The dynamic interplay of transport, electrostatic, and magnetic effects in the resonant tunneling through ferromagnetic quantum wells is theoretically investigated. It is shown that the carrier-mediated magnetic order in the ferromagnetic region not only induces, but also takes part in intrinsic, robust, and sustainable high-frequency current oscillations over a large window of nominally steady bias voltages. This phenomenon could spawn a new class of quantum electronic devices based on ferromagnetic semiconductors.