Title: MARINE PNEUMATIC SYSTEM

Abstract: A retractable marine cleat is operable from a remote location such as the helm of a watercraft. Retraction and extension of the cleat is remotely controlled through a pneumatic actuator or an electric motor assembly. The cleat is spring-biased upwardly to automatically extend the cleat in the event of an on-board power failure. The cleat housing can be provided with doors to conceal the cleat when it is retracted and provide a generally continuous deck surface.

Published: — without international search report and to be republished upon receipt of that report

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MARINE PNEUMATIC SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Application No. 60/319,180 filed in the U.S. Patent and Trademark Office on April 11, 2002.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to marine pneumatic systems for watercraft. In one aspect, the invention relates to remotely-controlled retractable devices such as cleats and seats.

Description of the Related Art


There remains a need for a comprehensive pneumatic system that can actuate a multitude of devices on a boat. Such a system would enhance convenience and safety because any or all of such devices could be moved, retracted or operated remotely from the helm or other single location.

Such devices may include cleats. Retractable cleats have been developed which are selectively retracted below the surrounding deck surface when not in use, and extended above the deck surface when in use. Prior art retractable cleats are generally extended and retracted manually, although spring-type assemblies can be employed to assist in the extension and retraction of the cleat. With a manually operated cleat, it is necessary for a crew member or the pilot to leave his or her post and move to each cleat location to extend or retract each cleat. In some weather or sea conditions it is risky for the crew member to move about the deck to extend or retract
the cleats. Furthermore, a person operating a craft solo must leave the helm to extend or retract the cleats, leaving the craft without direct human control while the cleats are being adjusted, and increasing the risk of a mishap.

Seats could also be operated in such a system. It is known to raise and lower boat seats by a pneumatic system, but many other features that could be adapted for marine seats remain underutilized because of the lack of an effective driving system.

**SUMMARY OF THE INVENTION**

A pneumatic power system for a watercraft is characterized by an air compressor electrically connectable to a power source, an air reservoir capable of holding air at a predetermined maximum pressure, a pressure relief valve fluidly connected to the air reservoir to maintain air in the air reservoir at or below the predetermined maximum pressure, and at least one fluid conduit connecting the air reservoir with a plurality of devices. The devices include retractable cleats, retractable navigation lights, seats and a quick connection port by way of flow control valves. At least one of the flow control valves is connected to a remote switch so that any one of the plurality of devices is remotely operable by a user.

Preferably the remote switch is located at the helm of the watercraft. Also, there are as many remote switches as there are flow control valves. Further, preferably, the compressor or air reservoir is removable from the watercraft.

In another aspect of the invention, a marine cleat assembly for a watercraft is characterized by a cleat mounted to a receptacle for movement between an extended position and a retracted position. In the extended position, the cleat projects from the receptacle for use and in the retracted position the cleat is received within the receptacle for storage. An actuator is operably connected to the cleat, so that the cleat can be moved between the extended and retracted positions upon selective actuation of the actuator. Preferably, the actuator is a pneumatic cylinder.

Further, a marine cleat assembly as described can be connected to a pneumatic power system according to the invention. Preferably, the cleat is biased to an extended position. In one aspect, the cleat rotates between the extended and retracted positions. In another, the cleat moves linearly between the extended and retracted
positions.

A watercraft can include a marine pneumatic system according the invention. Also, a watercraft can include a marine cleat assembly according to the invention.

Another aspect of the invention calls for a marine seat comprising a pneumatically operated pedestal having first and second protective tubes wherein the second protective tube is above and telescopes over the first protective tube.

**Brief Description of the Drawings**

In the drawings:

1. Fig. 1 is a perspective view of a portion of a watercraft showing a retractable cleat assembly according to the invention.

2. Fig. 1A is a perspective close-up view of the retractable cleat assembly of Fig. 1.

3. Fig. 2 is a sectional view of a first embodiment of the retractable cleat assembly taken along line 2-2 of Fig. 1 showing the cleat in an extended position.

4. Fig. 3 is a sectional view of the retractable cleat assembly of Fig. 2 showing the cleat in a retracted position.

5. Fig. 4 is a lateral side view of a second embodiment of a retractable cleat assembly with an alternate power actuator and linkage assembly.

6. Fig. 5 is a longitudinal side view of the linkage assembly and a portion of the retractable cleat assembly of Fig. 4.

7. Fig. 6 is a perspective view of a third embodiment of the retractable cleat assembly showing the cleat in an extended position.

8. Fig. 7 is a perspective view of the third embodiment of the retractable cleat assembly showing the cleat in a retracted position.

