CLAIMS

1. An ice-worthy jack-up rig for drilling for hydrocarbons in potential ice conditions in offshore areas comprising:

a flotation hull having a relatively flat deck at the upper portion thereof and an ice-bending shape along the lower portion thereof and extending downwardly and inwardly around the periphery of the hull where the ice-bending shape extends from an area of the hull near the level of the deck and extends downwardly near the bottom of the hull;

an ice deflecting portion extending around the perimeter of the bottom of the hull to direct ice around the hull and not under the hull;

at least three legs that are positioned within the perimeter of the bottom of the flotation hull wherein the legs are arranged to be lifted up off the seafloor so that the rig may be towed through shallow water and also extend to the sea floor and extend further to lift the hull partially or fully out of the water;

a jack-up device associated with each leg to both lift the leg from the sea bottom so that the ice worthy jack-up rig may float by the buoyancy of the hull and push the legs down to the seafloor and push the hull partially up and out of the water when ice floes threaten the rig and fully out of the water when ice is not present; and

a gas agitation system to agitate the water near the legs and reduce issues with ice near the legs.

2. The ice worthy jack-up rig according to claim 1, further including an anchoring mechanism associated with a foot of each leg to provide additional resistance to the forces an ice floe may impose on the rig.

3. The ice worthy jack-up rig according to claim 1 or claim 2, wherein the ice bending surface is slanted upwardly and outwardly from a smaller dimension neckline to a larger dimension shoulder.

4. The ice worthy jack-up rig according to any preceding claim, wherein the ice bending surface extends vertically at least 8 to 10 or more meters.

5. The ice worthy jack-up rig according to claim 4, wherein the angle of the ice-bending surface is in the range of 30 to 60 degrees from the vertical.

6. The ice worthy jack-up rig according to any preceding claim, wherein the ice-bending surface comprises a plurality of relatively flat, sloped, segments extending around the periphery of the rig.

7. The ice worthy jack-up rig according to any preceding claim, wherein the ice-bending surface is a reinforced surface.

8. A method for drilling a well in ice prone waters, the method comprising:

providing a rig having a flotation hull having a relatively flat deck at the upper portion thereof and an ice-bending shape along the lower portion thereof where the ice-bending shape extends from an area of the hull near the level of the deck and extends downwardly near the bottom of the hull and an ice deflecting portion extending around the perimeter of the bottom of the hull to direct ice around the hull and not under the hull;

providing at least three legs that are positioned within the perimeter of the bottom of the hull;

jacking down each leg in a manner that feet on the bottom of the legs engages the sea floor and lifts the hull up and fully out of the water when ice is not threatening the rig while the rig is drilling a well on a drill site; and

lowering the hull into the water into an ice defensive configuration so that the ice-bending shape extends above and below the sea surface to bend ice that comes against the rig to cause the ice to submerge under the water and

endure bending forces that break the ice where the ice flows past the rig: and

agitating the water near the legs to reduce issues with ice near the legs.

9. The method according to claim 8 further including the step of anchoring the legs to the seafloor to further resist the force of ice floes.

10. The method according to claim 8 or claim 9 wherein the ice-bending surface extends from a shoulder to a neckline and the step of lowering the hull into the water more particularly comprises lowering the hull into the water so that the neckline is at least 4 meters below the sea surface and the shoulder is at least 7 meters above the sea surface.

11. The method according to any one of claims 8 to 10 further including the step of raising the hull up out of the water when the threat of ice floes are reduced.

12. The method according to any of claims 8 to 11 wherein the step of agitating the water near the legs comprises directing gas into the water below the surface and near the legs to agitate the water near the legs.

13. A method for exploratory drilling in ice prone waters comprising the use of a rig as claimed in any of claims 1 to 7.

CLAIMS

1. An ice-worthy jack-up rig for drilling for hydrocarbons in potential ice conditions in offshore areas comprising:

a flotation hull having a relatively flat deck at the upper portion thereof and an ice-bending shape along the lower portion thereof and extending downwardly and inwardly around the periphery of the hull where the ice-bending shape extends from an area of the hull near the level of the deck and extends downwardly near the bottom of the hull;

an ice deflecting portion extending around the perimeter of the bottom of the hull to direct ice around the hull and not under the hull;

at least three truss form legs that are positioned within the perimeter of the bottom of the flotation hull wherein the legs are arranged to be lifted up off the seafloor so that the rig may be towed through shallow water and also extend to the sea floor and extend further to lift the hull partially or fully out of the water;

a jack-up device associated with each leg to both lift the leg from the sea bottom so that the ice worthy jack-up rig may float by the buoyancy of the hull and push the legs down to the seafloor and push the hull partially up and out of the water when ice floes threaten the rig and fully out of the water when ice is not present;

leg ice shields arranged to protect the truss form legs from ice; and

a gas agitation system including holes in seafloor engaging spud cans at bottom ends of the legs for releasing bubbles through the holes to agitate the water near the legs and reduce issues with ice near the legs.

2. The ice worthy jack-up rig according to claim 1, wherein the truss form legs include vertical posts and cross members connecting the posts and the ice shields are positioned between the posts to protect the cross members.

3. The ice worthy jack-up rig according to claim 1, wherein the ice bending surface is slanted upwardly and outwardly from a smaller dimension neckline to a larger dimension shoulder.

4. The ice worthy jack-up rig according to claim 1, wherein the ice bending surface extends vertically at least 8 to 10 or more meters.

5. The ice worthy jack-up rig according to claim 4, wherein the angle of the ice-bending surface is in the range of 30 to 60 degrees from the vertical.

6. The ice worthy jack-up rig according to claim 1, wherein the ice-bending surface comprises a plurality of relatively flat, sloped, segments extending around the periphery of the rig.

7. A method for drilling a well in ice prone waters, the method comprising:
providing rig having a flotation hull having a relatively flat deck at the upper portion thereof and an ice-bending shape along the lower portion thereof where the ice-bending shape extends from an area of the hull near the level of the deck and extends downwardly near the bottom of the hull and an ice

deflecting portion extending around the perimeter of the bottom of the hull to direct ice around the hull and not under the hull;

providing at least three truss form legs that are positioned within the perimeter of the bottom of the hull where each leg comprises a plurality of vertically oriented posts connected by cross members and ice shields are arranged between the posts to protect the cross members from ice;

jacking down each leg in a manner that feet on the bottom of the legs engages the sea floor and lifts the hull up and fully out of the water when ice is not threatening the rig while the rig is drilling a well on a drill site;

lowering the hull into the water into an ice defensive configuration so that the ice-bending shape extends above and below the sea surface to bend ice that comes against the rig to cause the ice to submerge under the water and endure bending forces that break the ice where the ice flows past the rig; and

agitating water near the legs to reduce issues with ice near the legs while the hull is lifted fully out of the water and while the hull is lowered into the ice defensive configuration.

8. The method according to claim 7 further including the step of anchoring the legs to the seafloor to further resist the force of ice floes.

9. The method according to claim 7 wherein the ice-bending surface extends from a shoulder to a neckline and the step of lowering the hull into the water more particularly comprises lowering the hull into the water so that the neckline is at least 4 meters below the sea surface and the shoulder is at least 7 meters above the sea surface.

10. The method according to claim 7, wherein the agitating includes blowing air underwater.