Popular Science
The What's New magazine

Feed logs to your oil burner?
MULTI-FUEL HOME FURNACES

New home compute

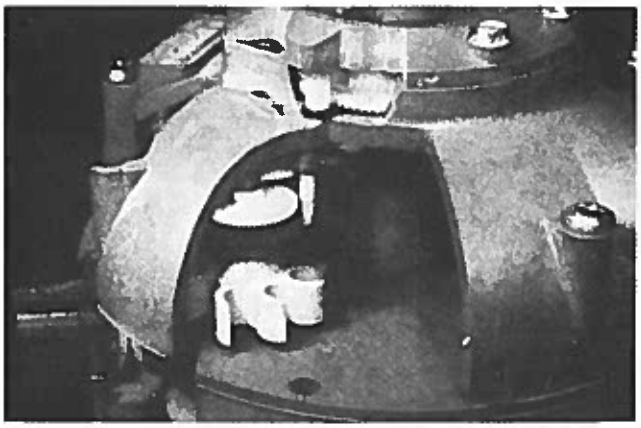
Low-cost models can change your life-style

GM and CHRYSLER for '78
—the shrink

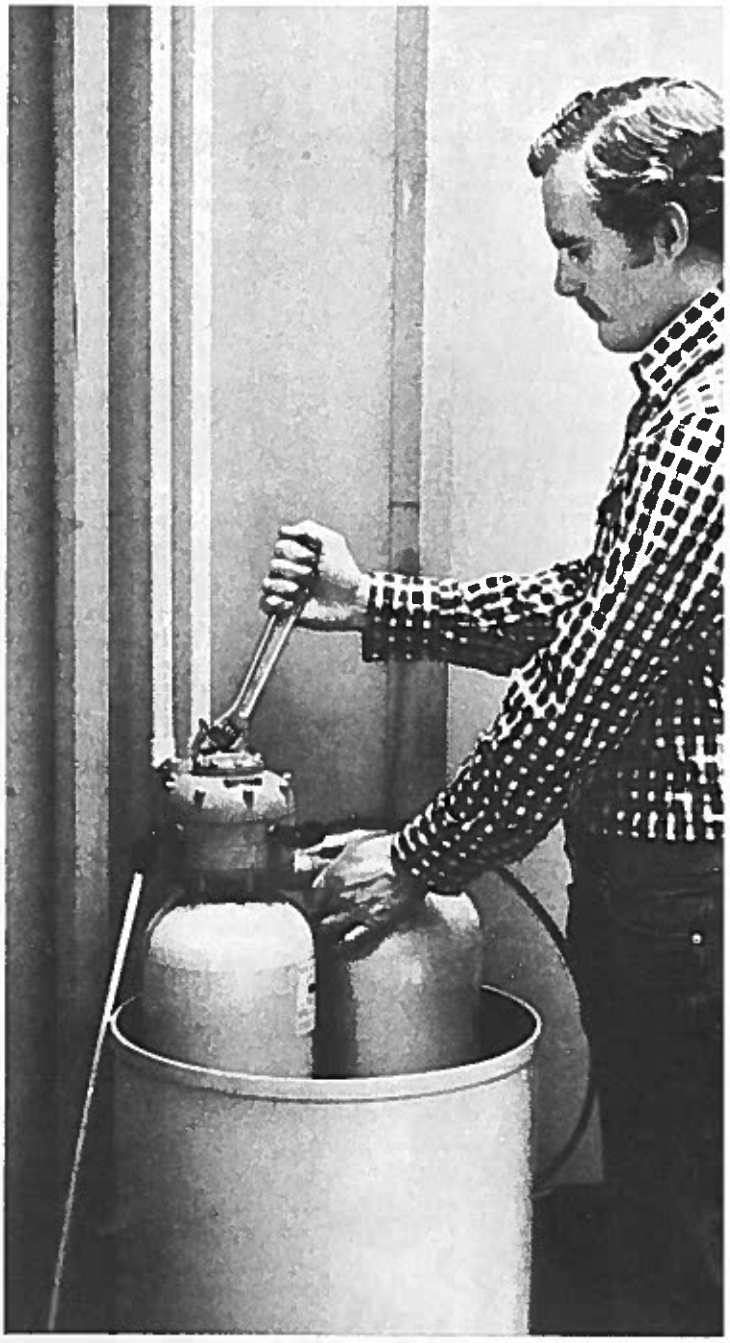
Our changing weather:
COLDER WINTERS AHEAD?

