Claims:

1. A method of assembling and operating a submersible well pump motor, comprising:

(a) providing a stator with a central bore;

(b) making up a rotor assembly with a shaft with an axis, first and second rotor sections spaced apart from each other, and a carrier bearing having an anti-rotation member and a central portion located between the first and second rotor sections;

(c) inserting the rotor assembly into the bore of the stator with the anti-rotation member in frictional engagement with the stator;

(d) installing the motor in a well and operating the pump;

(e) allowing the shaft and the rotor sections to grow axially in response to an increase in temperature of the motor; and wherein

steps (b) and (c) are performed such that any thermal growth axial force imposed on the central portion of the carrier bearing due to the thermal growth is less than a dislodging force required to move the anti-rotational member axially within the stator.

2. The method according to claim 1, wherein step (b) comprises:

mounting a deflectable thrust washer between a hub of the carrier bearing and an end of the second rotor section; and

step (e) comprises causing the deflectable thrust washer to reduce in thickness in response to a thermal growth axial force that is less than the dislodging force.

3. The method according to claim 1, wherein step (b) comprises:

mounting a thrust washer between a hub of the carrier bearing and an end of the second rotor section, the thrust washer being formed of a deformable material; and

step (e) comprises deforming the thrust washer in response to a thermal growth axial force that is less than the dislodging force.

4. The method according to claim 1, wherein step (b) comprises:

mounting a thrust washer between a hub of the carrier bearing and an end of the second rotor section, the thrust washer being elastically movable from a maximum to a minimum thickness and being biased to the maximum thickness; and

step (e) comprises moving the thrust washer to the minimum thickness in response to a thermal grow axial force that is less than the dislodging force.

5. The method according to claim 1, wherein step (b) comprises:

mounting a bushing to the shaft for rotation therewith and axially movable relative to the shaft, the bushing being located between the rotor sections and having an axial length greater than an axial length of the central portion of the carrier bearing.

6. The method according to claim 1, wherein:

step (b) comprises:

mounting a bushing on the shaft with a length greater than the central portion of the carrier bearing, and inserting the central portion of the carrier bearing over the bushing; and step (c) comprises:

inserting the rotor assembly into the bore of the stator in a first direction and axially sliding the anti-rotational member in frictional engagement with the bore of the stator, the frictional engagement causing a second end of the carrier bearing to contact the second rotor section;

when the anti-rotational member is at a desired axial position within the bore of the stator, moving the shaft, the rotor sections and the bushing in a second direction a selected axial increment relative to the carrier bearing, which is held against axial movement by the frictional engagement of the anti-rotation member with the bore of the stator, the selected axial increment axially centering the carrier bearing between the first and second rotor sections.

7. The method according to claim 1, wherein:

step (b) comprises:

mounting a bushing on the shaft within the central portion of the carrier bearing;

providing the central portion of the carrier bearing with a hub having sacrificial washers on each end of the hub, the central portion of the carrier bearing having an axial length equal to an axial length of the bushing; then

after step (c), dissolving the thrust washers, leaving axial gaps between each of the ends of the hub and the rotor sections.

8. The method according to claim 1, wherein step (b) comprises:

axially securing a lower end of the first rotor section to the shaft, the first rotor section having an upper end that is free of any axial engagement with the shaft;

axially securing a lower end of the second rotor section to the shaft, the second rotor section having an upper end that is free of any axial engagement with the shaft; and

mounting a bushing between the first and second rotor sections, the bushing having an axial length less than an axial distance between the first and second rotor sections, the carrier bearing slidably receiving the bushing and having an axial length less than the axial distance between the first and second rotor sections.

9. A submersible well pump motor, comprising:

a stator having an inner diameter;

a rotor within the inner diameter of the stator, the rotor having a shaft and first and second rotor sections spaced apart from each other, the shaft having an axis;

a carrier bearing located between the first and second rotor sections and having an anti-rotation member that frictionally engages the inner diameter of the stator to prevent spinning of the carrier bearing; and

a deflectable thrust washer located between an end of the carrier bearing and one of the rotor sections, the thrust washer reducing in thickness in response to a thermal growth axial force of sufficient magnitude applied to the thrust washer in response to axial movement of the rotor sections due to thermal growth, the thermal growth axial force being less than a dislodging force required to cause the anti-rotation member to axially move relative to the stator.