9. Fig. 8 is a perspective view of the third embodiment of the retractable cleat assembly showing the cleat intermediate the retracted and an extended positions.

10. Fig. 9 is a sectional view of the retractable cleat assembly of Fig. 8 taken along line 9-9.

11. Fig. 10 is a perspective view of a fourth embodiment of a retractable cleat assembly showing the cleat in an extended position.
Fig. 11 is a perspective view of the fourth embodiment of the retractable cleat assembly showing the cleat in a retracted position.
Fig. 12 is a sectional view of the fourth embodiment of the retractable cleat assembly taken along line 12-12 of Fig. 11.
Fig. 13 is a perspective view of a fifth embodiment of the retractable cleat assembly showing the cleat in an extended position.
Fig. 14 is a perspective view of the fifth embodiment of the retractable cleat assembly showing the cleat in a retracted position.
Fig. 15 is a schematic view of a marine pneumatic system according to the invention.

Figs 15a and 15b are continuations of Fig. 15 showing the remainder of the marine pneumatic system according to the invention.

Fig. 16 is a perspective view with portions broken away of a seat pedestal of the type used in the marine pneumatic system according to the invention.

**DESCRIPTION OF THE PREFERRED EMBODIMENT**

Fig. 1 shows a powered marine cleat assembly 10 according to the invention mounted to the deck 14 of a watercraft 12. As shown also in Fig. 1A, the cleat assembly 10 comprises generally a cleat 16 mounted to be enclosed within a housing 18. The housing 18 is fixedly mounted to the deck 14 in a conventional manner, such as with screws, or other threaded connectors, so that the top of the housing 18 is flush with the deck 14 and the cleat 16 in an extended position projects above the deck 14. The cleat 16 is of a generally conventional configuration and comprises a pair of generally parallel, spaced-apart, upwardly extending legs 20 attached at an upper end to a transversely-extending head 22. The housing 18 is a generally semi-ovoid shaped, hollow structure defining a receptacle 24 therein for housing the cleat 16 when the cleat 16 is in a retracted position. As shown in Fig. 2, the housing 18 is provided with at least one drain outlet 26 at a lower portion thereof connected through a suitable drain line either to the bilge area of the watercraft 12 or to the boat hull above the waterline for removal of water from the housing 18. The perimeter of the housing 18 is provided with a mounting flange 28.

Referring now to Figs. 2-5, a first embodiment of a retractable cleat assembly
10 is shown. The legs 20 are attached at a lower portion to a plate 40 comprising a generally oval-shaped plate-like member having an obverse surface 42 and a reverse surface 43. The plate 40 is adapted to rotate within the housing 18 and fit closely within the housing 18 so that the reverse surface 43 is generally continuous with the adjoining deck 14 when the cleat assembly 10 is in a retracted position, as hereinafter described.

A pair of spaced-apart, axially aligned pivot pins 44, 45 are located at each end of the plate 40 extending outwardly along an axis generally parallel to the longitudinal axis of the head 22 for rotation of the plate 40. The housing 18 is provided with a pair of bearings 46 into which the pivot pins 44 are rotatably retained. A first pivot pin 44 has a gear 48 rigidly attached thereto so that rotation of the gear 48 will rotate the first pivot pin 44 and thus also rotate the plate 40. A drive unit 50 is operably connected to the gear 48.

The drive unit 50 comprises either a 12-volt DC motor or a pneumatically driven actuator (not shown) driving a drive gear operably interconnected with the gear 48. Activation of the motor or pneumatic actuator rotates the drive gear which rotates the gear 48 and the bottom plate 40, thereby extending or retracting the cleat 16 into a selected position.

In another embodiment, a linear pneumatic actuator 60 as shown in Figs. 4-5 can be used to rotate the cleat 16 through a mechanical linkage assembly. In this embodiment, components similar to those in the first embodiment of Figs. 1-3 bear like numerals. A pivot arm 52 is rigidly attached to the first pivot pin 44. A link 54 is pivotably attached to the pivot arm 52 through a first pivot connection 56. A piston rod 64 is pivotably attached to the link 54 through a second pivot connection 58. The actuator 60 comprises a cylinder 66 and a piston 62 attached to the piston rod 64 so that pressurized air delivered to the actuator 60 will selectively move the piston rod 64 inwardly and outwardly of the cylinder 66. Pressurized air is selectively delivered to the cylinder 66 through a first air inlet 65 for extending the piston rod 64 and rotating the cleat 16 to an extended position, or through a second air inlet 67 for retracting the piston rod 64 and rotating the cleat 16 to a retracted position. The linear movement of the piston rod 64 is translated through the link 54 and pivot arm 52 into rotation of the
cleat 16 within the housing 18 for extension and retraction of the cleat 16. Preferably, the cleat 16 will be biased toward the extended position. For example, a spring (not shown) in the linkage or acting on the piston can bias the cleat 16 to an extended position. Thus the “default” extended position will be one where the cleat is functional rather than unusable.

