

CLAIMS

1. A locking device, comprising:

a processor defined to control operation of the locking device;

a radio defined in electrical communication with the processor;

5 a location determination device defined in electrical communication with the processor, wherein a combination of the processor, the radio, and the location determination device forms a wireless tracking and communication system;

a shackle; and

10 a locking mechanism defined in electrical communication with the processor, wherein the processor is defined to operate the locking mechanism to control locking and unlocking of the shackle based on information obtained through the wireless tracking and communication system.

2. A locking device as recited in claim 1, further comprising:

15 a power source defined to supply electrical power to the processor, the radio, the location determination device, and the locking mechanism.

3. A locking device as recited in claim 2, further comprising:

a solar film electrically connected to the power source and defined to electrically re-charge the power source.

20 4. A locking device as recited in claim 1, wherein the radio is an international frequency radio, and wherein the location determination device is a global positioning system receiver device.

25 5. A locking device as recited in claim 1, wherein the processor is defined to operate the locking mechanism based on one or more of a proximity of the locking device to a secure wireless communication network, a terrestrial position of the locking device, and one or more commands received through the wireless tracking and communication system.

6. A locking device as recited in claim 1, wherein the locking mechanism includes a latch plate defined to be movable to engage with and lock the shackle, and defined to be movable to disengage from and unlock the shackle,

30 wherein the locking mechanism also includes a cam defined to be movable in a first direction to engage with the latch plate such that movement of the cam in a second direction causes movement of the latch plate in the second direction, and

wherein the locking mechanism also includes a motor mechanically connected to control movement of the cam in the first direction to engage with the latch plate, wherein the motor is electrically connected to be controlled by the processor.

7. A locking device as recited in claim 6, wherein the shackle can only be unlocked through operation of the processor to control the motor to move the cam to engage the latch plate.

8. A locking device as recited in claim 6, further comprising:  
lock sensors defined to determine a position of the cam relative to the latch plate and electrically communicate the determined position of the cam to the processor.

9. A locking device as recited in claim 1, further comprising:  
a memory disposed in electrical communication with the processor for recording data, the data including program instructions for operating the wireless tracking and communication system, the data also including settings associated with operation of the locking device, the data also including a recording of a time-dependent status of the locking device;

a user interface display disposed in electrical communication with the processor and defined to visually render data recorded in the memory; and

a user interface control device disposed in electrical communication with the processor and defined to control which data is rendered in the user interface display.

10. A locking device as recited in claim 9, wherein the user interface display is a liquid crystal display, and wherein the user interface control device is a mechanical button.

11. A locking device, comprising:  
a shell;  
a shackle disposed within a channel inside the shell, the shackle defined to insert into an opening in the shell to close a shackle loop, the shackle defined to release from the opening in the shell to open the shackle loop;

a latch plate disposed inside the shell and defined to engage the shackle to lock the shackle when inserted into the shell to close the shackle loop;

a push plate disposed inside the shell, the push plate defined to be moved within the shell by an applied external force;

a motor mechanically fixed to the push plate;  
a cam mechanically connected to be moved by the motor to engage with the latch plate, whereby movement of the push plate by the applied external force with the motor operated to

engage the cam with the latch plate causes the latch plate to move to disengage from the shackle, thereby freeing the shackle to release from the shell to open the shackle loop; and

a processor defined onboard the locking device to monitor a state of the locking device and autonomously control the motor to move the cam based on the monitored state of the locking device.

12. A locking device as recited in claim 11, wherein the cam is rigidly connected to the motor such that movement of the motor through movement of the push plate causes corresponding movement of the cam.

13. A locking device as recited in claim 11, further comprising:

a first spring defined to disengage the cam from the latch plate when the motor is not powered to move the cam to engage with the latch plate;

a second spring defined to engage the latch plate with the shackle in an absence of the applied external force to move the push plate when the cam is also moved to engage the latch plate; and

a third spring defined to resist the external force applied to move the push plate such that the push plate is returned to its home position in the absence of the applied external force.

14. A locking device as recited in claim 11, wherein the push plate and latch plate physically interface with each other such that a force applied to the shackle is transferred through the shackle to the latch plate to the push plate to the shell.

