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(54) **ATTACHMENT OF CONTROL LINES TO OUTSIDE OF TUBULAR**

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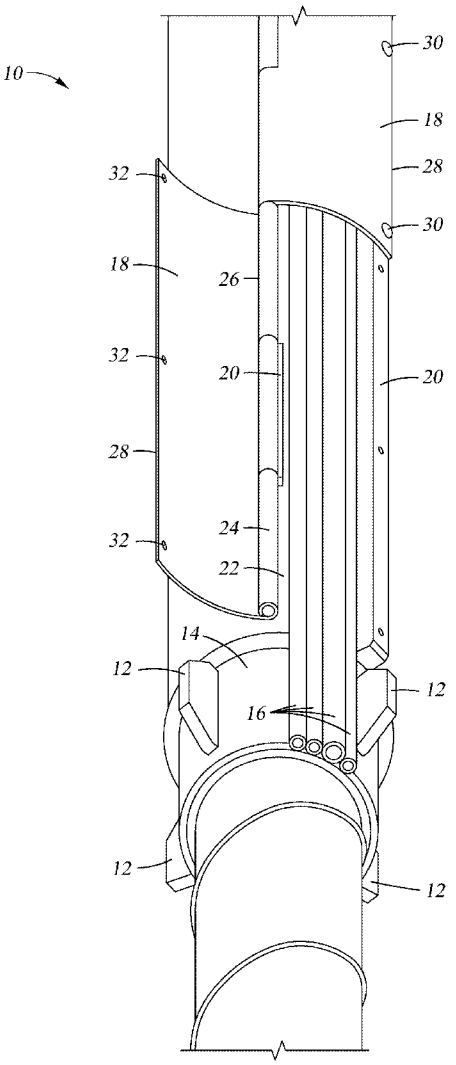
(57) **ABSTRACT**

Disclosed is a downhole apparatus including a tubular and at least one support extending radially outwardly of an outer surface of a radially outward most member of the tubular. At least one cover is secured to the at least one support defining a protected space between the at least one cover and the outer surface. Further disclosed is a downhole tubular system including at least two tubular apparatus, each tubular apparatus including at least one tubular and at least one support extending radially outwardly of an outer surface of a radially outward most member of the tubular. At least one cover is secured to the at least one support defining a protected space between the at least one cover and the outer surface. The system further includes at least one coupling clamp located at a coupling of the at least two tubular apparatus.



