possible here.
- **Note:** 'Millions of gallons per minute': I'd scale that back. Stennis's B-2 stand gets up to 335,000 gallons a minute. The Pad 39B launch system peaks around 1.1 million gallons a minute, but only for seconds.
- **Note:** 'Temperatures from thousands of degrees Celsius': fair. NASA cites exhaust up to 6,000 degrees Fahrenheit, about 3,300 degrees Celsius.
- **Note:** My Reel vs. Record note: the footage looks like a launch pad water-flow test, not a Stennis engine test. I treated it as an exemplar of the same idea.

SOURCES

1. NASA: NASA Stennis Completes Key Test Complex Water System Upgrade: <https://www.nasa.gov/centers-and-facilities/stennis/nasa-stennis-completes-key-test-complex-water-system-upgrade/>
2. NASA APPEL: Historic Test Stand at Stennis Points Way to the Moon (2019): <https://appel.nasa.gov/2019/08/26/historic-test-stand-at-stennis-points-way-to-the-moon/>
3. NASA: Pad 39B Water Flow Test Comes Through Loud and Clear (2019): <https://www.nasa.gov/centers-and-facilities/kennedy/pad-39b-water-flow-test-comes-through-loud-and-clear/>
4. NASA: Launch Pad 39B: <https://www.nasa.gov/humans-in-space/exploration-ground-systems/launch-pad-39b/>

Permalink: <https://detailenjoyer.com/case/deluge-days/> · Last updated Jun 12, 2025



DD-755 TECH · 19 OF 29

VERTICAL PARKING

Before the robot could fetch a bike in seconds, someone had to decide to bury the bike rack. Giken designed the ECO Cycle to end messy, illegal bike parking around busy train stations, under a simple idea: keep only a compact entrance booth on the sidewalk and put the parking underground. The bikes sit in racks arranged around a round shaft, with a rotating elevator in the middle, and the shaft is built to withstand a quake of Japanese seismic intensity 6-upper. The first unit opened at Kochi University of Technology in June 1998.

QUICK FACTS

DD-755-F01

Giken's ECO Cycle was designed to end messy, illegal bike parking around busy train stations.

DD-755-F02

An ECO Cycle leaves only a compact entrance booth on the sidewalk; the parking is buried below it.

DD-755-F03

ECO Cycle bikes are stored in racks arranged around a round shaft, filed by a rotating elevator in the middle.

DD-755-F04

The ECO Cycle shaft is built to withstand a quake of Japanese seismic intensity 6-upper.

DD-755-F05

The first ECO Cycle opened at Kochi University of Technology in June 1998.

THE WRITE-UP

Just a booth on the sidewalk. Above ground there's only a compact entrance booth. The parking is buried below it.

200+ bikes underground. Each unit stores 200 or more bicycles in racks arranged around a round shaft.

A rotating elevator. A robot in the middle spins as it moves, filing each bike into the racks around it.

Tap a card. Push a button to store your bike. Swipe an IC card or tag to call it back.

Back in 13–15 seconds. That's the average wait for your bike to come up, even at rush hour.

Built to clear sidewalks. It was designed to end messy, illegal bike parking around busy train stations.

First unit: 1998. The first ECO Cycle opened at Kochi University of Technology in June 1998.

Earthquake-ready. The shaft is built to withstand a quake of Japanese seismic intensity 6-upper.

Permalink: <https://detailenjoyer.com/case/vertical-parking/> · Last updated Oct 20, 2026



OVER 0

Mechanical calculators divide the way people do long division: by subtracting the divisor over and over and counting the subtractions. With a divisor of zero, each subtraction takes nothing away, so the count never ends. Some machines simply keep cycling, carriage and counters spinning, until the operator stops them by hand. Others jam or trip a stop. That behavior is a physical version of why division by zero is undefined in arithmetic: no number multiplied by zero gives a nonzero result, so there's no answer to find. Desktop mechanical calculators were common office tools from the late 1800s until electronic calculators replaced them in the late 1960s and early 1970s. The footage shows a mechanical calculator's carriage and keys in motion, with a hand at the controls.

QUICK FACTS

DD-284-F01

Mechanical calculators divide by repeated subtraction.

DD-284-F02

Some keep cycling forever when asked to divide by zero.

THE WRITE-UP

Division by subtraction. Mechanical calculators divide by repeated subtraction, counting how many times the divisor fits.

Zero never runs out. Subtracting zero never shrinks the number, so the count never ends.

