SUMMARY

[0012] In accordance with some embodiments of the present disclosure, a swivel assembly for an actuator includes: a rod defining a socket, the rod defining an arcuate surface at a floor of the socket; a cap dimensioned to fit into the socket, the cap defining a convex arcuate surface dimensioned to correspond to the arcuate surface of the floor of the socket; a first extended surface defined by the rod, the first extended surface, defined at least in part, by side portions of the socket having a cylindrical wall projecting vertically upward from an edge of the socket and providing depth to the socket; a second extended surface defined by the cap providing an extended length to the cap to allow the cap to extend out of the socket when the convex arcuate surface of the cap contacts the arcuate surface of the floor of the socket the second extended surface being defined by a cylindrical wall projecting vertically upward from the convex arcuate surface of the cap; a flange integral to the cap and extending past the second extended surface on the cap, a lower surface of the flange having a tilt stop structure defined by an annular step disposed between the cap and the lower surface of the flange; an end surface of the rod and a lower surface of the tilt stop structure located on the cap between the second extended surface and an end of the flange wherein when the cap tilts within the socket, the lower surface of the tilt stop contacts an end surface of the rod thereby preventing the cap from tilting at greater than a predetermined amount; and a cylinder assembly operatively connected to a piston and the cap to permit the piston and the cap to move axially along a longitudinal axis of the cylinder assembly to move inwardly and outwardly of the cylinder assembly.

[0013] In accordance with some embodiments of the present disclosure, a method of reducing a bending moment in a cylinder assembly includes: providing a first extended surface to an elongated socket, the first extended surface having a cylindrical wall projecting vertically upward from an edge of the elongated socket to give the socket additional depth into a rod; providing a second extended surface on a cap having a convex arcuate surface and dimensioning the second extended surface and the convex arcuate surface to fit into the elongated socket, the second extended surface being defined by a cylindrical wall projecting vertically upward from the convex arcuate surface of the cap; providing a flange integral to the cap and extending past the second extended surface on the cap, a lower surface of the flange having a tilt stop structure defined by an annular step disposed between the cap and the lower surface of the flange; providing an end surface of the first extended surface and a lower surface of the tilt stop structure located on the cap between the second extended surface and an end of the flange wherein when the cap tilts within the socket, the lower surface of the tilt stop contacts an end surface of the rod thereby preventing the cap from tilting at greater than a predetermined amount; placing the cap into the elongated socket; providing a top surface on the cap; operatively connecting the cap to a piston and cylinder assembly wherein the piston has a bearing surface against the sidewall of the cylinder assembly; and orienting the elongated socket to minimize a distance between the top surface of the cap and the bearing surface of the piston when the cap is located in the elongated socket.

[0014] There is disclosed a swivel assembly for an actuator includes: a rod defining a socket, the rod defining an arcuate surface at the floor of the socket; a cap dimensioned to fit into the socket, the cap defining a convex arcuate surface dimensioned to correspond to the arcuate surface of the floor the socket; a means for extending a depth of the socket; a means for extending the convex arcuate surface to allow the cap to fit within the extended socket; and means for extending and contracting the first and second bodies away from and toward an actuating cylinder.

[0015] In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of aspects in addition to those described and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract, are for the purpose of description and should not be regarded as limiting.

[0016] As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures, methods and

CLAIMS

What is claimed is:

1. A swivel assembly for an actuator comprising:

a rod defining a socket, the rod defining an arcuate surface at a floor of the socket;

a cap dimensioned to fit into the socket, the cap defining a convex arcuate surface dimensioned to correspond to the arcuate surface of the floor of the socket;

a first extended surface defined by the rod, the first extended surface, defined at least in part, by side portions of the socket having a cylindrical wall projecting vertically upward from an edge of the socket and providing depth to the socket;

a second extended surface defined by the cap providing an extended length to the cap to allow the cap to extend out of the socket when the convex arcuate surface of the cap contacts the arcuate surface of the floor of the socket, the second extended surface being defined by a cylindrical wall projecting vertically upward from the convex arcuate surface of the cap;

