



## ⚙️ Sprag Handle Wrenches

These wrenches could supplant conventional ratcheting wrenches.

*Goddard Space Flight Center, Greenbelt, Maryland*

Sprag handle wrenches have been proposed for general applications in which conventional pawl-and-ratchet wrenches and sprag and cam “clickless” wrenches are now used. Sprag handle wrenches are so named because they would include components that would

function both as parts of handles and as sprags (roller locking/unlocking components). In comparison with all of the aforementioned conventional wrenches, properly designed sprag handle wrenches could operate with much less backlash; in comparison with the con-

ventional clickless wrenches, sprag handle wrenches could be stronger and less expensive (because the sprags would be larger and more easily controllable than are conventional sprags and cams).

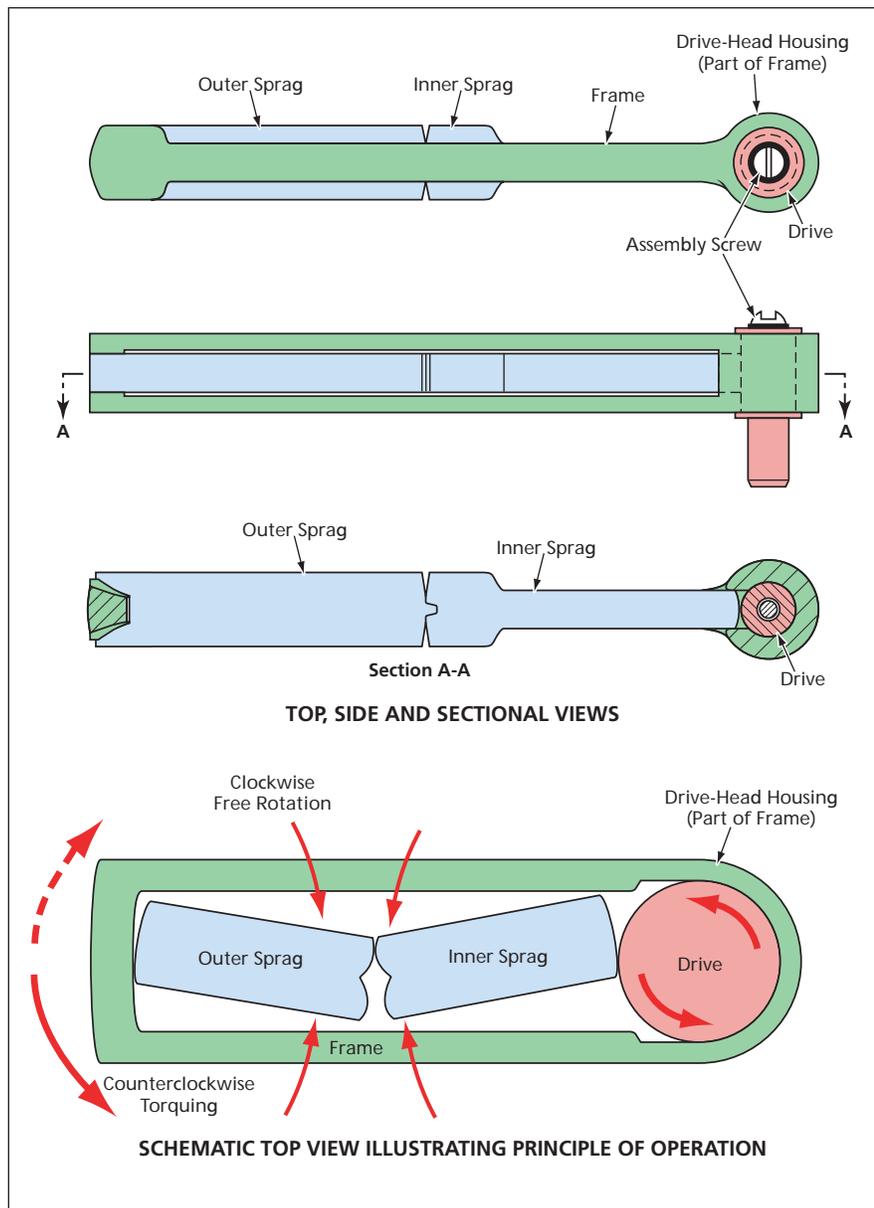
A basic sprag handle wrench, shown in the upper part of the figure, would include the following parts:

