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Collisionless plasma shocks (CPSs), forming when supersonic plasma streams encounter a magnetized obstacle, are invoked to explain the acceleration of ubiquitously energetic cosmic rays. It has long been theorized from magnetohydrodynamics, but not directly observed that the CPSs develop from the growth of small-amplitude, low-frequency plasma waves which excited by reflected ion beams from the obstacle. We present in situ observations of an entire formation sequence of the periodic plasma shocks by the MAVEN spacecraft's magnetic field and particle instruments. The magnetometer first detected small-amplitude circularly polarized magnetosonic waves that further steepened and eventually evolved into periodic shocks. Moreover, differing from the traditional understanding, characterizations of the fast mode waves show that the free energy of the wave/shock generation is provided by newborn protons, and the increasing sunward proton fluxes provided persistent energy for wave steepening. The unusual evidence presents itself from the combination of two circumstances: radial-aligned (Sun-Mars) magnetic fields and Martian atmospheric atom (hydrogen) photoionization and solar wind pickup. These observations lead to the conclusion that newborn ions play a crucial role in the formation process of some CPSs in the astrophysical and space plasma.