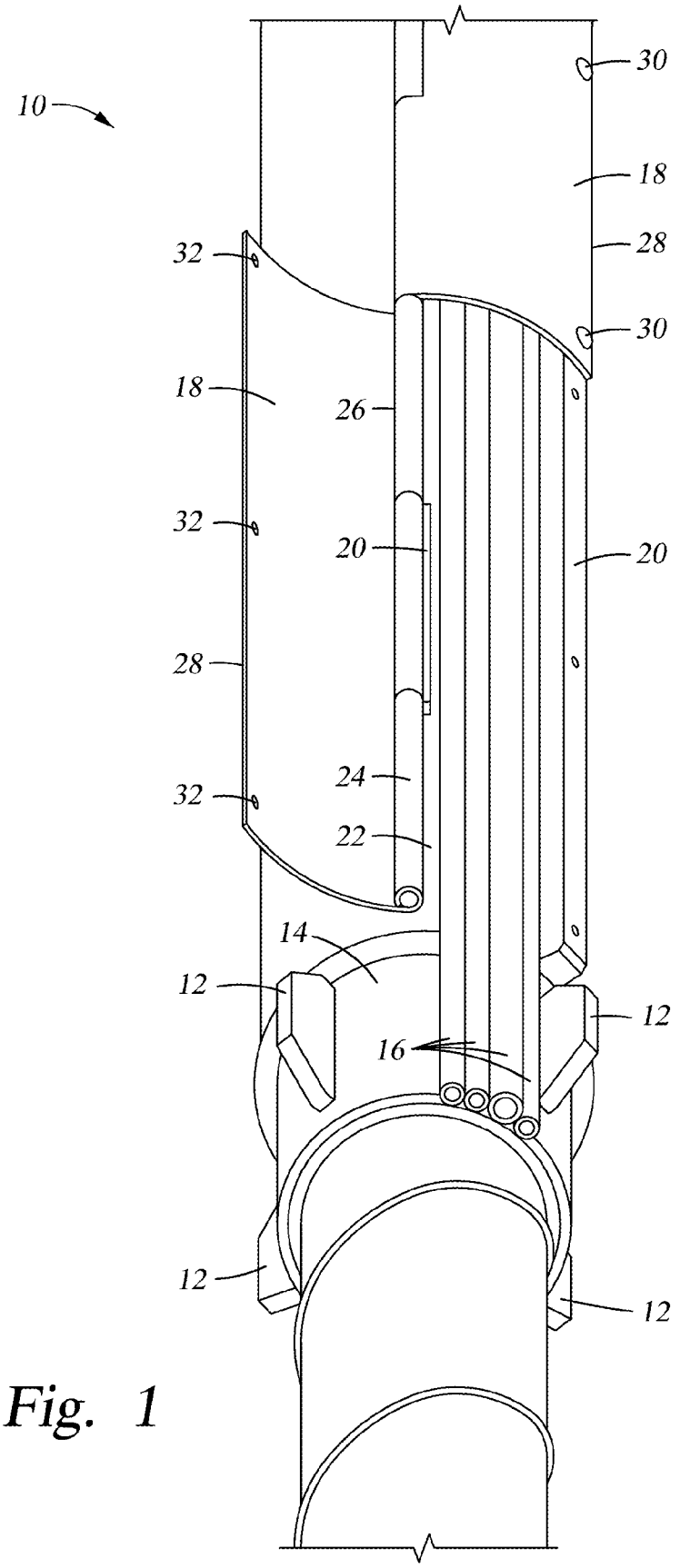


Fig. 1

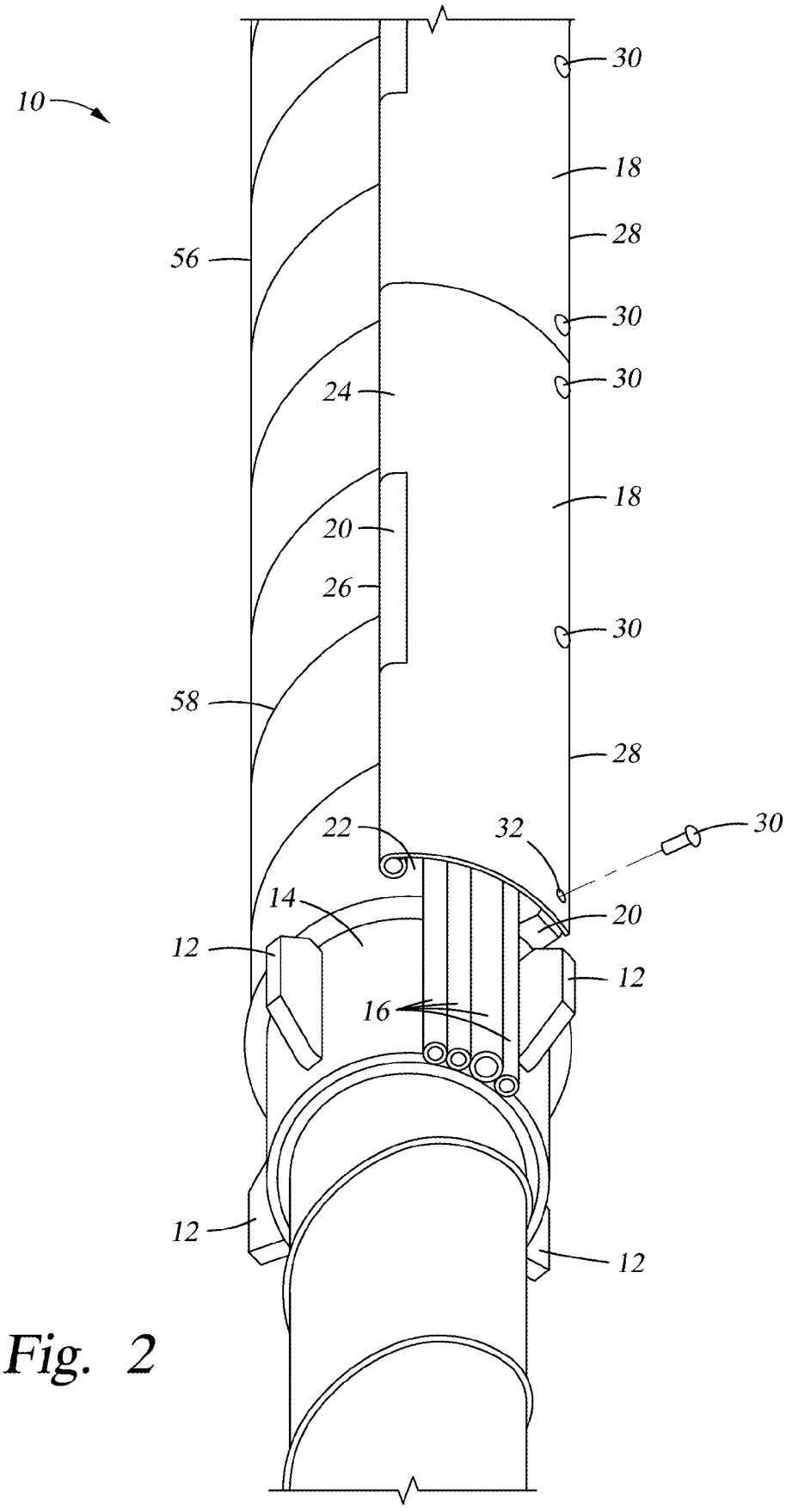


Fig. 2