- A frame that would constitute both the drive-head housing and part of the handle,
- A drive that would rotate freely within the drive-head housing except when engaged by sprags,
- An outer sprag that would constitute the rest of the handle, and
- An inner sprag that would engage the outer sprag at its outer end and the drive head at its inner end.

The frame would include a gap, into which the two sprags could be placed. Taken together, the inner sprag, the drive-head housing, and the drive would constitute the drive head. The inner and outer sprags would act as a roller-locking/unlocking pair that would afford low-backlash ratcheting, as described below.

Omitted from the figure for the sake of clarity are gear-tooth-based roller surfaces, on the sprags and in the frame, that would ensure the proper alignment and engagement between the sprags, between the outer sprag and frame, and between the inner sprag and the drive. These surfaces would be such that (1) in preparation for applying torque, the operator could bring the ends of the sprags into contact with each other and with the frame and drive, by twisting the outer sprag slightly clockwise and (2) in preparation for free rotation for ratcheting to the starting position for the next torque-application stroke, the operator could relieve the contact forces on the sprags by twisting the outer sprag slightly counterclockwise.

In clockwise torquing, depicted schematically in the lower part of the figure, the operator would push or pull on the outer-sprag portion of the handle in a clockwise direction; this action would jam the inner and outer sprags together



A Basic Sprag Handle Wrench would be a low-backlash, “clickless” ratcheting wrench that would offer advantages over conventional pawl-and-ratchet, sprag, and cam wrenches — essential when working in tight places.

between the frame at the outer end and the drive at the inner end. The jamming of the inner sprag against the drive would prevent rotation of the drive relative to the drive housing, so that clockwise torque would be exerted on the drive. At the end of the clockwise torque-application stroke, the operator would twist the outer sprag to relieve the

contact forces as described above. Then by exerting a small counterclockwise force on the outer-sprag portion of the handle, the operator could further unjam the sprags to complete the disengagement with the drive, and turn the handle counterclockwise to the starting position for the next clockwise torque-application stroke. Except for reversal of

the directions of all forces, torques, and rotations, counterclockwise torquing and ratcheting would be the same as in the clockwise case described above.

*This work was done by John M. Vranish of Goddard Space Flight Center. For further information, contact the Goddard Innovative Technology Partnership (ITTP) Office at (301) 286-5810. GSC-14682-1*

## ⚙️ **Miniature Low-Mass Drill Actuated by Flextensional Piezo Stack**

**This extremely small impact drill can be used for testing soil for toxic chemicals, and other analytical tests.**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

Recent experiments with a flextensional piezoelectric actuator have led to the development of a sampler with a bit that is designed to produce and capture a full set of sample forms including