Twin-turbine softener

knows when to regenerate



Water-use turbine drives water-meter disk's gear teeth (top cutaway) through a 40,000:1 gear reduction to kick off each regeneration cycle. During and after each regeneration, it continues to monitor water use.



Twin-tank, twin-turbine Kinetico Water Conditioner comes calibrated to suit a water analysis. Softener tanks of smaller models fit inside salt-storage bin. Regenerations are governed by water use, not by periods of time as in most automatic water softeners.

New water-powered unit always has soft water on tap—without electricity

By RICHARD DAY

Meet a fully automatic water softener that saves water by regenerating only when needed. Unlike time-controlled softeners, it delays regeneration when little water is used and brings it on sooner when much is used. And, unlike sensor-controlled softeners, this water-controlled unit needs no electricity.

What's regeneration? Water softeners remove calcium and magnesium ions from hard water by running it through a resin bed that contains sodium ions (salt). In a chemical process the hardness ions are exchanged for softer, soap-compatible sodium ions. Periodically, the calcium and magnesium ions must be flushed from the resin bed; this is the regeneration cycle. (In December's issue, I'll describe in detail how water softeners work, plus how to install one yourself.)

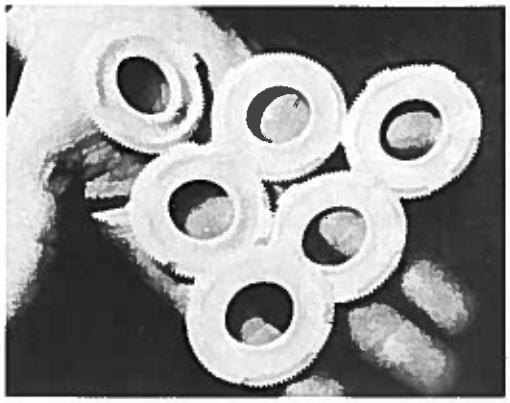
Called Kinetico, this new water softener uses the kinetic energy of flowing water to gauge how much water you use. Then, when the softening capacity in one of its two tanks has been depleted, it switches that tank off-line and switches a fresh tank on-line. You're never without soft water. The off-line tank is regenerated automatically.

Increased water use by house guests cannot fool the system. Neither can decreased use during vacations. Cut down on your water use and the softener cuts down on regenerations. Salt savings of as much as 50 percent are claimed. Furthermore, during the regeneration, only the amount of water necessary to do the job flows through the unit.

How does the Kinetico work?

I won't say it's simple—ingenious would be closer to the truth. The unit's controls are housed in a six-section labyrinthine fiberglass control module to which both tanks are attached. The module's system of inner passages would make an automobile carburetor blush. Water, diverted past a water-use turbine, shoots at the turbine's

One of seven servo valves and pistons in control module: These turn on, turn off, reroute, and divert water.

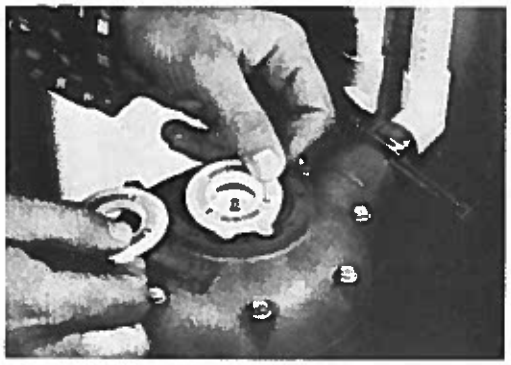


Water-meter disks come with from one to six wide spots around their perimeter gear teeth. These mesh with an idler gear to initiate each brine/rinse/backwash cycle. Disks are numbered from 1 to 6 for softest to hardest water, corresponding to their wide spots.