In a third embodiment, shown in Figs. 6-9, the retractable cleat assembly 10 is concealed behind a pair of doors 78, 80 pivotably mounted to the housing 18 when the cleat 16 is fully retracted. When the cleat 16 is extended, the doors 78, 80 close around the legs 20 to conceal the interior 24 of the housing 18.

As shown in Fig. 9, the legs 20 terminate at a lower portion in a bottom crosspiece 70 parallel to the cleat head 22. At each end of the crosspiece 70 is a pivot pin 72 axially aligned therewith. The pivot pins 72 are mounted in suitable bearings (not shown) in the housing 18 for rotation of the pivot pins 72 in the bearings.

A door lift arm 77 is rigidly attached to either the crosspiece 70 or a pin 72 and extends radially therefrom to communicate with a cam surface 76 formed in the underside of the door 80. The lift arm 77 and cam formation 76 are adapted to raise and lower the door 80 as the cleat 16 is rotated to an extended position and back to a retracted position. The door 78 can be operably connected to the door 80 so that opening and closing of the door 80 induces opening and closing of the door 78, such as by a suitable linkage mechanism.

The housing doors 78, 80 are pivotably connected to the housing 18 through suitable pin-type pivot connections 82, 84. The pins 82, 84 can be provided with a spring mechanism, such as helical springs 86, 88 circumferentially communicating with the pins 82, 84, to bias the doors in a closed position. The doors 78, 80 are provided with leg cutouts 92 conforming to the cross-sectional shape of the legs 20 so that, when the cleat 16 is extended, the housing doors 78, 80 close to define a top surface 90 with the leg cutouts 92 closely fitting around the legs 20. The cleat 16 can also be provided with a pair of suitably mounted cutout plugs 94 which matingly communicate with the leg cutouts 92 to provide a generally smooth continuation of the top surface 90 when the cleat 16 is retracted.

The third embodiment of the cleat assembly 10 is extended and retracted as
previously described by an electrical motor or pneumatic actuator. During rotation of the cleat 16 from the retracted to the extended position, the lift arm 77 engages the cam formation 76 of the housing door 80. As the cam lift arm 77 rotates, the housing door 80 is rotated upwardly by movement of the lift arm 77 against the cam formation 76. Through a suitable linkage assembly (not shown) the door 78 is induced to pivot by the pivoting of the door 80. As the cleat 16 is fully extended, the doors 78, 80 are returned to a closed position around the legs 20, such as through a spring mechanism (not shown) biasing the doors 78, 80 to a closed position, with the legs 20 extending through the cutouts 92. Also, the cleat 16 can be biased to one position or another. Preferably, the cleat 16 will be biased toward an extended position.

A fourth embodiment of the cleat assembly 10 is shown in Figs. 10-12. In this embodiment, the cleat 16 is extended vertically out of the housing 18 rather than pivotably about a pivot assembly. The cleat 16 comprises a head 100, a pair of generally parallel, spaced-apart legs 102, and a crosspiece 104 extending between the legs 102 at a lower portion thereof generally parallel with the head 100. Each leg 102 is further slidably retained in a spring chamber 112 comprising a part of the housing 18. Drain outlets 116 are provided at the lower portions of the spring chambers 112 and the housing 18, and are connected through a suitable drain line either to the bilge area of the watercraft 12 or to the boat hull above the waterline for removal of water from the spring chambers 112 and the housing 18.

The crosspiece 104 is rigidly attached to a downwardly-extending piston rod 106. The piston rod 106 is attached to a piston 108 slidably retained within an airtight cylinder 110. The cylinder 110 is provided with a pneumatic inlet 118 for connection to a pressurized air supply (not shown). Each spring chamber 112 is provided with a spring 114 which tends to bias the cleat 16 to an upwardly-extending position.