Endless cycling. Some machines keep cycling until the operator stops them manually.

Undefined in math. No number times zero gives a nonzero result, so division by zero has no answer.

Office staples. Desktop mechanical calculators were common until electronic ones replaced them around 1970.

REEL VS. RECORD

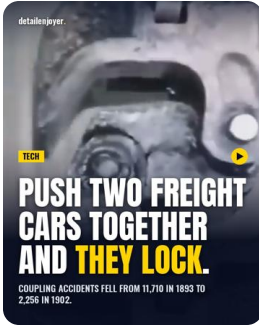
- **Note:** 'In the 1950s mechanical calculators were widely used': right, though I'd note they were common from the late 1800s through the 1960s, not just the 1950s.
- **Note:** 'Lock up or enter an endless cycle': right. Behavior depends on the model; some cycle until stopped by hand, others jam or trip a stop.

SOURCES

1. Wikipedia: Division by zero: https://en.wikipedia.org/wiki/Division_by_zero
2. Wikipedia: Mechanical calculator: https://en.wikipedia.org/wiki/Mechanical_calculator

3. YouTube: What happens when you divide by zero on a mechanical calculator? (March 7, 2021): https://www.youtube.com/watch?v=s_hbvRTGcUI

Permalink: <https://detailenjoyer.com/case/over-0/> · Last updated Jul 29, 2024



KNUCKLE COUPLING

The knuckle coupler, originally the Janney coupler, was patented by Eli H. Janney, a Confederate veteran of the American Civil War, in US patent 138,405 on April 29, 1873. Each coupler has a hinged knuckle; when two cars are pushed together, the knuckles swing closed and lock automatically, and a lever lets workers uncouple without stepping between the cars. Before that, link-and-pin couplers required a worker to stand between moving cars to drop a pin, and injuries were common. The Safety Appliance Act of 1893 required automatic couplers on US railroads. Railroads standardized on Janney's mating profile, and coupling accidents fell from 11,710 in 1893 to 2,256 in 1902 even as the workforce grew. Knuckle couplers remain standard in North America. The footage shows a coupler's knuckle opening and closing in close-up.

QUICK FACTS

DD-303-F01

Eli H. Janney patented the knuckle coupler in 1873.

DD-303-F02

The Safety Appliance Act of 1893 required automatic couplers.

THE WRITE-UP

Janney's 1873 patent. Eli H. Janney patented the knuckle coupler on April 29, 1873.

Locks on contact. The knuckles swing closed and lock when two cars are pushed together.

Required by law. The Safety Appliance Act of 1893 required automatic couplers on US railroads.

Fewer injuries. Coupling accidents fell from 11,710 in 1893 to 2,256 in 1902.

Still standard. Knuckle couplers remain standard in North America.

REEL VS. RECORD

- **Note:** 'Particularly in North America': right. Much of Europe still uses buffers and screw couplings on many trains.

SOURCES

1. Wikipedia: Janney coupler: https://en.wikipedia.org/wiki/Janney_coupler
2. Google Patents: US138405A, Improvement in car-couplings (Eli H. Janney, 1873): <https://patents.google.com/patent/US138405A/en>
3. Wikipedia: Safety Appliance Act: https://en.wikipedia.org/wiki/Safety_Appliance_Act

Permalink: <https://detailenjoyer.com/case/knuckle-coupling/> · Last updated Aug 18, 2024



DD-121 LOCATIONS / HISTORY · 22 OF 29

THE COLOSSEUM

The Colosseum (Flavian Amphitheatre) in Rome was completed in AD 80 under Emperor Titus and could hold tens of thousands of spectators for gladiator fights and animal hunts. It had a velarium, a retractable awning of canvas or sailcloth that could shade much of the seating. It was hung from ropes and masts set in brackets around the top of the outer wall; sailors specially enlisted from the Roman naval headquarters at Misenum and housed nearby worked it. Historians debate how it was rigged. The Colosseum is part of the Historic Centre of Rome World Heritage Site and was named one of the New 7 Wonders in 2007. The footage shows a reconstruction of the arena and its seating, with the presenter.

QUICK FACTS

DD-121-F01

The Colosseum was completed in AD 80.

DD-121-F02

Sailors from Misenum worked the velarium.

THE WRITE-UP

Completed in AD 80. The Colosseum was completed in AD 80 under Emperor Titus.

The velarium. A retractable awning, the velarium, shaded much of the seating.

Ropes and masts. It hung from ropes and masts around the top of the outer wall.

