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(54) **ADAPTIVE LIGHT SEATBELT BUCKLE**

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(52) **U.S. Cl.** **340/457.1**

(57) **ABSTRACT**

An adaptive light seatbelt system is provided. The system includes a buckle housing, a light positioned in the buckle housing so that the light is visible to an occupant of a vehicle, a controller for controlling the light, and a signaler for providing an input to the controller. The system indicates a state of the buckle housing by controlling the light.

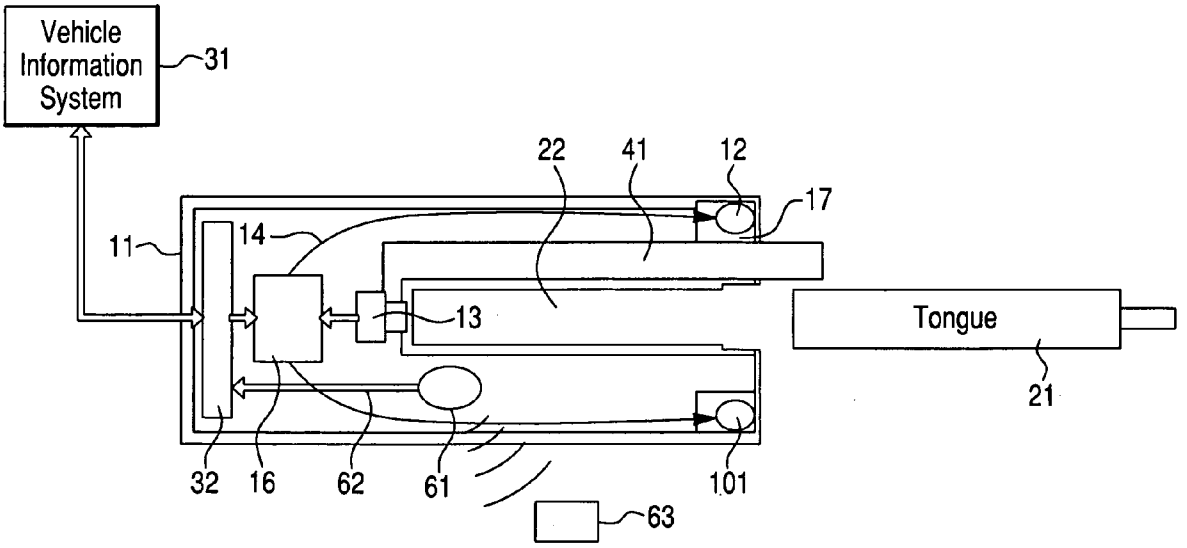

Fig. 1

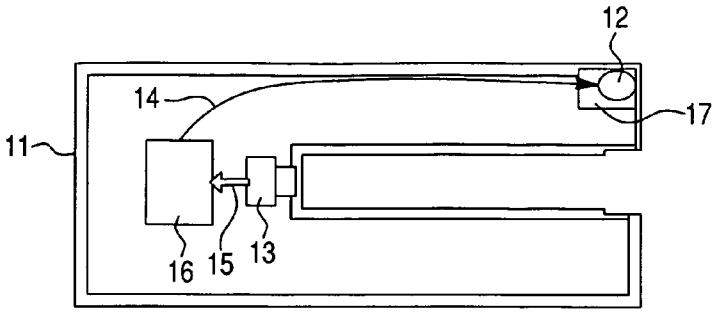

Fig. 2

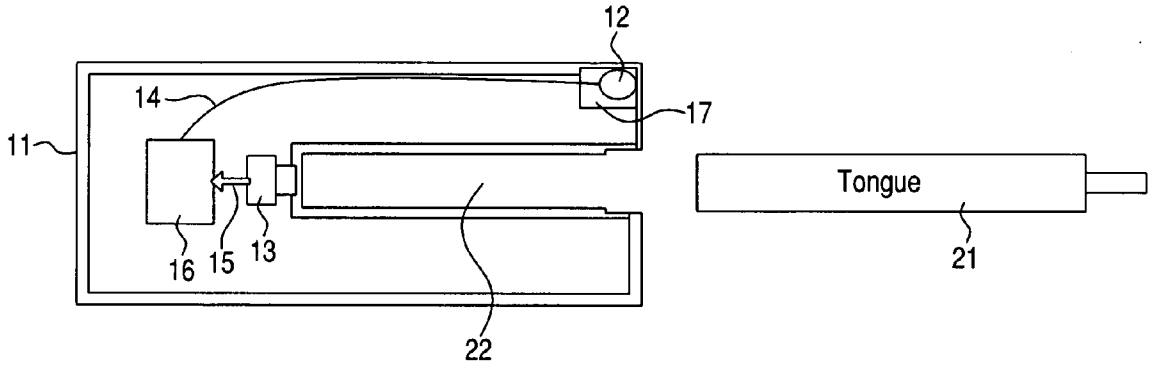

Fig. 3

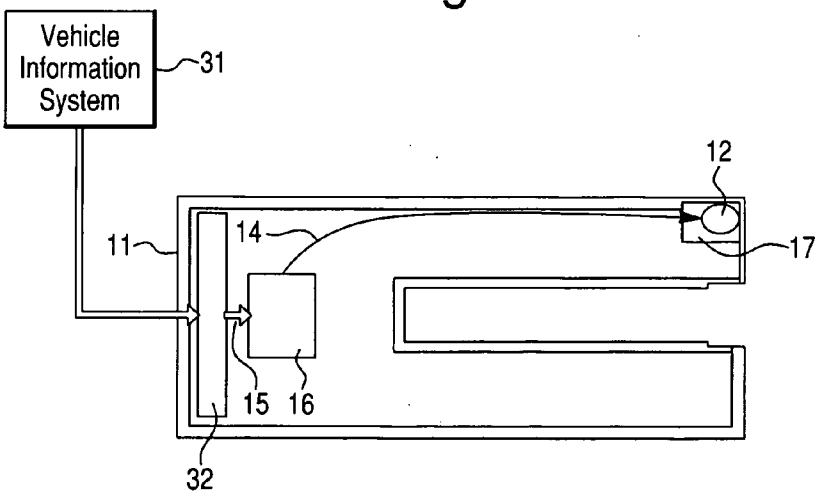

Fig. 4

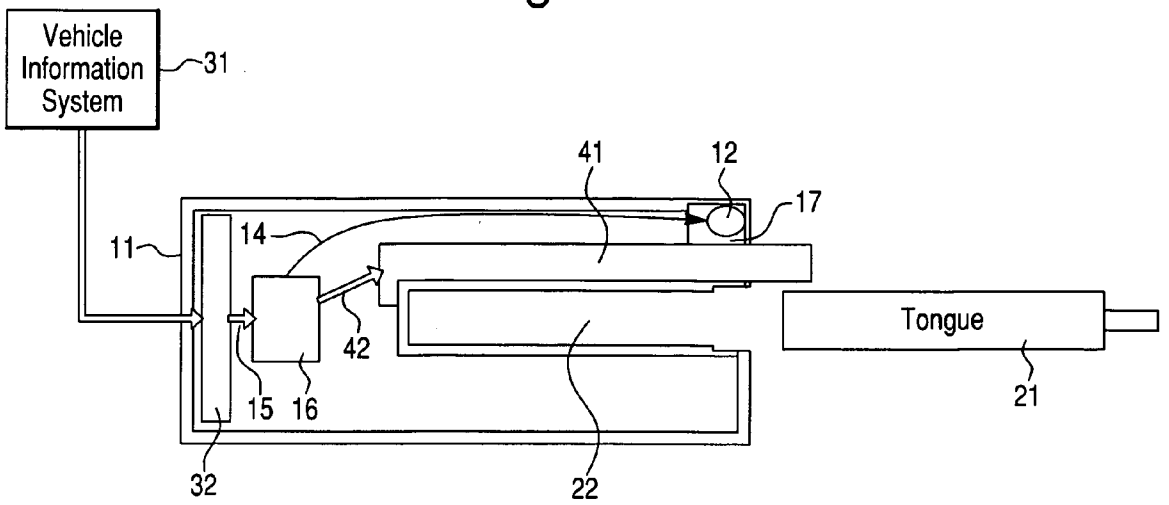
Vehicle Information System
31
41
12
17
11
14
42
Tongue
21
15
16
32
22

Fig. 5

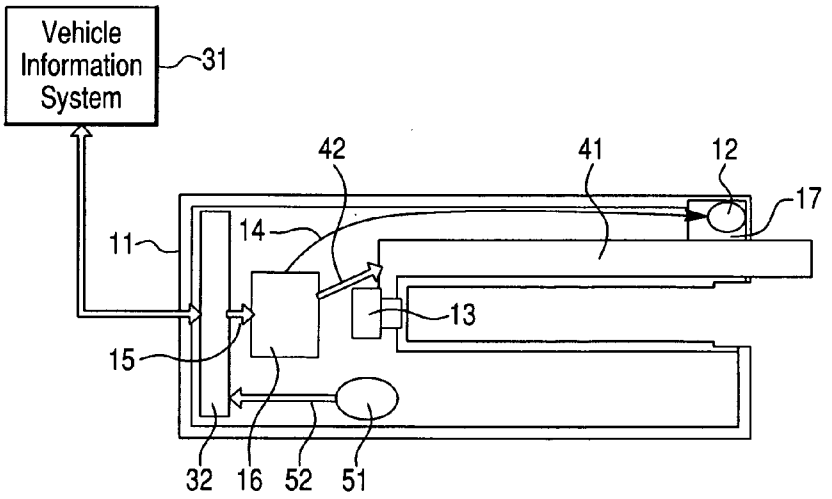
Vehicle Information System
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Fig. 6