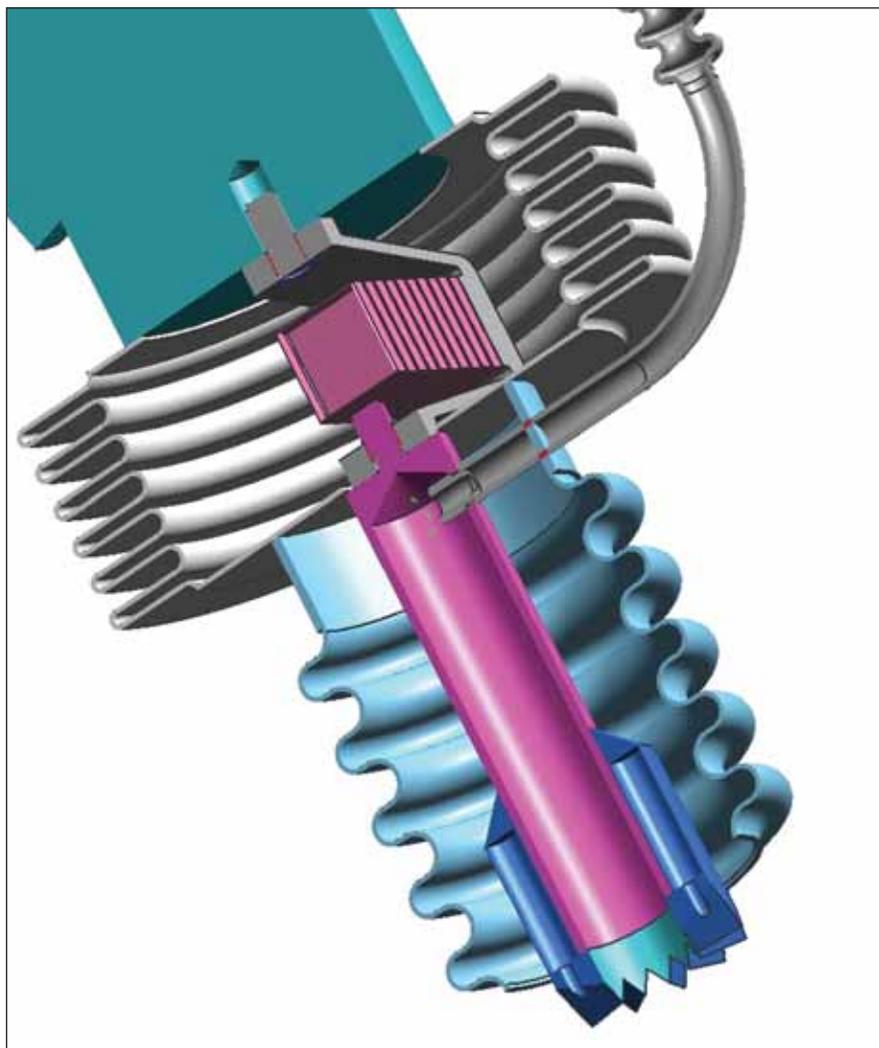
volatiles, powdered cuttings, and core fragments.

The flextensional piezoelectric actuator is a part of a series of devices used to amplify the generated strain from piezo-

electric actuators. Other examples include stacks, bimorphs, benders, and cantilevers. These devices combine geometric and resonance amplifications to produce large stroke at high power density. The operation of this sampler/drill was demonstrated using a 3×2×1-cm actuator weighing 12 g using power of about 10-W and a preload of about 10 N. A limestone block was drilled to a depth of about 1 cm in five minutes to produce powdered cuttings.

It is generally hard to collect volatiles from random surface profiles found in rocks and sediment, powdered cuttings, and core fragments. Toward the end of collecting volatiles, the actuator and the bit are covered with bellows-shaped shrouds to prevent fines and other debris from reaching the analyzer. A tube with a miniature bellows (to provide flexibility) is connected to the bit and directs the flow of the volatiles to the analyzer. Another modality was conceived where the hose is connected to the bellows wall directly to allow the capture of volatiles generated both inside and outside the bit. A wide variety of commercial bellows used in the vacuum and microwave industries can be used to design the volatiles' capture mechanism.

The piezoelectric drilling mechanism can potentially be operated in a broad temperature range from about -200 to <450 °C. The actuators used here are similar to the actuators that are currently baselined to fly as part of the inlet funnel shaking mechanism design of MSL (Mars Science Laboratory). The space qualification of these parts gives this drill a higher potential for inclusion in a future mission, especially when considering its characteristics of low mass, small size, low power, and low axial loads for sampling.



The Miniature Drill, the bit, and the covering of both the actuator and bit using bellows are shown. The tube with bellows also is shown.