Navy sailors. Sailors from the naval base at Misenum worked the awning.

World Heritage. It's part of the Historic Centre of Rome World Heritage Site.

REEL VS. RECORD

- **Note:** 'No. 6': the New 7 Wonders aren't ranked; I read the number as his own series order.

SOURCES

1. Wikipedia: Colosseum: <https://en.wikipedia.org/wiki/Colosseum>
2. Wikipedia: Velarium: <https://en.wikipedia.org/wiki/Velarium>
3. UNESCO World Heritage Centre: Historic Centre of Rome: <https://whc.unesco.org/en/list/91/>
4. Wikipedia: New 7 Wonders of the World: https://en.wikipedia.org/wiki/New_7_Wonders_of_the_World

Permalink: <https://detailenjoyer.com/case/the-colosseum/> · Last updated Dec 14, 2023



DD-323 TECH / LOCATIONS · 23 OF 29

DREDGING UP THE...GROUND?

Dredging ships remove sediment and debris from the bottoms of rivers, harbors and seas. They keep waterways navigable, deepen shipping channels and can reclaim land from the sea. They work with suction pipes, mechanical buckets or cutter heads. The footage shows a dredger's hopper and land reclamation; the on-screen credit is Eko Atlantic, a city being built on reclaimed land in Lagos, Nigeria.

QUICK FACTS

DD-323-F01

Dredgers remove sediment.

DD-323-F02

They keep channels deep.

THE WRITE-UP

Purpose. Dredgers remove sediment.

Channels. They keep channels deep.

Reclamation. They can reclaim land.

Methods. Suction, buckets or cutters.

Eko Atlantic. Eko Atlantic is built on reclaimed land.

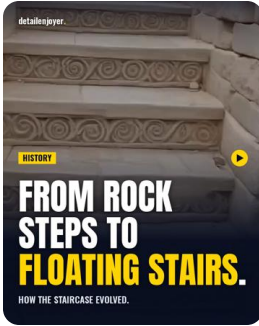
REEL VS. RECORD

- **Note:** None needed.

SOURCES

1. Wikipedia: Dredging: <https://en.wikipedia.org/wiki/Dredging>
2. Wikipedia: Eko Atlantic: https://en.wikipedia.org/wiki/Eko_Atlantic

Permalink: <https://detailenjoyer.com/case/dredging-up-the-ground/> · Last updated Sep 14, 2024



DD-341 HISTORY / TECH · 24 OF 29

A STEP UP

Stairs began as steps cut into hillsides and rock. Romans built more elaborate stairs with stone and concrete; medieval castles used spiral staircases, which tradition says favored right-handed defenders; and Renaissance architects made grand decorative staircases. Steel and reinforced concrete later allowed floating and helical designs. The footage is a computer-generated sequence of staircases through the ages.

QUICK FACTS

DD-341-F01

Early stairs were cut into rock.

DD-341-F02

Romans built elaborate stairs.

THE WRITE-UP

Rock steps. Early stairs were cut into rock.

Romans. Romans built elaborate stairs.

Spiral. Castles used spiral stairs.

Renaissance. Grand staircases rose in the Renaissance.

Modern. Steel allows floating stairs.

REEL VS. RECORD

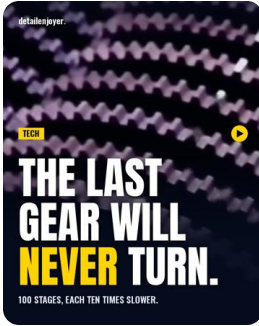
- **Note:** The idea that spiral stairs were built to favor right-handed defenders is a popular tradition that historians question.

SOURCES

1. Wikipedia: Stairs: <https://en.wikipedia.org/wiki/Stairs>

2. Wikipedia: Spiral stairs: https://en.wikipedia.org/wiki/Spiral_stairs

Permalink: <https://detailenjoyer.com/case/a-step-up/> · Last updated Oct 10, 2024



DD-327 TECH / SCIENCE · 25 OF 29

THE GOOGOL GEARS

A googol is 1 followed by 100 zeros. Daniel de Bruin built a gear machine to make that number tangible: a chain of 100 gear stages, each reducing speed by a factor of ten, driven by a hand crank. The first gear spins freely, but the final gear would need a googol turns of the crank to rotate once, far longer than the age of the universe at any practical speed. The footage shows the long row of gears.

QUICK FACTS

DD-327-F01

A googol is 10 to the 100th.