10. The motor according to claim 9, wherein the thrust washer is formed of a material selected to deform in response to the thermal growth axial force.

11. The motor according to claim 9, wherein

the thrust washer is elastically movable from a maximum to a minimum thickness in response to the thermal axial force and is biased to the maximum thickness.

12. The motor according to claim 9, wherein the thrust washer comprises first and second rings separated by a spring that urges the rings apart from each other.

13. The motor according to claim 9, wherein the thrust washer comprises:

a first ring having a plurality of slots circumferentially spaced around the first ring;

a second ring having a plurality of lugs that mate with the slots, but allow axial movement of the first and second rings relative to each other; and

a wavy annular spring located between the first and second rings to urge the first and second rings apart from each other.

14. A submersible well pump motor, comprising:

a stator having an inner diameter;

a driven shaft extending concentrically through the inner diameter of the stator, the shaft having an axis;

first and second rotor sections axially spaced apart from each other and mounted to the shaft for rotation therewith, the rotor sections being axially movable relative to the shaft;

a bushing mounted to the shaft for rotation therewith and axial movement relative to the shaft, the bushing having ends engaging the first and second rotor sections, fixing an axial distance between the first and second rotor sections;

a carrier bearing having a central portion that slidably receives the bushing, the carrier bearing having an anti-rotation member that engages the inner diameter of the stator to prevent spinning of the carrier bearings; and

a length of the bushing is greater than a length of the central portion of the carrier bearing to allow axial movement of the bushing and rotor sections relative to the carrier bearing due to thermal growth.

15. The motor according to claim 14, wherein the central portion of the carrier bearing comprises:

a hub in rotational sliding engagement with the bushing; and

thrust washers mounted on ends of the hub and axially spaced from the rotor sections prior to initial start-up of the motor.

16. The motor according to claim 14, wherein the central portion of the carrier bearing, wherein the central portion of the carrier bearing comprises:

a hub integrally formed with a body of the carrier bearing, the hub having first and second ends;

a first axial gap located between the first end of the hub and the first rotor section prior to initial start-up of the motor; and

a second axial gap located between the second end of the hub and the second rotor section prior to the initial start-up, the first and second axial gaps being substantially equal to each other prior to the initial start-up.

17. The motor according to claim 14, wherein the central portion of the carrier bearing comprises:

a hub in rotational sliding engagement with the bushing;

sacrificial thrust washers mounted on ends of the hub and in contact with the first and rotor sections prior to sustained operation of the motor, an axial length of the hub including thicknesses of the sacrificial thrust washers, being equal to the length of the bushing prior to sustained operation of the motor; and

the sacrificial thrust washers dissolve prior to sustained operation of the motor.

18. A submersible well pump motor, comprising:

a stator having an inner diameter;

a driven shaft extending concentrically through the inner diameter of the stator, the shaft having an axis;

upper and lower rotor sections axially spaced apart from each other and mounted to the shaft for rotation therewith;

a lower retainer axially securing a lower end of the lower rotor section to the shaft, the lower rotor section having an upper end that is free of any axial engagement with the shaft;

an upper retainer axially securing a lower end of the upper rotor section to the shaft, the upper rotor section having an upper end that is free of any axial engagement with the shaft;

a bushing mounted to the shaft for rotation therewith and axially movable relative to the shaft, the bushing being located between the upper end of the lower rotor section and the lower end of the upper rotor section, the bushing having an axial length less than an axial distance between the upper end of the lower rotor section and the lower end of the upper rotor section, so

that any axial thermal growth of the lower rotor section does not transmit through the bushing to the upper rotor section;

a carrier bearing having a central portion that slidably receives the bushing, the carrier bearing having an anti-rotation member that engages the inner diameter of the stator to prevent spinning of the carrier bearings; and

an axial length of the central portion of the carrier bearing is less than the axial distance between the upper end of the lower rotor section and the lower end of the upper rotor section.

19. The motor according to claim 18, wherein each of the retainers comprises a snap ring that engages a mating groove in the shaft.