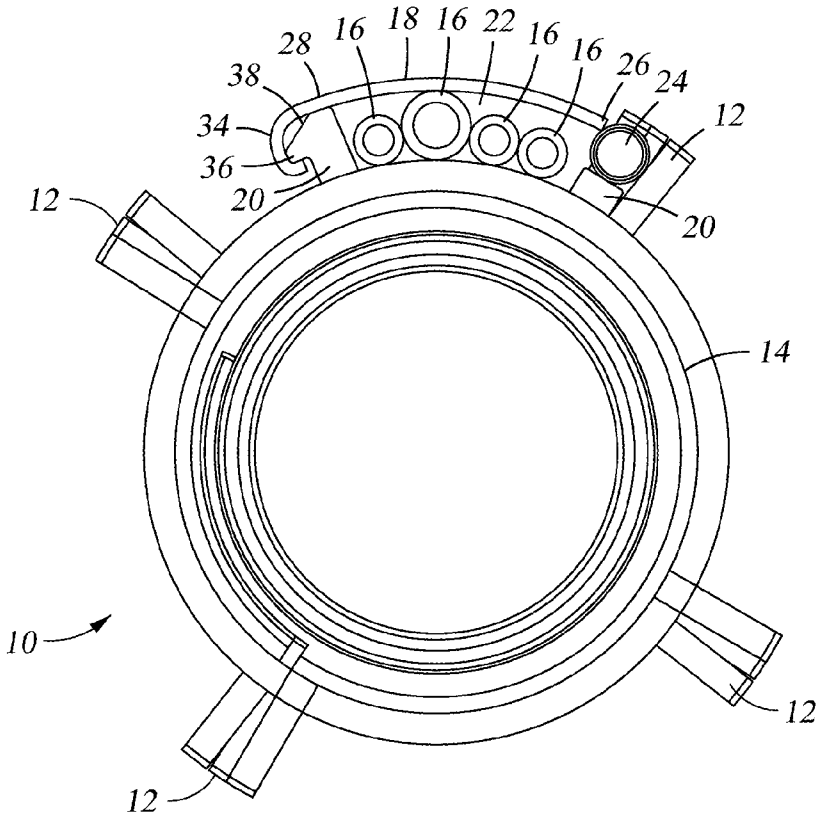

28
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Fig. 3

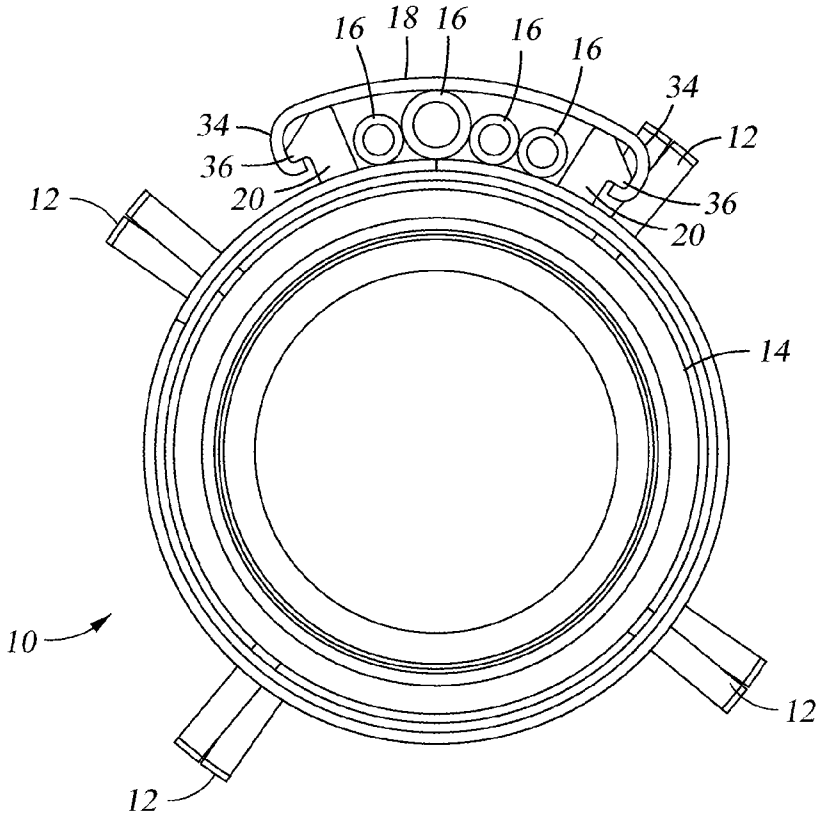