DD-327-F02

Gears can reduce speed.

THE WRITE-UP

Googol. A googol is 10 to the 100th.

Gear train. Gears can reduce speed.

Ten to one. Each stage slows motion tenfold.

Builder. Daniel de Bruin built it.

Last gear. The last gear effectively never turns.

REEL VS. RECORD

- **Note:** None needed.

SOURCES

1. Wikipedia: Googol: <https://en.wikipedia.org/wiki/Googol>
2. Wikipedia: Gear train: https://en.wikipedia.org/wiki/Gear_train

Permalink: <https://detailenjoyer.com/case/the-googol-gears/> · Last updated Sep 20, 2024



DD-359 TECH · 26 OF 29

EARTH MOVERS I

The Caterpillar 793F is an off-highway haul truck for mining and large construction projects, with a payload class of about 250 short tons (roughly 227 metric tons). Its large diesel engine and heavy-duty frame let it carry rock and dirt over rough haul roads. The footage, credited to timothyreinehart, shows a 793F at work.

QUICK FACTS

DD-359-F01

It is an off-highway haul truck.

DD-359-F02

About 250 short tons.

THE WRITE-UP

Type. It is an off-highway haul truck.

Payload. About 250 short tons.

Metric. About 227 metric tons.

Use. Mining and earthmoving.

Maker. Caterpillar builds it.

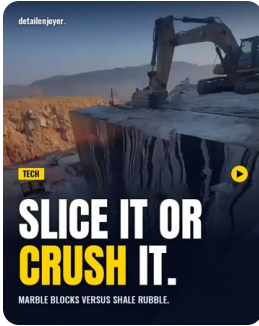
REEL VS. RECORD

- **Note:** None needed.

SOURCES

1. Wikipedia: Haul truck: https://en.wikipedia.org/wiki/Haul_truck

Permalink: <https://detailenjoyer.com/case/earth-movers-i/> · Last updated Nov 3, 2024



DD-376 TECH · 27 OF 29

QUARRELS WITH QUARRYING?

Decorative stones such as marble and onyx are quarried with diamond wire saws and other precision cutters to free large, undamaged blocks. Shale, used for cement and bricks, is broken out with heavy machinery or blasting and crushed. The method depends on whether the stone's appearance matters. The footage shows wire saws and machines working a quarry.

QUICK FACTS

DD-376-F01

Cut in blocks.

DD-376-F02

Diamond wire saws cut stone.

THE WRITE-UP

Marble. Cut in blocks.

Wire saws. Diamond wire saws cut stone.

Shale. Broken and crushed.

Uses. Cement and bricks.

Appearance. Looks decide the method.

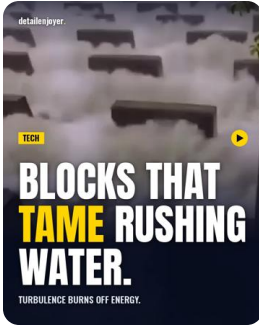
REEL VS. RECORD

- **Note:** None needed.

SOURCES

1. Wikipedia: Quarry: <https://en.wikipedia.org/wiki/Quarry>
2. Wikipedia: Wire saw: https://en.wikipedia.org/wiki/Wire_saw

Permalink: <https://detailenjoyer.com/case/quarrels-with-quarrying/> · Last updated Nov 17, 2024



DD-410 TECH / NATURE · 28 OF 29

BAFFLING

Baffle blocks are concrete blocks set in spillways, canals, chutes and stilling basins to break up fast flows. They create turbulence that dissipates the water's energy and slows it, reducing erosion and damage downstream. Their size and spacing are designed for the expected flow. The footage shows water churning over rows of baffle blocks.

QUICK FACTS

DD-410-F01

Spillways and canals.

DD-410-F02

Concrete.

THE WRITE-UP

Location. Spillways and canals.

Material. Concrete.

Turbulence. They create turbulence.

Energy. Dissipate energy.

Erosion. Reduce erosion.

REEL VS. RECORD

- **Note:** None needed.

SOURCES

1. Wikipedia: Baffle block: https://en.wikipedia.org/wiki/Baffle_block
2. Wikipedia: Stilling basin: https://en.wikipedia.org/wiki/Stilling_basin

Permalink: <https://detailenjoyer.com/case/baffling/> · Last updated Dec 5, 2024



DD-423 TECH · 29 OF 29

ROLLING STEEL

Plate rolling bends flat steel into curves and cylinders. In a common three-roll machine, two lower rollers support the plate while an upper roller presses down, and the plate is run back and forth as the pressure increases step by step. Adjusting roller position and pressure sets the curve for plates of different thicknesses. The footage shows a thick plate being rolled.