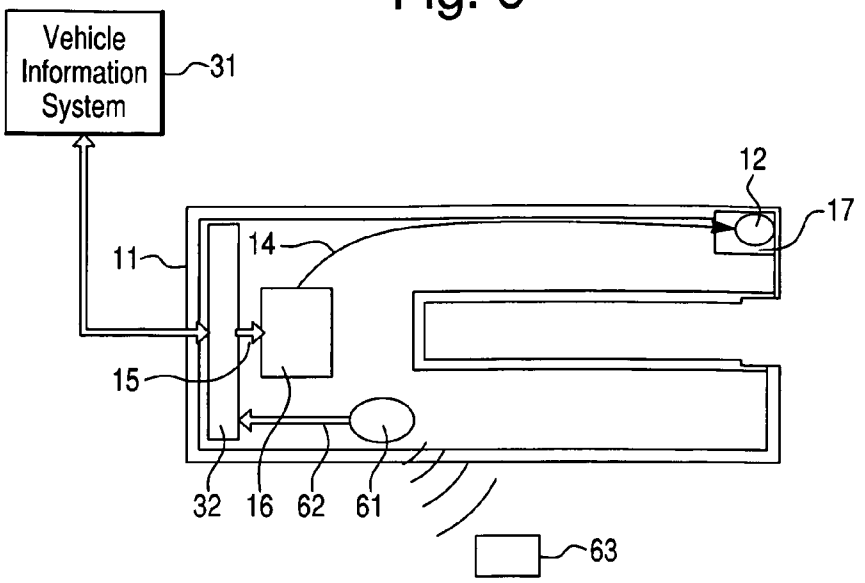


Fig. 7

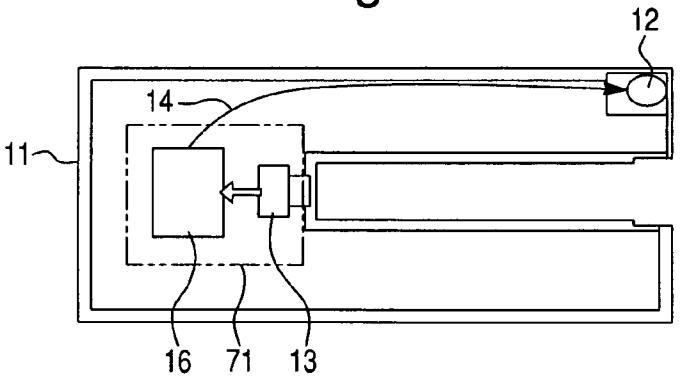


Fig. 8

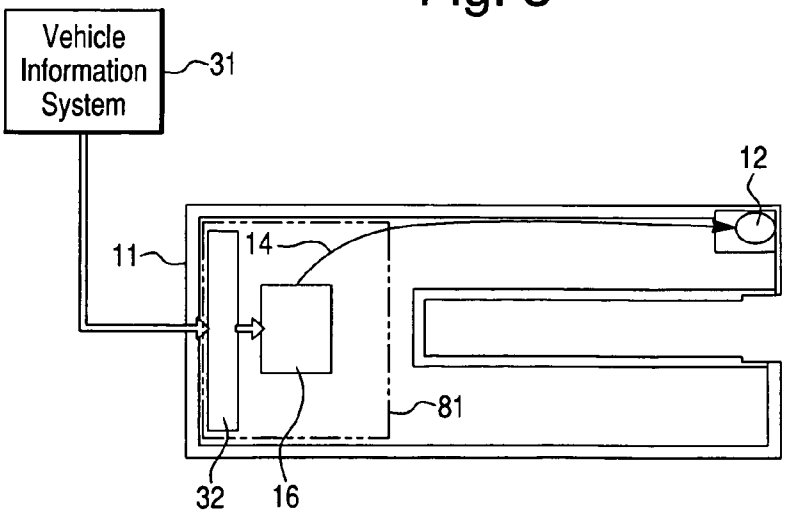


Fig. 9

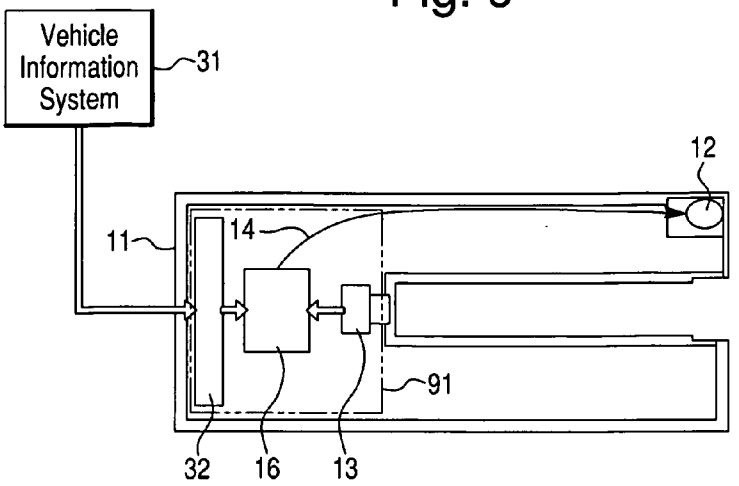
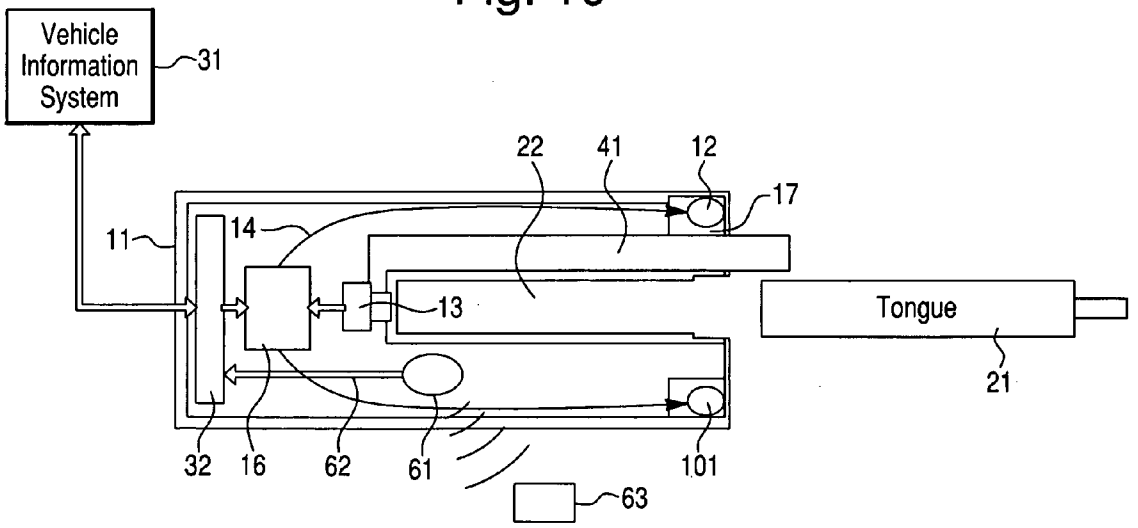

Vehicle Information System
31
12
11
14
91
32
16
13

Fig. 10


Vehicle Information System
31
22
41
12
17
11
14
13
Tongue
21
32
16
62
61
101
63

ADAPTIVE LIGHT SEATBELT BUCKLE

BACKGROUND

[0001] The present disclosure relates generally to the field of automobile safety equipment. More specifically, the present disclosure relates to the use of light devices in conjunction with automobile seatbelt systems.

[0002] Conventional seatbelt systems do not incorporate a controllable lighting element capable of indicating the current state of the seatbelt buckle. The state of the seatbelt buckle can convey useful information to passengers of a vehicle as well as rescue personnel.

[0003] In light of the above, there is a need for an improved seatbelt buckle.

SUMMARY

[0004] According to one disclosed embodiment, an adaptive light seatbelt system for a vehicle includes a buckle housing, a light positioned in the buckle housing so that the light is visible to an occupant of a vehicle, a controller for controlling light, wherein the controller is located in the buckle housing, and a signaler for providing an input to the controller, wherein the signaler is located in the buckle housing.

[0005] According to another disclosed embodiment, a method of adaptively lighting a seatbelt buckle having a buckle housing is provided. The seatbelt buckle includes a light positioned in the buckle housing, a controller located in the buckle housing and connected to the light, and a signaler located in the buckle housing and connected to the controller. The method comprises the steps of receiving an input from the signaler at the controller, and controlling the light with the controller according to the input received from the signaler.