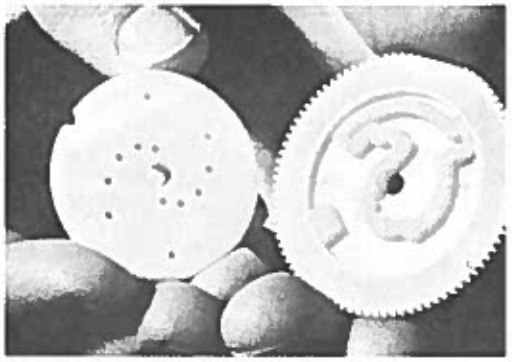
Hydraulic-control programming of Kinetico softener

PROGRAMMED ACTION	Step No.	Master-control valve	VALVE POSITION* Tank no. 1 Inlet valve	Tank no. 1 Outlet valve	Tank no. 1 Drain valve	Tank no. 2 Inlet valve	Tank no. 2 Outlet valve	Tank no. 2 Drain valve
TANK NO. 1 REGENERATES	1. Tank 1 on-line in service, tank 2 off-line ready	Closed	Open	Open	Closed	Closed	Open	Closed
	2. Regeneration starts on No. 1 tank	**Open**	Open	Open	Closed	Closed	Open	Closed
	3. Tank 2 placed in parallel service with No. 1	Open	Open	Open	Closed	**Open**	Open	Closed
	4. Tank 1 taken off-line	Open	**Closed**	Open	Closed	Open	Open	Closed
	5. Backpressure to tank 1 through its outlet valve is cut off	Open	Closed	**Closed**	Closed	Open	Open	Closed
	6. Brine aspirated into tank 1 until brine container is empty, then soft-water rinse continues	Open	Closed	Closed	**Open**	Open	Open	Closed
	7. Rapid backwash rinse with soft water	Open	Closed	**Open**	Open	Open	Open	Closed
	8. Regenerated tank 1 put on hold	Open	Closed	Open	**Closed**	Open	Open	Closed
	9. Flow to regeneration turbine stopped to end regeneration cycle: tank 2 is on-line tank 1 is off-line ready	**Closed**	Closed	Open	Closed	Open	Open	Closed
TANK NO. 2 REGENERATES	10. Regeneration starts on No 2 tank	**Open**	Closed	Open	Closed	Open	Open	Closed
	11 Tank 1 placed in parallel service with 2	Open	**Open**	Open	Closed	Open	Open	Closed
	12 Tank 2 taken off-line	Open	Open	Open	Closed	**Closed**	Open	Closed
	13. Backpressure to tank 2 is cut off	Open	Open	Open	Closed	Closed	**Closed**	Closed
	14 Brining rinse of tank 2	Open	Open	Open	Closed	Closed	Closed	**Open**
	15. Backwash of tank 2	Open	Open	Open	Closed	Closed	**Open**	Open
	16 Regenerated tank 2 on hold	Open	Open	Open	Closed	Closed	Open	**Closed**
	17 Flow to regeneration turbine is stopped to end cycle tank 1 on-line, tank 2 off-line ready	**Closed**	Open	Open	Closed	Closed	Open	Closed

*Boldface in body of table indicates active valve



To change a water-meter disk (seldom, if ever, required), you remove top of control module containing a see-through window. Then you lift off the old water-meter disk and replace it with another. Top of disk shows through window to indicate softener cycling.



Mating faces of ceramic disk and regeneration control gear (far right) are lapped flat to about 11-millionths of an inch to prevent leakage of pressurized water. Portholes in disk are linked to servo valve pistons. One gear recess is pressurized; other is for drainage.

reaction-type blades through an orifice, making the turbine spin. Through a clock-like system of reduction gears, the water-use turbine starts each regeneration cycle.