QUICK FACTS

DD-423-F01

Curves and cylinders.

DD-423-F02

Two lower, one upper.

THE WRITE-UP

Purpose. Curves and cylinders.

Three rolls. Two lower, one upper.

Incremental. Pressure increases each pass.

Adjustment. Sets the curve.

Thickness. Various plates.

REEL VS. RECORD

- **Note:** None needed.

SOURCES

1. Wikipedia: Rolling (metalworking): [https://en.wikipedia.org/wiki/Rolling_\(metalworking\)](https://en.wikipedia.org/wiki/Rolling_(metalworking))

Permalink: <https://detailenjoyer.com/case/rolling-steel/> · Last updated Dec 13, 2024

COLLECTION QUIZ

Test Your Knowledge: 58 questions from Engineering Oddities. Answers are on the next page.

1. Which company makes the ECO Cycle underground bike park? (DD-009 · Vertical Parking II)

- A. Toyota
- B. Giken Ltd.
- C. Panasonic
- D. Hitachi

2. About how many bikes does a standard ECO Cycle hold? (DD-009 · Vertical Parking II)

- A. About 20
- B. About 200
- C. About 2,000
- D. About 20,000

3. What does an automatic mahjong table use to shuffle the tiles? (DD-017 · Modern Mahjong)

- A. A rotating chamber hidden under the playing surface
- B. A robotic arm above the table
- C. Jets of compressed air
- D. Players still shuffle by hand

4. How does the machine make sure every tile ends up face-down? (DD-017 · Modern Mahjong)

- A. A camera reads each tile
- B. Magnets inside the tiles let it orient them
- C. Tiles are weighted at the bottom
- D. It doesn't; players flip them

5. Which Japanese station tested a 'power-generating floor' at its ticket gates? (DD-014 · Footstep Power)

- A. Tokyo Station
- B. Osaka Station
- C. Sapporo Station
- D. Kyoto Station

6. What turns footsteps into electricity in JR East's floor? (DD-014 · Footstep Power)

- A. Solar cells
- B. Piezoelectric discs
- C. Tiny wind turbines
- D. Thermoelectric plates

7. What was the Probe IV concept car's drag coefficient? (DD-002 · Probe IV)

- A. About 0.60
- B. About 0.45
- C. About 0.30
- D. About 0.15

8. In what year did Ford build the Probe IV concept? (DD-002 · Probe IV)

- A. 1983
- B. 1963
- C. 1999
- D. 2008

9. What are the two main ways inkjet printheads eject ink? (DD-005 · Print Precision)

- A. Laser and toner
- B. Thermal bubbles and piezoelectric elements
- C. Magnets and springs
- D. Compressed air and vacuum

10. How small can Epson's Micro Piezo inkjet drops be? (DD-005 · Print Precision)

- A. 1.5 picoliters
- B. 1.5 milliliters
- C. 1.5 microliters
- D. 1.5 liters

11. Which torque converter part is driven by the engine? (DD-075 · Torque Conversion)

- A. Turbine
- B. Impeller
- C. Stator
- D. Lock-up clutch

12. What does the stator do? (DD-075 · Torque Conversion)

- A. Cools the oil
- B. Redirects returning fluid to multiply torque
- C. Shifts gears
- D. Starts the engine

13. What type of pump is a piston diaphragm pump? (DD-072 · Piston Pumps)

- A. Centrifugal
- B. Positive displacement
- C. Jet
- D. Axial-flow

14. In most designs, what actually flexes the diaphragm? (DD-072 · Piston Pumps)

- A. The piston, directly
- B. Hydraulic fluid moved by the piston
- C. Compressed air
- D. The pumped liquid

15. Where was CO₂ blasting first conceived? (DD-070 · Gas Blasting)

- A. Wales
- B. Southern Illinois
- C. Ruhr Valley
- D. Siberia

16. What makes the liquid CO₂ burst out of the tube? (DD-070 · Gas Blasting)

- A. A fuse of dynamite
- B. A chemical heater and rupture disc
- C. A hydraulic ram
- D. A spark plug igniting the CO₂