[0006] According to yet another disclosed embodiment, an adaptive light seatbelt system includes a buckle housing, a tongue, configured to insert into the buckle housing, a release mechanism, located in the buckle housing, for releasing the tongue, a light positioned in the buckle housing so that the light is visible to an occupant of a vehicle, a light diffuser located between an outer edge of the buckle housing and the light, a controller, located in the buckle housing for controlling the light and a signaler for providing an input to the controller, wherein the signaler is located in the buckle housing.

[0007] In a further disclosed embodiment, a method of adaptively lighting a seatbelt buckle is provided. The method comprises the steps of determining whether a tongue is inserted into a buckle housing, receiving an input, and controlling a light according to the input.

[0008] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only, and are not restrictive of the invention as claimed. These and other features, aspects and advantages of the present invention will become apparent from the following description, appended claims, and the accompanying exemplary embodiments shown in the drawings, which are briefly described below.

BRIEF DESCRIPTION

[0009] FIG. **1** is a sectional view of a buckle housing for an adaptive light seatbelt, according to one embodiment.

[0010] FIG. **2** is a sectional view of a buckle housing and a tongue for an adaptive light seatbelt, according to one embodiment.

[0011] FIG. **3** is a sectional view of a buckle housing for an adaptive light seatbelt, including a simplex communication system, according to one embodiment.

[0012] FIG. **4** is a sectional view of a buckle housing and a tongue for an adaptive light seatbelt, including a simplex communication system and a release mechanism, according to one embodiment.

[0013] FIG. **5** is a sectional view of a buckle housing for an adaptive light seatbelt, including a duplex communication system, a release mechanism, and a status sensor, according to one embodiment.

[0014] FIG. **6** is a sectional view of a buckle housing for an adaptive light seatbelt, including a duplex communication system and a radio frequency chip reader, according to one embodiment.

[0015] FIG. **7** is a sectional view of a buckle housing for an adaptive light seatbelt, including a switch and a controller housed in a system control unit, according to one embodiment.

[0016] FIG. **8** is a sectional view of a buckle housing for an adaptive light seatbelt, including a simplex communication system and a controller housed in a system control unit, according to one embodiment.

[0017] FIG. **9** is a sectional view of a buckle housing for an adaptive light seatbelt, including a simplex communication system, a switch, and a controller housed in a system control unit, according to one embodiment.

[0018] FIG. **10** is a sectional view of an adaptive light seatbelt, including a switch, a duplex communication system, a release mechanism, a second light, a radio frequency chip reader, and a tongue, according to one embodiment.

DETAILED DESCRIPTION

[0019] Embodiments of the present invention will be described below with reference to the accompanying drawings. It should be understood that the following description is intended to describe exemplary embodiments of the invention, and not to limit the invention.

[0020] FIG. **1** is a sectional view of a buckle housing **11** for an adaptive light seatbelt, according to one embodiment. The illustrated embodiment includes a buckle housing **11**, and a light **12** positioned in the buckle housing **11** so that the light is visible. The system includes a signaler **13**, located in the buckle housing **11**, and connected to a controller **16** by a connection **15**. The signaler **13** provides an input through the connection **15** to the controller **16**. The controller **16** is located in the buckle housing **11**, and is connected to the light **12** by a connection **14**. The controller **16** controls the light **12**.

[0021] In one embodiment related to FIG. **1**, the light **12** is an LED. In some embodiments, the LED is a conventional semiconductor diode LED. In other embodiments, the LED is a quantum dot LED composed of semiconductor nanocrystals. In yet other embodiments, the LED is an organic LED.

[0022] In some embodiments, the controller **16** is a computer board with a plurality of computer chips, designed to implement the desired control. In other embodiments, the controller **16** is part of a larger computer board, designed to implement a plurality of functions. Similarly, the signaler **13** may be a simple on-off switch connected to the controller **16**. In alternative embodiments, the signaler **13** may be a computer board with a plurality of computer chips, designed to

implement the desired signaling. In yet other embodiments, the signaler **13** may be part of a larger computer board, designed to implement a plurality of functions.

[0023] In some embodiments, the controller **16** controls at least one of a duty cycle, a brightness, and a color of the light **12**. In such an embodiment, the controller **16** may control the brightness and the duty cycle of the light **12** to create a flashing effect. Additionally, the controller **16** may control the brightness, duty cycle and the color of the light **12** to create a colored flashing effect. For instance, in some embodiments, the controller **16** may control the light **12** to flash the color red or green. Alternatively, the controller **16** may control the light **12** to simply illuminate a color. In some embodiments, the controller **16** may also control the directionality of the light **12**. In such an embodiment, the light emitted from the light **12** may be directed to occupy a particular region of space. In addition, the system may include a light diffuser **17**. The light diffuser **17** is located between an outer edge of the buckle housing **11** and the light **12**. The light diffuser **17** spreads or diffuses the light emitted from the light **12**.

