CLAIMS

1. A flow booster for optimizing flow of a fuel passing into an aircraft via a refueling unit being operable to continuously adjust a flow of fuel into the aircraft in real time during refueling, the refueling unit comprising a fuel circuit, the flow booster comprising:

a fuel intake fluidly coupled to the fuel circuit, the fuel intake comprising a housing and a piston, the piston comprising a piston head slidably movable in the housing to define a variable fuel inlet to receive the fuel therethrough and into the fuel circuit, wherein the fuel has a fuel force applied to the piston;

an intake tuner operatively connected to the fuel intake, the intake tuner having a tuning force applied to the piston against the fuel force;

a trigger coupled to the intake tuner to selectively vary the tuning force applied by the intake tuner; and

a flow regulator operatively coupled to the trigger and sensors configured to capture fuel measurements, the fuel measurements comprising at least one of a nozzle pressure measured at a nozzle configured to fluidly couple with the aircraft, and a simulated nozzle pressure measured at the fuel circuit, such that in response to a captured fuel measurement, the flow regulator selectively activates the trigger to apply the tuning force and thereby increase one or more of the fuel measurements resulting in an increased flow rate of the fuel entering the aircraft and thereby compensating a backpressure within the refueling unit.

2. The flow booster of claim 1, wherein the piston is urged toward a fully closed position of the fuel inlet when the tuning force exceeds the fuel force and toward a fully open position of the fuel inlet when the fuel force exceeds the tuning force.

3. The flow booster of claim 1, wherein the fuel force is defined by a fuel pressure of the fuel at one of: the fuel inlet, the fuel circuit, the aircraft, and combinations thereof.

4. The flow booster of claim 1, wherein the intake tuner comprises a pressurized fluid source with a pressurized fluid.

5. The flow booster of claim 4, wherein the fuel force comprises a fuel pressure of the fuel applied to a fuel side of the piston and wherein the tuning force comprises a fluid pressure of the pressurized fluid applied to a fluid side of the piston.

6. The flow booster of claim 5, wherein the piston further comprises a piston tail

connected to the piston head by a piston rod and movable therewith, the piston tail having the fuel side and the fluid side on opposite sides thereof, the piston tail separating a piston chamber in the housing into a fuel chamber on the fuel side of the piston tail and a fluid chamber on the fluid side of the piston tail, the fuel chamber in fluid communication with the fuel and the fluid chamber in fluid communication with the pressurized fluid.

7. The flow booster of claim 1, wherein the intake tuner comprises a motor operatively connected to the piston, and wherein the tuning force is defined by a driving force of the motor.

8. The flow booster of claim 1, wherein the trigger comprises one of driver, a solenoid, a valve, and combinations thereof.

9. The flow booster of claim 1, wherein the fuel measurements comprise a fuel pressure, and wherein the flow regulator has a minimum trigger level for activation of the trigger, the minimum trigger level corresponding to a fuel pressure of 75% of a predefined maximum fuel pressure.

10. A refueling system for optimizing flow of a fuel passing into an aircraft, the refueling system being operable to continuously adjust a flow of fuel into the aircraft in real time during refueling, the refueling system comprising:

a fuel source;

a refueling unit comprising a fuel circuit in selective fluid communication with the fuel source and the aircraft; and

a flow booster, comprising:

a fuel intake fluidly coupled to the fuel circuit, the fuel intake comprising a housing and a piston, the piston comprising a piston head slidably movable in the housing to define a variable fuel inlet to receive the fuel therethrough and into the fuel circuit, wherein the fuel has a fuel force applied to the piston;

an intake tuner operatively connected to the fuel intake, the intake tuner having a tuning force applied to the piston against the fuel force;

a trigger coupled to the intake tuner to selectively vary the tuning force applied by the intake tuner; and

a flow regulator operatively coupled to the trigger and sensors configured to capture fuel measurements, the fuel measurements comprising at least one of a nozzle pressure measured at a nozzle configured to fluidly couple with the aircraft, and a simulated nozzle pressure measured at the

fuel circuit, such that in response to a captured fuel measurement, the flow regulator selectively activates the trigger to apply the tuning force and thereby increase one or more of the fuel measurements resulting in an increased flow rate of the fuel entering the aircraft and thereby compensating a backpressure within the refueling unit.

11. The refueling system of claim 10, wherein the sensors comprise a fluid pressure (Pfluid) sensor, a fuel pressure (Pfuel) sensor, an intake pressure (Pintake) sensor, a fuel flow rate (Qfuel) sensor, a simulated nozzle pressure **(PNS)** sensor, an actual nozzle pressure (PNA) sensor, and a backpressure (Pplane) sensor at the aircraft.

12. A method of optimizing flow of a fuel into an aircraft by continuously adjusting a flow of the fuel entering the aircraft in real time, the method comprising:

passing the fuel through a fuel intake and into a fuel circuit and from the fuel circuit into the aircraft;

defining a dimension of a fuel inlet of the fuel intake by slidably positioning a piston in the fuel inlet and applying a fuel force of the fuel to the piston;

measuring fuel parameters of the fuel during the passing, wherein measuring the fuel parameters comprising at least one of:

capturing a nozzle pressure measured at a nozzle coupled with the aircraft, and

capturing a simulated nozzle pressure measured at the fuel circuit,

applying a tuning force in response to a measured fuel parameter resulting in:

an increase to a value of one or more of the fuel parameters,

an increase in a flow rate of fuel entering the aircraft, and

compensation of a backpressure within the fueling unit.

13. The method of claim 12, wherein the selectively boosting comprises maintaining a pressure of the fuel below a maximum pressure during the passing.

14. The method of claim 12, wherein the selectively boosting comprises selectively increasing the tuning force to overcome the fuel force.

15. The method of claim 12, wherein the fuel parameters comprise a fuel pressure of the fuel and wherein the selectively boosting comprises maintaining the fuel pressure within 75% of a predefined maximum pressure for more than 50% of the passing.