Pressurized air is delivered to the upper portion of the cylinder 110 through the pneumatic inlet 118, which tends to urge the piston 108 in a downward direction. This causes the cleat 16 to retract into the housing 18 against the force of the springs 114. When the air pressure is removed from the cylinder 110, the springs 114 urge the cleat 16 to an upward, extended position. Delivering pressurized air to the cylinder
110 again urges the piston 108 in a downward direction, thereby retracting the cleat 16. In this embodiment, a pneumatic system is shown. Alternatively, a suitable electric motor and gearing assembly can be used to extent and retract the piston rod 106 and thus the cleat 16. As shown in Figs. 10 and 11, the housing 18 is provided with the interior 24 contoured to the cleat 16 so that the top of the housing 18 and the cleat 16 in the retracted position form a generally continuous surface.

A fifth embodiment of a retractable cleat according to the invention is similar to the fourth embodiment shown in Figs. 10-12, except that doors are pivotably mounted to the housing 18 and operable to conceal the interior of the housing 18 when the cleat 16 is extended or retracted. The structure of the doors, their interconnection with the housing 18, and their operation are similar to that disclosed for the third embodiment described herein, comprising suitable cams, linkages, and bearing formations appropriate to the vertical movement of the cleat 16, rather than the rotational movement described previously. Preferably, the doors are spring-biased to a closed position.

As shown in Figs. 13-14, as with the third embodiment the housing 18 is provided with a first housing door 144 and a second housing door 146 pivotably connected to the housing 18 through suitable pivot assemblies (not shown). Each door 144, 146 has a pair of leg cutouts 148 so that the doors 144, 146 can close around the legs 102 of the cleat 16 when the cleat 16 is in the extended position. The head 100 of the cleat 16 is provided with a pair of cutout plugs 150 which matingly engage the leg cutouts 148 of the doors 144, 146 when the cleat 16 is in the retracted position, thereby providing a generally continuous surface.

In operation, as the cleat 16 is urged upwardly to an extended position by action of the springs 114, the doors 144, 146 are urged to an open position by the cleat head 100 bearing against the underside of the doors 144, 146. As the cleat head 100 clears the doors 144, 146, the doors 144, 146 are returned to a closed position around the legs 102, such as by the action of springs. When the cleat 16 is to be retracted, the doors 144, 146 can be opened by a separate dedicated mechanism, such as a pneumatic actuator and linkage assembly, adapted specifically for this purpose, until the head 100 is retracted below the top of the housing 18, at which time the pneumatic
actuator is automatically or selectively deactivated and the doors 144, 146 are then closed, such as by the action of springs. Other door opening and closing assemblies known to a person of ordinary skill in the art can be employed to open and close the doors in response to the extension and retraction of the cleat 16.

Figs. 15, 15a and 15b illustrate in a schematic diagram a marine pneumatic power system according to the invention, adapted for operation of a plurality of devices including a retractable cleat assembly as described above. Indeed, the pneumatic power system disclosed can be used to power anything on the watercraft using conventional pneumatic power sources, e.g., pneumatic motors, air springs, seat suspensions, connections for manually operated air hoses, and the like. In this embodiment a 12-volt DC air compressor 170 is connected to the watercraft’s 12-volt on-board power supply 162. The power supply 162 is connected by way of electrical wiring 164 to the compressor 170 through an ignition switch 166 and a pressure switch 168. A quick-connect fitting (not shown) can enable the air compressor 170 to be readily removed from the watercraft for use on shore or in another watercraft. The compressor air line 172 fluidly connects to an air reservoir 176, preferably a five-gallon air tank capable of handling air pressure at or about 120 psi (8.27 bar). Between the compressor 170 and the air reservoir 176 is a regulator 174. Between the regulator 174 and the ignition switch 166 is a first pressure switch 168. Between the compressor 170 and the ignition switch 166 is a second, similar pressure switch 168. Between the air reservoir 176 and the ignition switch 166 is a third, similar pressure switch 168. The compressor switches 168 sense the air pressure in the air reservoir 176, the regulator 174, and the compressor 170, and will shut down the system if the sensed pressure exceeds a preset level. The air reservoir 176 is also provided with a pressure valve 178 for purging air if the air pressure exceeds a preset level. Typical of pneumatic systems, the regulator 174 will also include an air dryer to minimize moisture in the system.

The air reservoir 176 is connected through a flow control valve 180 to an access point 190 on deck for manual operation of a pneumatic device, such as a pneumatic tool, or an air line for inflation of inflatable devices or even for supplying pressurized air for cleaning. The air reservoir 176 is also connected through a check
valve 182 to a plurality of devices. Here, the devices include a plurality of starboard retractable cleats 192, port retractable cleats 194, retractable navigation lights 196, marine seats 198, and a quick connect port 200. Toggle switches 184 and pneumatic valves 186 operably interconnect the air reservoir 176 with the pneumatic actuators through flow control valves 188 at each device. The toggle switches 184 are operable remotely from the devices with which they are associated, preferably from the helm of the watercraft. Thus, for example, the pilot can selectively extend or retract one or more cleats 16 from the helm.