[0024] FIG. **2** is a sectional view of a buckle housing **11** and a tongue **21** for an adaptive light seatbelt, according to another embodiment of the present disclosure. The embodiment illustrated in FIG. **2** includes all the features as discussed and illustrated in FIG. **1**. Additionally, the illustrated embodiment of FIG. **2** includes a tongue **21**, configured to insert into a region of the buckle housing **22**. In this embodiment, the signaler **13** is a switch. The switch **13** is configured to change states when the tongue **21** is inserted to the buckle housing **11**.

[0025] In some embodiments, the controller **16** may control the color of the light **12** based on the state of switch **13**. For instance, the controller **16** may control the light **12** to illuminate red when the state of the switch **13** indicates that the tongue **21** is not inserted into the buckle housing **11**. The controller **16** may also control the light **12** to illuminate green when the state of the switch **13** indicates that the tongue **21** is inserted into the buckle housing **11**.

[0026] FIG. **3** is a sectional view of a buckle housing **11** for an adaptive light seatbelt, including a simplex communication system **32**, according to one embodiment. The embodiment illustrated in FIG. **3** includes all the features as discussed and illustrated in FIG. **1**. However, in the embodiment of FIG. **3**, the signaler **32** is a communication system. The communication system **32** is configured to communicate with a vehicle information system **31**. In some embodiments, the communication system **32** is simplex and only receives communications from the vehicle information system **31**. In other embodiments, the communication system **32** is duplex, and receives communications from the vehicle information system **31**, as well as transmits communications to the vehicle information system **31**.

[0027] In the illustrated embodiment of FIG. **3**, the communication system **32** is a simplex communication system. The controller **16** controls the light **12** under a variety of different input signals received from the simplex communication system **32** following reception of a communication from the vehicle information system **31**. For example, the vehicle information system **31** may send a communication to the simplex communication system **32** indicating that lighting outside a vehicle is low. Following reception of the communication, the simplex communication system **32** may provide an input to the controller **16** which increases the brightness of the light **12**. In another example, the controller **16** may increase the brightness of the light **12** when a vehicle door is opened, to aid a passenger in properly inserting the tongue **21** into the buckle housing **11**. Additionally, the vehicle information system **31** may be configured to send a communication to the simplex communication system **32** to cause the controller **16** to adjust at least one of the brightness, duty cycle, or color of the light **12** based on passenger input or pre-programmed lighting effects.

[0028] In another embodiment, the controller **16** may be configured to adjust at least one of the duty cycle, brightness, and color of the light **12** following a communication to the simplex communication system **32** indicating the vehicle has been involved in an accident. For example, the vehicle information system **31** may send a communication indicating the intensity of a vehicle accident to the simplex communication system **32**, and the controller **16** may control the duty cycle, brightness, and color of the light **12** to create a flash in relation to the intensity of the accident. The flashing of the light **12** conveys important information to rescue personnel. Additionally, the controller **16** may be configured to adjust the duty cycle, brightness, and color of the light **12** to create a flash indicating that certain occupants of a vehicle were are securely fastened into their seatbelts at the time of the accident. Conversely, the controller **16** may be configured to adjust the duty cycle, brightness, and color of the light **12** to create a a flash indicating that certain occupants of a vehicle were not securely fastened into their seatbelts at the time of the accident.

[0029] The simplex communication system **32** may also directly control features of the system. By way of example, FIG. **4** is a sectional view of a buckle housing **11** and a tongue **21** for an adaptive light seatbelt, including a simplex communication system **32** and a release mechanism **41**. In such an embodiment, the simplex communication system **32** is configured provide an input through connection **42** to the release mechanism **41** to release the tongue **21** from the buckle housing **11** on a communication from the vehicle information system **31**. For example, the vehicle information system **31** may send a communication to release the tongue **21** to the simplex communication system **32** following a vehicle accident, allowing the occupants of a vehicle to more easily exit the vehicle.

