Nov. 12, 1968 F. J. SCHUH 3,410,096

STREAMLINED RISER PIPE

Filed Dec. 7, 1966 3 Sheets-Sheet 1

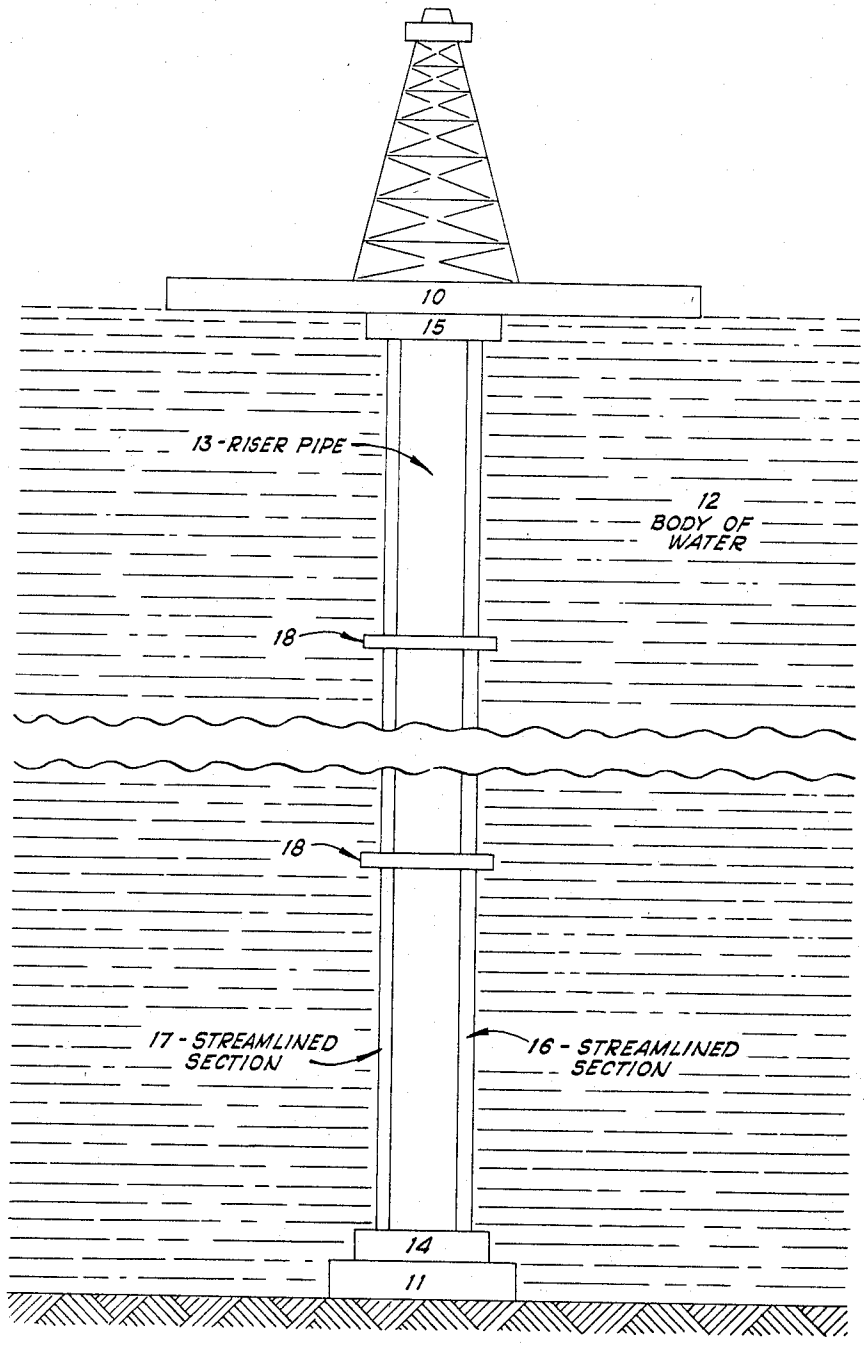