17. How many LEDs does a HYPERVSN Solo M fan carry? (DD-630 · HoloFans)

- A. 672
- B. About 60
- C. About 10,000
- D. About 1 million

18. About how fast do HYPERVSN fans spin? (DD-630 · HoloFans)

- A. About 670 rpm
- B. About 6 rpm
- C. About 67,000 rpm
- D. About 60 rpm

19. What makes the image in a 'hologram fan'? (DD-700 · HoloFans II)

- A. Spinning LED strips
- B. Lasers
- C. Mirrors and smoke
- D. Water spray

20. Is a hologram fan a true hologram? (DD-700 · HoloFans II)

- A. No, it draws a flat image
- B. Yes, it's a laser hologram
- C. Yes, but only in daylight
- D. Only with 3D glasses

21. How many snow melters did NYC run in January 2026? (DD-702 · New York Hot Tub)

- A. 2
- B. 5
- C. 8
- D. 20

22. How much snow can each melter handle per hour? (DD-702 · New York Hot Tub)

- A. 6-12 tons
- B. 60-120 tons
- C. 600-1,200 tons
- D. 1 ton

23. What does CIPP stand for? (DD-676 · CIPP)

- A. Cured-in-place pipe
- B. Concrete-insulated plastic pipe
- C. Cast-iron pressure pipe
- D. Coated industrial polymer pipe

24. Where was CIPP first used in 1971? (DD-676 · CIPP)

- A. London
- B. New York
- C. Tokyo
- D. Berlin

25. What kind of pump is a peristaltic pump? (DD-689 · Peristaltic Pumps)

- A. Positive displacement
- B. Centrifugal
- C. Jet
- D. Axial

26. What does the fluid touch in a peristaltic pump? (DD-689 · Peristaltic Pumps)

- A. Only the inside of the tube
- B. The rollers
- C. The motor
- D. The pump housing

27. How does a walking-floor trailer unload? (DD-665 · Walking Floors)

- A. Slats walk the load out the back
- B. The trailer tips up
- C. A conveyor belt lifts it out
- D. A crane lifts it out

28. Into how many groups are the slats usually split? (DD-665 · Walking Floors)

- A. Three
- B. Two
- C. Ten
- D. One

29. What holds up an air-supported construction dome? (DD-631 · Construction Covers)

- A. Air pressure from fans
- B. Steel columns inside
- C. Helium
- D. Wooden arches

30. What is the main reason for these domes in Chinese cities? (DD-631 · Construction Covers)

- A. Keeping dust and noise from neighbors
- B. Hiding the design
- C. Growing plants
- D. Storing water

31. What does the 'NOL' in nitinol stand for? (DD-616 · Shape Memory)

- A. Naval Ordnance Laboratory
- B. Nickel Oxide Layer
- C. National Optics Lab
- D. Non-Oxidizing Liquid

32. Which phase of nitinol is easily deformed? (DD-616 · Shape Memory)

- A. Martensite
- B. Austenite
- C. Ferrite
- D. Plasma

33. What turns the head of an impact sprinkler? (DD-581 · Sprinkle Of Truth)

- A. A spring-loaded arm striking the body
- B. An electric motor
- C. A wind vane
- D. A clockwork spring

34. Who invented the impact sprinkler? (DD-581 · Sprinkle Of Truth)

- A. Orton Englehart
- B. Thomas Edison
- C. Clem LaFetra
- D. Henry Ford

35. Why do test-stand engines need so much cooling water? (DD-594 · Deluge Days)

- A. They fire in place, so exhaust keeps hitting the same spot
- B. The engines run on water
- C. To make rainbows
- D. To clean the rocket

36. How much water a minute can Stennis's B-2 stand receive? (DD-594 · Deluge Days)

- A. 335,000 gallons
- B. 3,350 gallons
- C. 33 million gallons
- D. 335 gallons

37. How many bikes does each ECO Cycle unit store underground? (DD-755 · Vertical Parking)

- A. About 20
- B. About 50
- C. 200 or more
- D. 2,000

38. About how long does it take to get your bike back? (DD-755 · Vertical Parking)

- A. 13–15 seconds
- B. 1–2 minutes
- C. 5 minutes
- D. 30 seconds to 1 minute

39. How do mechanical calculators divide? (DD-284 · OVER 0)

- A. By repeated subtraction
- B. By looking up tables
- C. With vacuum tubes
- D. By guessing

40. Why does dividing by zero never finish? (DD-284 · OVER 0)

- A. Subtracting zero never shrinks the number
- B. The gears overheat
- C. Zero is too large
- D. The keys stick