[0030] FIG. **5** is a sectional view of a buckle housing **11** for an adaptive light seatbelt, including a duplex communication system **32**, a release mechanism **41**, and a status sensor **51** according to one embodiment. The illustrated embodiment includes all of the features discussed and illustrated in FIGS. **3** and **4**. However, in the illustrated embodiment of FIG. **5**, the communication system **32** is a duplex communication system configured to receive communications from the vehicle information system **31** as well as send communications to the vehicle information system **31**. By way of example, FIG. **5** includes a status sensor **51** connected to the duplex communication system **32** through a connection **52**. The status sensor **51** is configured to send status messages to the vehicle information system **31** by way of the duplex communication system **32** through the connection **52**. The status sensor **51** may be configured to send a temperature of the buckle housing **11**. The status sensor **51** may also be configured to send a status indicating whether the tongue **21** is inserted into the buckle housing **11** by an input received from the switch **13** indicating the state of the switch **13**. Additionally, the status sensor **51** may be configured to send a status indicating whether a release mechanism **41** is degraded or non-functional.

[0031] FIG. **6** is a sectional view of a buckle housing **11** for an adaptive light seatbelt, including a duplex communication system **32** and a radio frequency chip reader **61**, according to one embodiment. In such an embodiment, the radio chip reader **61** is connected to the duplex communication system **32** through a connection **62**. The radio chip reader **61** is configured to read a radio frequency identification chip **63** which uniquely identifies an occupant. The unique identification of the occupant determined from the radio frequency identification chip **63** may be sent to the vehicle information system **31** by way of the duplex communication system **32** through the connection **62**. Such an embodiment may be extended to use in school buses, to facilitate an accounting of children which is based on information collected from radio frequency identification chips **63** associated with individual children.

[0032] Referring now to FIGS. **1** and **3**, in some embodiments the signaler (**13** in FIG. **1** and **32** in FIG. **3**) may be housed in the same unit as the controller **16**. In other embodiments, more than one signaler (**13** in FIG. **1** and **32** in FIG. **3**) may be housed in the same unit as the controller **16**. By way of example, FIG. **7** is a sectional view of a buckle housing **11** for an adaptive light seatbelt, including a switch **13** and a controller **16** housed in a system control unit **71**, according to one embodiment. In another illustrated embodiment, FIG. **8** is a sectional view of a buckle housing **11** for an adaptive light seatbelt, including a simplex communication system **32** and a controller **16** housed in a system control unit **81**. In yet another illustrated embodiment, FIG. **9** is a sectional view of a buckle housing **11** for an adaptive light seatbelt, including a simplex communication system **32**, a switch **13**, and a controller **16** housed in a system control unit **91**.

[0033] FIG. **10** is a sectional view of an adaptive light seatbelt, including a switch **13**, a duplex communication system **32**, a release mechanism **41**, a second light **101**, a radio frequency chip reader **61**, and a tongue **21**, according to one embodiment. The illustrated embodiment includes two signalers in the form of the duplex communication system **32** and the switch **13**, as well as two light sources in lights **12** and **101**. The duplex communication system **32** is capable of all of the functions of a simplex communication system. Accordingly, in the illustrated embodiment, the duplex communication system **32** may control the release mechanism **41**, as previously disclosed in the discussion of FIG. **4**. Additionally, the controller **16** may control the lights **12** and **101** based on the input provided by the duplex communication system **32** as discussed in the disclosure of FIG. **3**. The controller **16** may also control the lights **12** and **101** based on a state of the switch **13** as previously disclosed in the discussion of FIG. **2**. Lastly, the radio frequency chip reader **61** may read a radio frequency chip **63** and communicate the unique identification as discussed previously in the disclosure of FIG. **6**.

[0034] By way of example, in an embodiment related to FIG. **10**, the light **12** may illuminate red when a vehicle ignition is active but the tongue **21** is not inserted into the buckle housing **11**, wherein the activation of the vehicle ignition is communicated to the duplex communication system **32** by the vehicle information system **31**. In such an embodiment, the second light **101** illuminates green once the tongue **21** is inserted into the buckle housing **11**. In a further embodiment, the light **12** may flash the color red if the tongue **21** is removed from the buckle housing **11** while the vehicle is moving, wherein the movement of the vehicle is communicated to the duplex communication system **32** by the vehicle information system **31**.

[0035] Importantly, these embodiments may be used to provide a simple training paradigm for children. A child may learn to buckle her seatbelt based on the paradigm of the light **12** illuminating red when the tongue **21** is not inserted into the buckle housing **11** and the second light **101** illuminating green when the tongue **21** is inserted properly into the buckle housing **11**. This paradigm may be further extended to school bus seatbelt systems. The clear visual indication provided by the lights **12** and **101** that the tongue **21** is or is not inserted into the buckle housing **11** for each seatbelt on a school bus provides a simple way to identify which children are not secured properly. Further, children around a child whose buckle is illuminating red, indicating that the tongue **21** is not inserted into the buckle housing **11**, may notify the driver of the bus or tell the child to buckle their seatbelt. In a further embodiment, the light **12** may flash a distinct color if the tongue **21** is removed from the buckle housing **11** by the child while the bus is moving, to provide a more direct visual indicator that a child is not securely fastened, wherein the movement of the bus is communicated to the duplex communication system **32** by the vehicle information system **31**.