FIGURE 1

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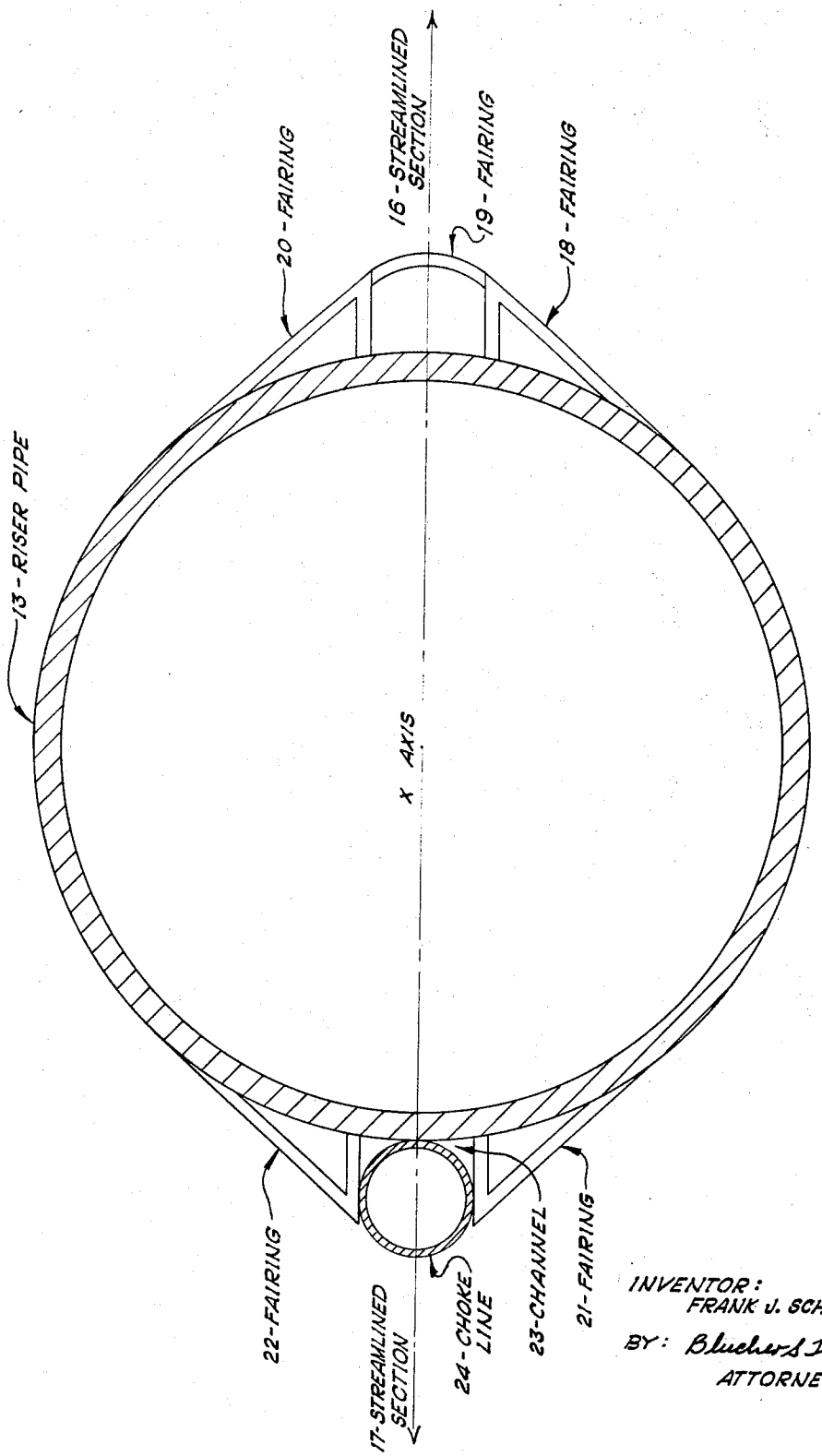