a flange integral to the cap and extending past the second extended surface on the cap, a lower surface of the flange having a tilt stop structure defined by an annular step disposed between the cap and the lower surface of the flange;

an end surface of the rod and a lower surface of the tilt stop structure located on the cap between the second extended surface and an end of the flange wherein when the cap tilts within the socket, the lower surface of the tilt stop contacts an end surface of the rod thereby preventing the cap from tilting at greater than a predetermined amount; and

a cylinder assembly operatively connected to a piston and the cap to permit the piston and the cap to move axially along a longitudinal axis of the cylinder assembly to move inwardly and outwardly of the cylinder assembly.

2. The swivel assembly of claim 1, wherein the piston is integrated with the rod.

3. The swivel assembly of claim 1, wherein the rod is a rod operatively connected to the piston and the cap.

4. The swivel assembly of claim 3, a top surface defined by the cap.

5. The swivel assembly of claim 4, wherein the convex arcuate surface is at least partially spherical, the spherical portion having a radius having an origin located on the top surface of the cap.

6. The swivel assembly of claim 4, further comprising an end surface of the rod and wherein the first extended surface and the second extended surface are dimensioned so that the top surface of the cap extends above the end surface of the rod.

7. The swivel assembly of claim 4, wherein the convex arcuate surface is at least partially spherical, the spherical portion having a radius having an origin located below the top surface of the cap.

8. The swivel assembly of claim 7, wherein the convex arcuate surface is at least partially spherical, the spherical portion having an origin located below the top surface of the cap.

9. The swivel assembly of claim 4, further comprising an end surface of the rod and the first and second extended surfaces are dimensioned so that when the cap is located in the socket, the top surface extends above the end surface of the rod is a sufficient distance such that a load located on the top surface and extending beyond the top surface will contact the end surface of the rod if the cap tilts greater than a predetermined distance.

10. The swivel assembly of claim 9, wherein the predetermined distance is about 5° from a center position where the top surface is substantially parallel to the end surface of the rod.

11. The swivel assembly of claim 1, wherein the predetermined amount is 5° from a center position where the top surface is substantially parallel to the end surface of the rod.

12. The swivel assembly of claim 1, further comprising an annular seal groove in at least one of the first and second extended surface.

13. The swivel assembly of claim 12, further comprising a resilient material located in the seal groove.

14. The swivel assembly of claim 1, further comprising a projection in the arcuate surface at the floor of the socket in the rod wherein the projection provides a bearing surface configured to contact the convex arcuate surface of the cap.

15. A method of reducing a bending moment in a cylinder assembly comprising:

providing a first extended surface to an elongated socket, the first extended surface having a cylindrical wall projecting vertically upward from an edge of the elongated socket to give the socket additional depth into a rod;

providing a second extended surface on a cap having a convex arcuate surface and dimensioning the second extended surface and the convex arcuate surface to fit into the elongated socket, the second extended surface being defined by a cylindrical wall projecting vertically upward from the convex arcuate surface of the cap;

providing a flange integral to the cap and extending past the second extended surface on the cap, a lower surface of the flange having a tilt stop structure defined by an annular step disposed between the cap and the lower surface of the flange;

providing an end surface of the first extended surface and a lower surface of the tilt stop structure located on the cap between the second extended surface and an end of the flange wherein when the cap tilts within the socket, the lower surface of the tilt stop contacts an end surface of the rod thereby preventing the cap from tilting at greater than a predetermined amount;

placing the cap into the elongated socket;

providing a top surface on the cap;

operatively connecting the cap to a piston and cylinder assembly wherein the piston has a bearing surface against the sidewall of the cylinder assembly; and

orienting the elongated socket to minimize a distance between the top surface of the cap and the bearing surface of the piston when the cap is located in the elongated socket.

16. The method of claim 15, further comprising sealing a connection between the piston and cylinder assembly.

17. The method of claim 15 further comprising dimensioning the convex arcuate surface to have a radius wherein the radius originates at least one of on and below the top surface of the cap.