Fig. 16 shows a pneumatically operated pedestal 210 of the type that will support a marine seat 198. The pedestal 210 comprises a base 212 having a number of apertures 214 for securing the base to the deck of a boat. A first protective tube 216 extends upwardly from the base 212. Inside the first protective tube 216 is an air spring 218. A shaft 220 connected to the air spring 218 projects through a guide bushing 222 at the upper end of the first protective tube 216. A seat mounting plate 224 is mounted to the shaft 220 and supports a seat. The mounting plate 224 can be swiveled to the shaft 220 for rotation about one or more axes. An air line 226 fluidly connects the air spring 218 to a source of pressurized air (not shown in Fig. 16). An example would be the conduit 172 in Fig. 15a. A second protective tube 228 depends from the mounting plate 224 and telescopes over the first protective tube 216. A switch (not shown) for actuating the air spring 218 can be provided either on the pedestal itself or on the seat that would be mounted to the pedestal. If the seat were to have some type of air suspension, then a separate air line or a continuation of the air line 226 can fluidly connect to the air suspension.

The compressor 170 and/or the air reservoir 176 can be made removable from the pneumatic system 160 so it can be used elsewhere on the vessel 12, or taken ashore or to another vessel for remote use, such as to operate pneumatic power tools.

The cleat assemblies 10 enable the operator of the watercraft to selectively extend and retract the cleats 16 without moving from one cleat to another. The cleats 16 are preferably biased to an extended position so that, in the event of an on-board power failure, the cleats 16 will be fully operable. With a pneumatic system, the compressor 170 can be readily removed from the vessel for off-board use, thereby
enhancing the usefulness of the pneumatic system.

While the invention has been specifically described in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration and not of limitation, and the scope of the appended claims should be construed as broadly as the prior art will permit.
CLAIMS

I claim:

1. A pneumatic power system for a watercraft (12), the system characterized by an air compressor (170) electrically connectable to a power source, an air reservoir (176) capable of holding air at a predetermined maximum pressure, a pressure relief valve (178) fluidly connected to the air reservoir to maintain air in the air reservoir at or below the predetermined maximum pressure, and at least one fluid conduit (72) connecting the air reservoir with a plurality of devices including retractable cleats (192, 194), retractable navigation lights (196), seats (198) and a quick connection port (200) by way of flow control valves (180, 188), wherein at least one of the flow control valves is connected to a remote switch (184) so that at least one of the plurality of devices is remotely operable by a user.

2. A pneumatic power system according to claim 1 wherein the remote switch (184) is located at the helm of the watercraft (12).

3. A pneumatic power system according to claims 1 or 2 wherein there are as many remote switches (184) as there are flow control valves (180, 188).

4. A pneumatic power system according to claims 1-3 wherein the compressor (170) or air reservoir (176) are removable from the watercraft (12).

5. A marine cleat assembly (10) for a watercraft (12) characterized by a cleat (16) mounted to a receptacle (24) for movement between an extended position wherein the cleat projects from the receptacle for use and a retracted position wherein the cleat is received within the receptacle for storage, and an actuator (60) operably connected to the cleat, wherein the cleat can be moved between the extended and retracted positions upon selective actuation of the actuator.

6. A marine cleat assembly (10) according to claim 5 wherein the actuator (60) is a pneumatic cylinder.

7. A marine cleat assembly (10) according to claims 5 or 6 wherein the
actuator (60) is connected to a pneumatic power system according to any of claims 1-4.

8. A marine cleat assembly (10) according to any of claims 5-7 wherein the cleat (16) is biased to an extended position.

9. A marine cleat assembly (10) according to any of claims 5-8 wherein the cleat (16) rotates between the extended and retracted positions.

10. A marine cleat assembly (10) according to any of claims 5-8 wherein the cleat (16) moves linearly between the extended and retracted positions.

11. A watercraft (12) comprising a marine pneumatic system according to any of claims 1-4.

12. A watercraft (12) comprising a marine cleat assembly (10) according to any of claims 5-10.

13. A marine seat (198) comprising a pneumatically operated pedestal (210) having first and second protective tubes (216, 228) wherein the second protective tube (228) is above and telescopes over the first protective tube (216).

14. A watercraft (12) comprising a marine seat (198) according to claim 13.