A second turbine, for regeneration, monitors water used for brining, rinsing, and backwashing of the off-line tank's resin bed. Through a 13,000:1 reduction gearing, this turbine whirs off the various phases of the regeneration cycle, controlling the length of each.

The system, which is patented, combines the skills of a watchmaker with those of a hydraulic engineer.

Although small, the Kinetico conditioner has a phenomenal capacity. Model 30, the smallest unit the firm makes, can remove up to 8000 grains of water hardness an hour, continuously. That's 7680 gallons of water a day at 25-grain-per-gallon (gpg) hardness. How? The softener knows when to regenerate without waiting for an electric timer to tell it. And it holds a freshly regenerated tank on standby, ready to keep the soft water coming. Model 30's capacity per cycle is 6200 grains, which uses two pounds of softener salt. This model is suited to water with hardness to 30 gpg. Other models can handle harder water.

But the real story is what happens while the turbines turn. Inside Kinetico's control module, along with the turbines, are seven water-controlled servo valves. These turn on, turn off, reroute, and divert water where and when it's needed. Each softener tank has an inlet valve, outlet valve, and drain valve. And there's one master control valve. Servo valve pistons connect through internal passages to a tiny port critically positioned in a ceramic disk. Stationary, the ceramic disk's flat-lapped surface mates with a similarly lapped surface on a regeneration control gear that rotates above it. Pressurized water around the two cannot leak in. Instead, control water must flow where it's directed.

To direct it, there are two shaped recesses on the gear's bottom (see photo). One recess is pressurized with soft water; the other functions at ambient pressure and leads to a drain. When the port leading to the

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top end of a two-way servo valve's piston is passed over by the pressurized recess and the port leading to the piston's bottom end is under the drain recess, the piston moves downward, opening the valve. The other way around, it closes.

Three servo valve pistons are single-acting—pressurized to open, self-closing under fluid pressure. The other four are double-acting. Depending on which recess passes above a valve's ceramic disk ports as the regeneration control gear rotates, the valve opens or closes. (The table shows a full double-cycle program.) Together, the ceramic disk and regeneration control gear produce 24 hydraulic signals that control all of the softener's regeneration actions.

One side of the ceramic disk serves tank 1 ports; the other side serves tank 2 ports. A 180-degree revolution of the gear thus goes through the entire regeneration cycle for one tank. A projection into the gear's drain recess closes the master control valve's port twice each revolution. When the valve is closed, water to the regeneration turbine is cut off, stopping it and halting the gear in its "regeneration-accomplished" position. It stays there until it's time for another regeneration.

When to start another cycle?

The unit senses this in the function of the top gear, called the water-meter disk, which is turned about one revolution every 1000 gallons by the water-use turbine. The water-meter disk has from one to six wide spots around its gear teeth. The teeth merely idle as it turns, until a wide spot reaches out to engage a small idler gear that spans between it and the regeneration control gear. A matching wide spot in the lower regeneration control gear in its stopped position stands enmeshed with the idler. As the upper wide spot meshes, the idler rotates, turning the regeneration control gear in unison with it and exposing a control-valve port. This starts the regeneration turbine going on its own cycle.

Another bit of hydraulic heroics is in a balance system. The softener must be able to work at water pressures ranging from 15 to 125 psi, yet the regeneration control gear works best under a constant load. It's done with a coil-spring preload from above. The underside of an O-ring-sealed balance piston works at ambient pressure, its topside at water pressure. For balance, piston area equals pressurized recess area. The piston pushes down on the spring to equalize pressures.

Ohio inventors William C. Prior and James W. Kewley created the softener—and its incredible turbine-powered programming. In dream-come-true fashion, the inventors have become manufacturers and marketers of their product. They furnish it in four models to handle water hardness to 115 gpg. Retail prices are claimed to be competitive with other softener brands.

I have no idea how long the unit would keep working; however, the maker claims it has passed punishing accelerated 10-year-life tests, and claim reliability and efficiency never before achieved.

For more information, contact Kinetico, Inc., Newbury, Ohio 44065. PS