20. A method of installing a rotor within a stator of a submersible well pump motor, comprising:

mounting a first rotor section on a shaft having an axis;

mounting a bushing on the shaft and a carrier bearing with a central portion on the bushing, the central portion of the bushing having a lesser axial length than an axial length of the bushing, the carrier bearing having an outer diameter containing an anti-rotation member;

mounting a second rotor section on the shaft in engagement with the bushing, which axially spaces the first and second rotor sections apart from each other a fixed axial distance, the bushing and the rotor sections being rotatable and axially movable relative to the carrier bearing, the rotor sections, shaft, bushing and carrier bearing comprising a rotor assembly;

inserting the rotor assembly into a bore of the stator in a first direction and axially sliding the anti-rotational member in frictional engagement with the bore of the stator, the frictional engagement causing a second end of the carrier bearing to contact the second rotor section; and

when the anti-rotational member is at a desired axial position within the bore of the stator, moving the shaft, the rotor sections and the bushing in a second direction a selected axial increment relative to the carrier bearing, which is held against axial movement by the frictional engagement of the anti-rotation member with the bore of the stator, the selected axial increment axially centering the carrier bearing between the first and second rotor sections.

21. The method according to claim 20, wherein the movement of the shaft a selected axial increment in the second direction is equal to one half a difference in axial length between the bushing and the central portion of the carrier bearing.

22. The method according to claim 20, wherein the difference in axial length between the bushing and the central portion of the carrier bearing is less than an estimated amount of thermal growth of the shaft, the bushing and the rotor sections at a point adjacent the carrier bearing during operation.

23. A method of installing a rotor within a stator of a submersible well pump motor, comprising:

mounting a first rotor section on a shaft having an axis;

mounting a bushing on the shaft and a carrier bearing with a central portion on the bushing, the central portion of the bushing comprising a hub having sacrificial washers on each end of the hub, the central portion an axial length equal to an axial length of the bushing, the carrier bearing having an outer diameter containing an anti-rotation member;

mounting a second rotor section on the shaft in engagement with the bushing, which axially spaces the first and second rotor sections apart from each other a fixed axial distance, the

bushing and the rotor sections being rotatable and axially movable relative to the carrier bearing, the rotor sections, shaft, bushing and carrier bearing comprising a rotor assembly;

inserting the rotor assembly into a bore of the stator and frictionally engaging the anti-rotation member with the bore of the stator; then

prior to sustained operation of the motor, dissolving the thrust washers, leaving axial gaps between each of the ends of the hub and the rotor sections.

24. The method according to claim 23, wherein the method further comprises introducing motor lubricant into the bore of the stator and dissolving the sacrificial washers into the motor lubricant.

25. The method according to claim 23, wherein dissolving the thrust washers comprises operating the motor, which creates heat and causes the sacrificial washers to melt

26. The method according to claim 23, further comprising fabricating the sacrificial washers from a wax.

27. The method according to claim 23, wherein dissolving the sacrificial washers comprises:

introducing a solvent into the bore of the stator that dissolves the sacrificial washers;

then, draining the solvent from the bore of the stator and introducing a motor lubricant into the bore of the stator.

Claims:

1. A method of assembling and operating a submersible well pump motor, comprising:

(a) providing a stator with a central bore;

(b) making up a rotor assembly with a shaft with an axis, first and second rotor sections spaced apart from each other, and a carrier bearing having an anti-rotation member and a central portion located between the first and second rotor sections, and mounting a deflectable thrust washer between a hub of the carrier bearing and an end of the second rotor section;

(c) inserting the rotor assembly into the bore of the stator with the anti-rotation member in frictional engagement with the stator;

(d) installing the motor in a well and operating the pump;

(e) allowing the shaft and the rotor sections to thermally grow axially in response to an increase in temperature of the motor, causing the deflectable thrust washer to reduce in thickness in response to a thermal growth axial force imposed on the thrust washer due to the thermal growth; and wherein

the magnitude of the thermal growth axial force that causes the reduction in thickness is less than a dislodging force required to move the anti-rotational member axially within the stator.