FIGURE 2

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STREAMLINED RISER PIPE

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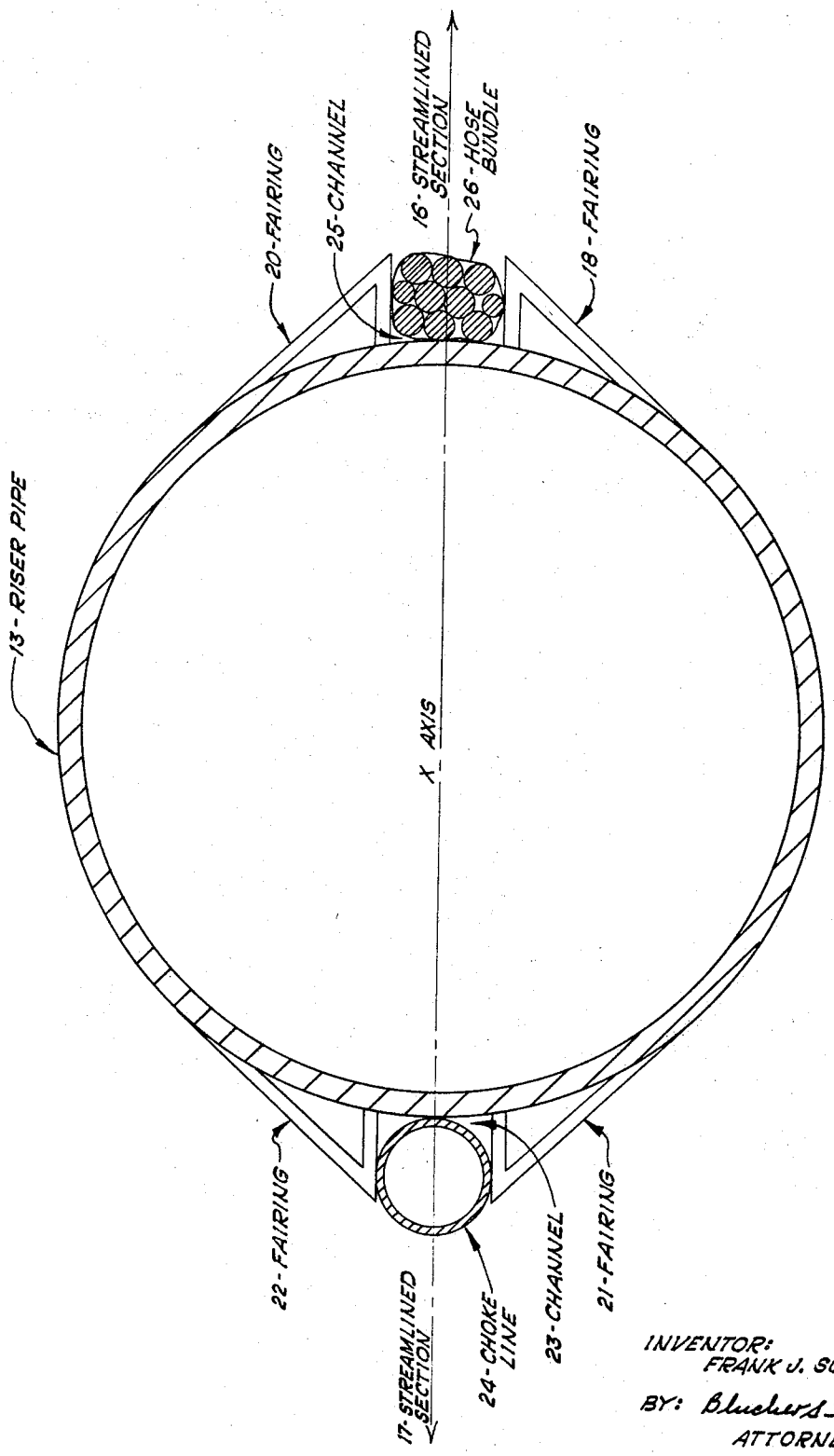


FIGURE 3

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United States Patent Office

3,410,096
Patented Nov. 12, 1968

3,410,096

STREAMLINED RISER PIPE

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Filed Dec. 7, 1966, Ser. No. 599,798
6 Claims. (Cl. 61—46)

ABSTRACT OF THE DISCLOSURE

A riser pipe is shown which incorporates an assembly for minimizing current-induced transverse vibrations and drag forces when critically aligned with respect to the current. The assembly is comprised of first and second streamlined sections which are attached to opposite sides of the riser and run lengthwise therewith. One of the streamlined sections has an externally channeled portion for mounting a choke line; optionally, the other streamlined section can be channeled to receive a hose bundle.

Background of the invention

The invention pertains to hydraulic engineering and particularly relates to stable structures in shifting media.