41. Who patented the knuckle coupler? (DD-303 · Knuckle Coupling)

- A. Eli H. Janney
- B. George Westinghouse
- C. Thomas Edison
- D. Henry Ford

42. How does a knuckle coupler engage? (DD-303 · Knuckle Coupling)

- A. It locks when cars are pushed together
- B. A worker drops a pin
- C. It's welded
- D. Magnets hold it

43. When was the Colosseum completed? (DD-121 · The Colosseum)

- A. AD 80
- B. 500 BC
- C. AD 1200
- D. AD 30

44. What was the velarium? (DD-121 · The Colosseum)

- A. A retractable awning
- B. A water tank
- C. An elevator
- D. A gate

45. What do dredgers remove? (DD-323 · Dredging Up the...Ground?)

- A. Sediment
- B. Fish
- C. Ice
- D. Oil only

46. Why deepen channels? (DD-323 · Dredging Up the...Ground?)

- A. For shipping
- B. For swimming
- C. For fishing only
- D. No reason

47. Where were early stairs cut? (DD-341 · A Step Up)

- A. Into hillsides and rock
- B. Into ice
- C. In trees
- D. In sand

48. What material did the Romans use? (DD-341 · A Step Up)

- A. Concrete
- B. Steel
- C. Plastic
- D. Glass

49. What is a googol? (DD-327 · The Googol Gears)

- A. 1 followed by 100 zeros
- B. A search engine only
- C. A million
- D. A gear

50. How does each gear compare? (DD-327 · The Googol Gears)

- A. Ten times slower
- B. Ten times faster
- C. Same speed
- D. Random

51. Who makes the 793F? (DD-359 · Earth Movers I)

- A. Caterpillar
- B. Ford
- C. Tesla
- D. Volvo Cars

52. About what payload? (DD-359 · Earth Movers I)

- A. 250 short tons
- B. 25 tons
- C. 2,500 tons
- D. 5 tons

53. What cuts marble blocks? (DD-376 · Quarrels With Quarrying?)

- A. Diamond wire saws
- B. Shovels
- C. Explosives only
- D. Hands

54. What is shale used for? (DD-376 · Quarrels With Quarrying?)

- A. Cement and bricks
- B. Jewelry
- C. Glass
- D. Fuel only

55. What are baffle blocks made of? (DD-410 · Baffling)

- A. Concrete
- B. Wood
- C. Plastic
- D. Glass

56. Where are they used? (DD-410 · Baffling)

- A. Spillways
- B. Roofs
- C. Roads
- D. Ships

57. How many rollers? (DD-423 · Rolling Steel)

- A. Three
- B. One
- C. Ten
- D. Two

58. Which roller presses? (DD-423 · Rolling Steel)

- A. The upper
- B. The lower
- C. None
- D. Both lower

ANSWER KEY

1. **B. Giken Ltd.** Now You Know: ECO Cycle is made by Giken Ltd. of Japan. *(DD-009)*
2. **B. About 200** Now You Know: The standard spec is 200 bikes; the upgraded model holds 204. *(DD-009)*
3. **A. A rotating chamber hidden under the playing surface** Now You Know: Tiles are churned in a chamber with a rotating floor beneath the felt. *(DD-017)*
4. **B. Magnets inside the tiles let it orient them** Now You Know: Each tile has a magnet or iron piece, so the machine's magnets can orient it face-down. *(DD-017)*
5. **A. Tokyo Station** Now You Know: JR East tested it at Tokyo Station's Yaesu North gates. *(DD-014)*
6. **B. Piezoelectric discs** Now You Know: Piezoelectric elements (35 mm discs, about 600 per m²) convert pressure and vibration into voltage. *(DD-014)*
7. **D. About 0.15** Now You Know: The Probe IV's drag coefficient was about 0.15. *(DD-002)*
8. **A. 1983** Now You Know: The Probe IV was a 1983 Ford concept car. *(DD-002)*
9. **B. Thermal bubbles and piezoelectric elements** Now You Know: Thermal heads boil ink into a bubble; piezo heads flex a crystal to squeeze it out. *(DD-005)*
10. **A. 1.5 picoliters** Now You Know: As small as 1.5 picoliters, one-and-a-half trillionths of a liter. *(DD-005)*
11. **B. Impeller** Now You Know: The impeller pumps fluid into the turbine. *(DD-075)*
12. **B. Redirects returning fluid to multiply torque** Now You Know: It turns the returning flow so it helps the impeller. *(DD-075)*
13. **B. Positive displacement** Now You Know: It moves a fixed volume with each stroke. *(DD-072)*
14. **B. Hydraulic fluid moved by the piston** Now You Know: The piston works on a sealed hydraulic fluid. *(DD-072)*
15. **B. Southern Illinois** Now You Know: It was sold as Cardox from 1927. *(DD-070)*
16. **B. A chemical heater and rupture disc** Now You Know: The disc shears at a set pressure. *(DD-070)*
17. **A. 672** Now You Know: Four rays of 168 LEDs. *(DD-630)*
18. **A. About 670 rpm** Now You Know: About 670 revolutions per minute. *(DD-630)*
19. **A. Spinning LED strips** Now You Know: LEDs on spinning blades. *(DD-700)*
20. **A. No, it draws a flat image** Now You Know: It's a persistence-of-vision display. *(DD-700)*
21. **C. 8** Now You Know: Eight. *(DD-702)*
22. **B. 60-120 tons** Now You Know: 60 to 120 tons an hour. *(DD-702)*
23. **A. Cured-in-place pipe** Now You Know: Cured-in-place pipe. *(DD-676)*
24. **A. London** Now You Know: London, by Eric Wood. *(DD-676)*
25. **A. Positive displacement** Now You Know: Positive displacement. *(DD-689)*
26. **A. Only the inside of the tube** Now You Know: Only the tube. *(DD-689)*