[0036] Given the disclosure of the present invention, one versed in the art would appreciate that there may be other embodiments and modifications within the scope and spirit of the invention. Accordingly, all modifications attainable by one versed in the art from the present disclosure within the scope and spirit of the present invention are to be included as further embodiments of the present invention.

What is claimed is:

1. An adaptive light seatbelt system for a vehicle, comprising:

a buckle housing;

a light positioned in the buckle housing so that the light is visible to an occupant of a vehicle;

a controller for controlling light, wherein the controller is located in the buckle housing; and

a signaler for providing an input to the controller, wherein the signaler is located in the buckle housing.

2. The adaptive light seatbelt system of claim **1**, wherein the buckle housing includes a light diffuser located between an outer edge of the buckle housing and the light.

3. The adaptive light seatbelt system of claim **1**, wherein the light comprises an LED.

4. The adaptive light seatbelt system of claim **1**, wherein the controller controls at least one of a duty cycle, a brightness, and a color of the light.

5. The adaptive light seatbelt system of claim **4**, wherein the controller controls the duty cycle and the brightness of the light to create flashing.

6. The adaptive light seatbelt system of claim **1**, wherein the signaler is a switch.

7. The adaptive light seatbelt system of claim **6**, further comprising a tongue, configured to insert into the buckle housing; wherein the switch is configured to change states when the tongue is inserted into the buckle housing.

8. The adaptive light seatbelt system of claim **7**, wherein the controller controls the color of the light based on a state of the switch.

9. The adaptive light seatbelt system of claim **1**, wherein the signaler is a communication system, further configured to communicate with a vehicle information system.

10. The adaptive light seatbelt system of claim **9**, further comprising a release mechanism located in the buckle housing for releasing the tongue based on a communication received from the vehicle information system.

11. The adaptive light seatbelt system of claim **9**, further comprising a status sensor located in the buckle housing, and wherein the communication system is configured to send status communications to the vehicle information system indicating a status of the adaptive light seatbelt system.

12. The adaptive light seatbelt system of claim **9**, further comprising:

a radio frequency identification chip reader located in the buckle housing, and connected to the communication system, for reading a radio frequency identification chip and sending communications to the vehicle information system identifying the radio frequency identification chip.

13. The adaptive light seatbelt system of claim **9**, wherein the communication system is a simplex communication system.

14. The adaptive light seatbelt system of claim **9**, wherein the communication system is a duplex communication system.

15. A method of adaptively lighting a seatbelt buckle having a buckle housing, a light positioned in the buckle housing, a controller located in the buckle housing and connected to the light, and a signaler located in the buckle housing and connected to the controller, comprising the steps of:

receiving an input from the signaler at the controller; and

controlling the light with the controller according to the input received from the signaler.

16. The method of claim **15**, wherein the step of controlling the light comprises controlling a duty cycle and a brightness of the light to create flashing.

17. The method of claim **15**, wherein the signaler comprises a switch, the seatbelt buckle further comprises a tongue, configured to insert into the buckle housing, the method, further comprising the step of:

determining whether the tongue is inserted into the buckle housing by considering a state of the switch.

18. The method of claim **17**, wherein the step of controlling the light comprises controlling a color of the light based on the state of the switch.

19. The method of claim **15**, wherein the signaler is a communication system and the method further comprises the step of:

receiving a communication from a vehicle information system at the signaler and providing the input to the controller according to the communication received from the vehicle information system.

20. The method of claim **19**, further comprising the step of:

sending a communication to the vehicle information system from the signaler.

21. An adaptive light seatbelt system, comprising:

a buckle housing;

a tongue, configured to insert into the buckle housing;

a release mechanism, located in the buckle housing, for releasing the tongue;

a light positioned in the buckle housing so that the light is visible to an occupant of a vehicle;

a light diffuser located between an outer edge of the buckle housing and the light;

a controller, located in the buckle housing for controlling the light; and

a signaler for providing an input to the controller, wherein the signaler is located in the buckle housing.

22. A method of adaptively lighting a seatbelt buckle, comprising the steps of:

determining whether a tongue is inserted into a buckle housing;

receiving an input; and

controlling a light according to the input.

* * * * *