Offshore wells are frequently located on a continental shelf, in a marine inlet, near a river mouth, etc. Such drilling sites are characterized by strong currents, particularly tidal currents. Drilling equipment may be subjected to currents having a velocity exceeding 10 feet/second, flowing either toward or away from the adjoining seashore, depending on whether the tide is coming in or going out. Submersed equipment is exposed to stresses which increase greatly as the velocity of the current increases. These stresses are magnified as the depth of water at the well location increases, so that drilling activities have generally been limited to depths not exceeding 150 feet and, even then, frequently must be curtailed due to strong tides.

Of particular concern is the effect of the currents on the riser pipe or tubular conduit which serves to connect the drilling vessel to the top of the well at the sea floor. During drilling operations the riser pipe is exposed to currents which can cause at least two kinds of stresses. The first is a vortex-induced alternating force that vibrates the riser in a direction perpendicular to the direction of the current. Vibrations of this type cause the middle portion of the pipe to oscillate transversely with respect to the base and the top. The second type of stress is a bending stress which pushes the riser in the direction of the current due to its resistance to fluid flow, i.e. drag.

To minimize the current-induced transverse vibrations oil operators have added current spoilers to their risers. The most popular spoiler is a perforated shroud or shield which surrounds the riser pipe; another spoiler frequently employed is a spiral wrap or band about the riser. While these spoiler designs have generally been successful in reducing the alternating side forces, they have the undesirable effect of increasing the drag forces. Accordingly, risers incorporating these spoiler designs still are restricted to use in relatively shallow water areas and/or locations where strong currents are not prevalent.

Summary of the invention

The present invention provides a streamlined cylinder or riser pipe that is largely unaffected by current-induced transverse vibrations and, in the same instance, shows an improved stability to drag. Basically the streamlined riser pipe has first and second streamlined sections attached to and extending vertically on opposite sides thereof, which

act as current spoilers when the pipe is properly oriented with the current.

Applicant's design is as effective in reducing the alternating side forces as the perforated shroud or the spiral wrap designs and has the decided advantage of having a much lower drag coefficient. Drag is directly proportional to the drag coefficient; hence, the lower the drag coefficient, the lower the resistance of the cylinder to fluid flow (and the greater the permissible operational depth).

Comparison studies of drag forces indicate that a riser protected by a perforated shroud and having a choke line and hose bundle attached thereto has a drag coefficient near 1.8; a riser of similar diameter with a spiral wrap has a drag coefficient on the order of 1.5; and the streamlined riser claimed herein has a drag coefficient around 0.5 or 0.6. Because of its relatively low drag coefficient, the riser pipe of the invention can be used in stronger currents or in deeper water than would be permitted by the prior art designs.

Brief description of the drawings

FIGURE 1 shows a diagrammatic view of the streamlined riser pipe of the invention connecting a floating drilling vessel to an underwater wellhead.

FIGURE 2 shows a cross sectional view of the streamlined riser pipe which illustrates one form of the invention.

FIGURE 3 shows a cross sectional view of the streamlined riser pipe according to a second embodiment of the invention.

Description of the preferred embodiments

In order to place the invention in proper perspective reference is made to FIGURE 1. Drilling vessel or barge **10** is located over wellhead **11** cemented to a well being drilled on the floor of body of water **12**. Wellhead **11** is comprised of an assemblage of drilling apparatus and customarily includes a suitable base, one or more blowout preventers, etc.

Riser pipe **13** connects drilling vessel **10** to wellhead **11** and provides tubular means through which drilling operations can be conducted. Riser pipe **13** is attached to wellhead **11** by ball joint **14** which permits the upper end of the riser to change in angular position relative to the bottom through an angle of about 10 degrees. Intermediate to riser pipe **13** and drilling vessel **10** is slip joint **15** which telescopes, allowing the riser to vary in longitudinal length by a distance of 25 feet or more.

Riser pipe **13** is contoured or streamlined by streamlined sections **16** and **17** which rigidly attach to the outer surface thereof. Sections **16** and **17** extend vertically on opposite sides of the riser over a major portion of the longitudinal length thereof acting as spoilers, i.e. they form an assembly for minimizing both current-induced transverse vibrations and drag forces. Sections **16** and **17** can be interrupted at riser couplings **18** and to provide spaces for clamps and brackets without affecting the performance of the spoiler arrangement.

