Applicant arguments filed with the USPTO on Aug. 5, 2013 to support US Patent Application 13,810,158, which was eventually granted as US Patent 9,144,188—Autonomous Self-Actuated Tillage Implement.

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The Invention:

For a quick appreciate of how the invention operates and to better assess how it differs from the prior art, please see the video clips showing prototypes of the claimed invention in operation at http://sedewa.com/prototypes.html. These video clips show the potential for autonomous, low (or no) outside energy consumption operation of the invention that is a claimed combination that is believed to be both novel and unobvious over the prior art.

What is fundamental to the invention is that there are two sets of implement frames that are interconnected by the "alternate approaching and distancing means." There is at least one plow share on one set of frames and at least one anti-rollback means on the other set of frames. It is the rollback means on one frame that actuates, i.e., that provides traction for the plow share(s) on the other frame. There can be two plow shares on one frame, and two crampons on the other frame; there can be two plow shares and crampons on each frame; etc. Plow shares and crampons can be connected or can be placed separately. The rearward portion of a plow share might be shaped in such a way as to provide anti-rollback for its counterpart on the other frame, without crampons. But there is always at least one frame with at least one plow share, the traction for which is provided by the anti-rollback means on the other frame. This allows the implement to autonomously crawl forward while tilling the soil.

The "anti-rollback means" refers to any mechanism that provides traction, and both the anti-rollback means in the claims and the phrase self-actuated in the title refers to the fact that this is the primary source of traction.

Technical Background:

Tillage is mechanical agitation of the soil to create suitable conditions for crop growth. Soil agitation can be soil fragmentation, soil mixing, cutting of weed roots, and more. Tillage is one of the most work intensive activities in agricultural, both in terms of man power and in terms of fossil fuel consumption. The mechanical force to agitate the soil is conventionally provided by dragging a tillage implement horizontally through the soil by means of a wheeled or tracked tractor. The draft force of the tillage implement depends on how deep the tillage implement penetrates the soil, its geometry, speed, soil properties, and other factors. A wheeled or tracked tractor generates the mechanical force that pulls a tillage implement through some portion of the soil by letting its tread make contact with another portion of the same soil, and by letting the tread apply a force on that other portion with a direction opposite to the direction of travel of the tillage implement. The force of the wheel needs to be at least equal to the draft of the tillage implement. It is in fact always greater as it also needs to overcome the motion resistance of the tractor.

According to ASABE standard D497.5 [1], the tractive efficiency of wheeled and tracked tractors is 55% on soft or sandy soil and can reach 77% on firm soil. That is, a wheeled or tracked tractor loses between 23% and 45% of axel power to generate traction. This inefficiency is independent of motor technology and transmission technology and depends only on the interaction between the wheels or tracks and the soil. The lost energy is attributed to soil deformation under the tire or track, flexing of the tire or track, and slip.

Without ballast, a wheel or track will slip excessively and will not pull the tillage implement. For the wheel or track to generate forward force, ballast is needed to force its tread downward into the ground. The optimal downward force depends on the draft of the tillage implement. The scientific consensus is that it is about 3 times the required draft force [2]. This downward force compacts the soil [8]. The work by W. Söhne is from the 1950s but is considered to be the standard work on deep soil compaction