27. **A. Slats walk the load out the back** Now You Know: Hydraulic slats walk the load out. *(DD-665)*
28. **A. Three** Now You Know: Three interleaved groups. *(DD-665)*
29. **A. Air pressure from fans** Now You Know: Fans keep the inside pressure slightly higher. *(DD-631)*
30. **A. Keeping dust and noise from neighbors** Now You Know: They contain dust and noise. *(DD-631)*
31. **A. Naval Ordnance Laboratory** Now You Know: Where it was discovered. *(DD-616)*
32. **A. Martensite** Now You Know: The low-temperature phase. *(DD-616)*
33. **A. A spring-loaded arm striking the body** Now You Know: Each strike nudges it a few degrees. *(DD-581)*
34. **A. Orton Englehart** Now You Know: A citrus grower in Glendora, California. *(DD-581)*
35. **A. They fire in place, so exhaust keeps hitting the same spot** Now You Know: Without water, the flame deflector could melt. *(DD-594)*
36. **A. 335,000 gallons** Now You Know: At 300 psi. *(DD-594)*
37. **C. 200 or more** Now You Know: Each unit stores 200 or more bicycles in racks around a round shaft. *(DD-755)*
38. **A. 13–15 seconds** Now You Know: The average wait is 13–15 seconds, even at rush hour. *(DD-755)*
39. **A. By repeated subtraction** Now You Know: They count how many times the divisor fits. *(DD-284)*
40. **A. Subtracting zero never shrinks the number** Now You Know: The count just keeps going. *(DD-284)*
41. **A. Eli H. Janney** Now You Know: The patent was issued on April 29, 1873. *(DD-303)*
42. **A. It locks when cars are pushed together** Now You Know: The knuckles swing closed automatically. *(DD-303)*
43. **A. AD 80** Now You Know: Under Emperor Titus. *(DD-121)*
44. **A. A retractable awning** Now You Know: It shaded the seating. *(DD-121)*
45. **A. Sediment** Now You Know: From the bottom. *(DD-323)*
46. **A. For shipping** Now You Know: Bigger ships. *(DD-323)*
47. **A. Into hillsides and rock** Now You Know: Basic steps. *(DD-341)*
48. **A. Concrete** Now You Know: And stone. *(DD-341)*
49. **A. 1 followed by 100 zeros** Now You Know: 10^{100} . *(DD-327)*
50. **A. Ten times slower** Now You Know: Reduction. *(DD-327)*
51. **A. Caterpillar** Now You Know: Heavy equipment. *(DD-359)*
52. **A. 250 short tons** Now You Know: Huge. *(DD-359)*
53. **A. Diamond wire saws** Now You Know: Precision. *(DD-376)*
54. **A. Cement and bricks** Now You Know: Construction. *(DD-376)*
55. **A. Concrete** Now You Know: Durable. *(DD-410)*
56. **A. Spillways** Now You Know: Waterways. *(DD-410)*
57. **A. Three** Now You Know: Common machine. *(DD-423)*

58. **A. The upper** Now You Know: Pressure. *(DD-423)*

NOW YOU KNOW!