For a more detailed description of the invention, reference is made to FIGURE 2 where riser pipe **13** and streamlined sections **16** and **17** are shown in cross section. Section **16** is formed from fairings **18**, **19**, and **20** in a manner such that the forward portion of the section is rounded and gradually curves back to the riser with the avoidance of sharp angles. Section **17** is comprised of fairings **21** and **22** and has an externally channeled protion or groove **23** adapted to receive or contain choke line **24** (which extends to a blowout preventer located on the wellhead).

An alternate embodiment of the invention is shown in FIGURE 3. The streamlined riser pipe is identical to that described in FIGURE 2 with the exception that section

16 has been modified to include an externally channeled portion 25 which is adapted to receive hose bundle 26.

By mounting choke line 24 and hose bundle 26 within the confines of channels 23 and 25, respectively, undesired drag forces which would otherwise act on the choke line and hose bundle are eliminated. Since the channeled portions of sections 16 and 17 are effectively filled, the performance of the spoiler arrangement for the riser is largely unaffected. Thus, a certain economy or efficiency of operation is effected.

The streamlined riser has one operational requirement: it is necessary that riser pipe 13 be oriented so that streamlined sections 16 and 17 are critically aligned in relation to the flow of the current. It has been found that the angle of alignment, i.e. angle of attack, must be less than about 30 degrees.

In FIGURES 2 and 3 the direction of flow of the current is indicated by and may be in either direction along the X axis. Accordingly, sections 16 and 17 should be aligned to within a plus or minus 30 degrees of the X axis. (A wide permissive angle of attack is desired in practice to counteract shifting and swirling currents.)

The cross section of the streamlined riser can be described as a somewhat pointed ellipse, the major diameter of which extends through sections 16 and 17 and is in a ratio of approximately four to three with the minor diameter. Similar designs with ratios different than the above are feasible and fall within the scope of the invention. However, where the ratio is reduced below the noted value, the streamlining effect is lessened to some extent and, where the ratio exceeds the noted value, alignment of the streamlined sections with respect to the direction of the current becomes increasingly critical. In the latter case the permissive angle of attack about the X axis may only be 20 or even 10 degrees.

While specific embodiments of the invention have been presented as required by the Rules of Practice, it is intended that the scope of the invention be limited only by the appended claims after due allowance for equivalents.

What is claimed is:

1. An assembly for minimizing current-induced transverse vibrations and drag forces in a cylinder attached to and extending upward from the floor of a body of water comprising first and second streamlined sections rigidly attached to the outer surface of said cylinder and extending vertically on opposite sides thereof over a major portion of its longitudinal length wherein said first section has an externally channeled portion adapted to receive a tubular member such that said first section presents a streamlined surface when said tubular member is in place.

2. An assembly according to claim 1 where said second section has an externally channeled portion adapted to contain a hose bundle which substantially fills the channel.

3. An assembly for minimizing current-induced transverse vibrations and drag forces in a riser pipe attached to a wellhead and extending upward through a body of water comprising a plurality of fairings rigidly attached to the outer surface of said pipe forming first and second streamlined sections extending vertically on opposite sides thereof over a major portion of its longitudinal length wherein the fairings forming said first section are spaced apart so that they define an external channel adapted to mount a choke line in a manner such that said first section presents a streamlined surface when said choke line is in place.

4. An assembly according to claim 3 where the fairings forming said second section are spaced apart so that they define an external channel adapted to contain a hose bundle which substantially fills the channel.

5. An assembly for minimizing current-induced transverse vibrations and drag forces in a riser pipe attached to a wellhead and extending upward through a body of water comprising a plurality of fairings rigidly attached to the outer surface of said pipe forming a streamlined section extending vertically over a major portion of its longitudinal length wherein said fairings are spaced apart so that they define an external channel adapted to mount a choke line in a manner such that said section presents a streamlined surface when said choke line is in place.

6. A method for minimizing current-induced transverse vibrations and drag forces in a riser pipe attached to a wellhead and extending upward through a body of water comprising the steps of (a) contouring the outer surface of said pipe by attaching fairings to form a streamlined section extending vertically over a major portion of its longitudinal length wherein said fairings are spaced apart so that they define an external channel and (b) mounting the choke line leading to said wellhead in said channel so as to complete the streamlining effect.

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