2. The method according to claim 1, wherein step (b) comprises:
forming the thrust washer of a deformable material that is sufficiently soft to deform the thrust washer to the reduced thickness at a force less than the dislodging force.

3. The method according to claim 1, wherein the thrust washer is elastically movable from a maximum to a minimum thickness and is elastically biased to the maximum thickness; and

step (e) comprises moving the thrust washer from the maximum thickness toward the minimum thickness in response to the thermal growth axial force.

4. The method according to claim 2, wherein the deformable material of step (b) comprises polytetrafluorethylene.

5. The method according to claim 1, wherein:

step (b) comprises:

mounting a bushing on the shaft with a length greater than the central portion of the carrier bearing plus the thrust washer, and inserting the central portion of the carrier bearing over the bushing; and step (c) comprises:

inserting the rotor assembly into the bore of the stator in a first direction and axially sliding the anti-rotational member in frictional engagement with the bore of the stator, the frictional engagement causing the thrust washer to contact the second rotor section;

when the anti-rotational member is at a desired axial position within the bore of the stator, moving the shaft, the rotor sections and the bushing in a second direction a selected axial increment relative to the carrier bearing, which is held against axial movement by the frictional engagement of the anti-rotation member with the bore of the stator, the selected axial increment axially centering the carrier bearing between the first and second rotor sections and axially spacing the thrust washer from the second rotor section.

6. The method according to claim 1, wherein step (b) comprises:

with a first retainer, axially securing a lower end of the first rotor section to the shaft, the first rotor section having an upper end that is free to move axially relative to the shaft in response to thermal growth;

with a second retainer, axially securing a lower end of the second rotor section to the shaft, the second rotor section having an upper end that is free to move axially relative to the shaft in response to thermal growth; and

mounting a bushing between the first and second rotor sections, the bushing having an axial length less than an axial distance between the first and second rotor sections, defining an initial axial clearance, the carrier bearing slidably receiving the bushing and having an axial length, including the thrust washer, that is less than the axial distance between the first and second rotor sections; and

wherein the thermal growth of the second rotor section is less than the initial axial clearance, thereby preventing the thermal growth of the second rotor section from pushing the bushing into contact with the first rotor section.

7. A method of assembling and operating a submersible well pump motor, comprising:

(a) providing a stator with a central bore;

(b) making up a rotor assembly with a shaft with an axis, first and second rotor sections spaced apart from each other, and a carrier bearing having an anti-rotation member and a central portion located between the first and second rotor sections, and mounting a thrust washer between a hub of the carrier bearing and an end of the second rotor section, the thrust washer being elastically movable from a maximum to a minimum thickness and elastically biased to the maximum thickness;

(c) inserting the rotor assembly into the bore of the stator with the anti-rotation member in frictional engagement with the stator;

(d) installing the motor in a well and operating the pump;

(e) allowing the shaft and the rotor sections to thermally grow axially in response to an increase in temperature of the motor, causing the thrust washer to move from the maximum thickness toward the minimum thickness in response to a thermal growth axial force imposed on the thrust washer due to the thermal growth; and wherein

the magnitude of the thermal growth axial force that causes the movement of the thrust washer toward the minimum thickness is less than a dislodging force required to move the anti-rotational member axially within the stator.

8. A method of assembling and operating a submersible well pump motor, comprising:

(a) providing a stator with a central bore;

(b) making up a rotor assembly with a shaft with an axis, first and second rotor sections spaced apart from each other, and a carrier bearing having an anti-rotation member and a central portion located between the first and second rotor sections, and mounting a thrust washer between a hub of the carrier bearing and an end of the second rotor section, the thrust washer being formed of a deformable material;

(c) inserting the rotor assembly into the bore of the stator with the anti-rotation member in frictional engagement with the stator;

(d) installing the motor in a well and operating the pump;

(e) allowing the shaft and the rotor sections to thermally grow axially in response to an increase in temperature of the motor, the thermal growth creating a thermal growth axial force on the thrust washer that causes the thrust washer to deform to a reduced thickness; and wherein

the deformable material is sufficiently soft to deform the thrust washer to the reduced thickness at a force less than a dislodging force required to move the anti-rotational member axially within the stator.