15. A locking device as recited in claim 11, wherein the motor is isolated from a force applied to the shackle.

16. A locking device as recited in claim 11, further comprising:

an interlocking plate disposed within and secured to the shell to cover the push plate, the motor, the cam, the latch plate, and the shackle such that a locking mechanism of the locking device cannot be accessed without removal of the interlocking plate, and wherein the interlocking plate is secured to the shell by a fastener that is only accessible through the opening in the shell when the shackle is released from the opening in the shell to open the shackle loop.

17. A method for autonomous operation of a locking device based on a status of the locking device, comprising:

operating a computing system onboard the locking device to automatically determine a real-time status of the locking device; and

based on the automatically determined real-time status of the locking device, operating the computing system to automatically control a locking mechanism of the locking device to either lock or unlock the locking device.

18. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 17, wherein the real-time status of the locking device includes one or more of a presence of any pending command to be executed by the computing system, a presence of a user interaction with a control of the locking device, a presence of a scheduled task to be performed by the computing system, a current state of a power supply of the locking device, and a current environment state of the locking device.

19. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 18, wherein the current environment state of the locking device includes one or more of a current state of motion of the locking device, a current terrestrial position of the locking device, a current proximity of the locking device to a wireless communication network to which the computing system can wirelessly communicate, a temperature near the locking device, a humidity near the locking device, a radioactivity level near the locking device, a chemical presence near the locking device, and an external movement near the locking device.

20. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 17, wherein operating the computing system onboard the locking device to automatically determine the real-time status of the locking device includes operating a wireless tracking system within the computing system onboard the locking device to determine a terrestrial position of the locking device.

21. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 17, wherein operating the computing system onboard the locking device to automatically determine the real-time status of the locking device includes operating a wireless communication system within the computing system onboard the locking device to access a wireless network and receive commands from one or more sources over the wireless network.

22. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 21, wherein the received commands update the real-time status of the locking device to direct the computing system onboard the locking device to either lock or unlock the locking device.

23. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 17, wherein operating the computing system onboard the locking device to automatically determine the real-time status of the locking device includes operating the computing system to acquire data from one or more sensors proximate to the locking device.

24. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 23, wherein some of the one or more sensors proximate to the locking device are physically attached to the locking device and communicate data with the computing system through wired connections.

25. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 23, wherein some of the one or more sensors proximate to the locking device are not physically attached to the locking device and communicate data with the computing system through a wireless means.

26. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 23, wherein the one or more sensors include one or more of a movement sensor, a temperature sensor, a humidity sensor, an infrared sensor, a radioactivity detection sensor, an acoustic sensor, and a chemical detection sensor.

27. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 17, further comprising:

operating the computing system onboard the locking device to automatically record data in a memory onboard the locking device, wherein the data includes information about the determined real-time status of the locking device.

28. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 27, wherein the data includes time-stamped information about one or more of a terrestrial position of the locking device, a security event associated with the locking device, a shackle state of the locking device, a network communication received or transmitted by the computing system onboard the locking device, a physical movement of the locking device, and an environmental condition to which the locking device is exposed.

29. A method for autonomous operation of a locking device based on a status of the locking device as recited in claim 27, further comprising:

operating a wireless communication system within the computing system onboard the locking device to transmit data automatically recorded in the memory onboard the locking device to a receiver within a wireless network within range of the locking device.

30. A method for operating a locking device, comprising:

5 maintaining the locking device in a minimum power consumption state while waiting for a wakeup signal to be issued by a processor of the locking device;

detecting an event that requires the locking device to operate at a normal power level;

operating the processor to issue the wakeup signal to transition the locking device from the minimum power consumption state to the normal power level;

10 receiving a command over a wireless communication system of the locking device;

operating the processor to execute the received command; and

transitioning the locking device from the normal power level to the minimum power consumption state following execution of the received command.

31. A method for operating a locking device as recited in claim 30, wherein the

15 received command directs the locking device to either lock or unlock.

## Claims

### 1. A locking device, comprising:

a processor defined to control operation of the locking device;

a radio defined in electrical communication with the processor;

a location determination device positioned within the locking device, the location determination device defined in electrical communication with the processor, wherein a combination of the processor, the radio, and the location determination device forms a wireless tracking and communication system;

a shackle;

a locking mechanism defined in electrical communication with the processor, wherein the processor is defined to operate the locking mechanism to control locking and unlocking of the shackle based on information obtained through the wireless tracking and communication system,

wherein the locking mechanism includes a latch plate defined to be movable to engage with and lock the shackle, and defined to be movable to disengage from and unlock the shackle,

wherein the locking mechanism also includes a cam defined to be movable in a first direction to engage with the latch plate such that movement of the cam in a second direction causes movement of the latch plate in the second direction, and

wherein the locking mechanism also includes a motor mechanically connected to control movement of the cam in the first direction to engage with the latch plate, wherein the motor is electrically connected to be controlled by the processor; and

lock sensors defined to determine a position of the cam relative to the latch plate and electrically communicate the determined position of the cam to the processor.

2. A locking device as recited in claim 1, further comprising:  
a power source defined to supply electrical power to the processor, the radio, the location determination device, and the locking mechanism.
3. A locking device as recited in claim 2, further comprising:  
a solar film electrically connected to the power source and defined to electrically re-charge the power source.
4. A locking device as recited in claim 1, wherein the radio is an international frequency radio, and wherein the location determination device is a global positioning system receiver device.
5. A locking device as recited in claim 1, wherein the processor is defined to operate the locking mechanism based on one or more of a proximity of the locking device to a secure wireless communication network, a terrestrial position of the locking device, and one or more commands received through the wireless tracking and communication system.
6. A locking device as recited in claim 1, wherein the shackle can only be unlocked through operation of the processor to control the motor to move the cam to engage the latch plate.

7. A locking device as recited in claim 1, further comprising:

a memory disposed in electrical communication with the processor for recording data, the data including program instructions for operating the wireless tracking and communication system, the data also including settings associated with operation of the locking device, the data also including a recording of a time-dependent status of the locking device;

a user interface display disposed in electrical communication with the processor and defined to visually render data recorded in the memory; and

a user interface control device disposed in electrical communication with the processor and defined to control which data is rendered in the user interface display.

8. A locking device as recited in claim 7, wherein the user interface display is a liquid crystal display, and wherein the user interface control device is a mechanical button.

9. A locking device, comprising:

a shell;

a shackle disposed within a channel inside the shell, the shackle defined to insert into an opening in the shell to close a shackle loop, the shackle defined to release from the opening in the shell to open the shackle loop;

a latch plate disposed inside the shell and defined to engage the shackle to lock the shackle when inserted into the shell to close the shackle loop;

a push plate disposed inside the shell, the push plate defined to be moved within the shell by an applied external force;

a motor mechanically fixed to the push plate;

a cam mechanically connected to be moved by the motor to engage with the latch plate, whereby movement of the push plate by the applied external force with the motor operated to engage the cam with the latch plate causes the latch plate to move to disengage from the shackle, thereby freeing the shackle to release from the shell to open the shackle loop; and

a processor defined onboard the locking device to monitor a state of the locking device and autonomously control the motor to move the cam based on the monitored state of the locking device.

10. A locking device as recited in claim 9, wherein the cam is rigidly connected to the motor such that movement of the motor through movement of the push plate causes corresponding movement of the cam.

11. A locking device as recited in claim 9, further comprising:

a first spring defined to disengage the cam from the latch plate when the motor is not powered to move the cam to engage with the latch plate;

a second spring defined to engage the latch plate with the shackle in an absence of the applied external force to move the push plate when the cam is also moved to engage the latch plate; and

a third spring defined to resist the external force applied to move the push plate such that the push plate is returned to its home position in the absence of the applied external force.

12. A locking device as recited in claim 9, wherein the push plate and latch plate physically interface with each other such that a force applied to the shackle is transferred through the shackle to the latch plate to the push plate to the shell.

13. A locking device as recited in claim 9, wherein the motor is isolated from a force applied to the shackle.

14. A locking device as recited in claim 9, further comprising:  
an interlocking plate disposed within and secured to the shell to cover the push plate, the motor, the cam, the latch plate, and the shackle such that a locking mechanism of the locking device cannot be accessed without removal of the interlocking plate, and wherein the interlocking plate is secured to the shell by a fastener that is only accessible through the opening in the shell when the shackle is released from the opening in the shell to open the shackle loop.