16
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Fig. 4

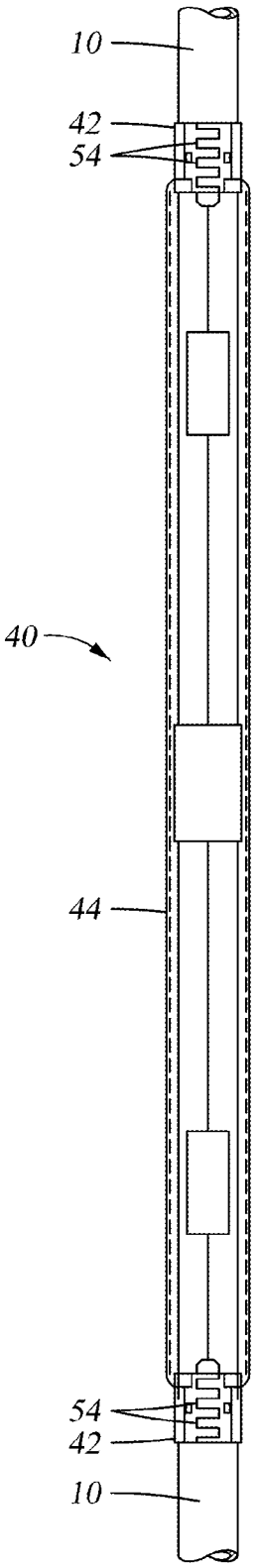

Fig. 5

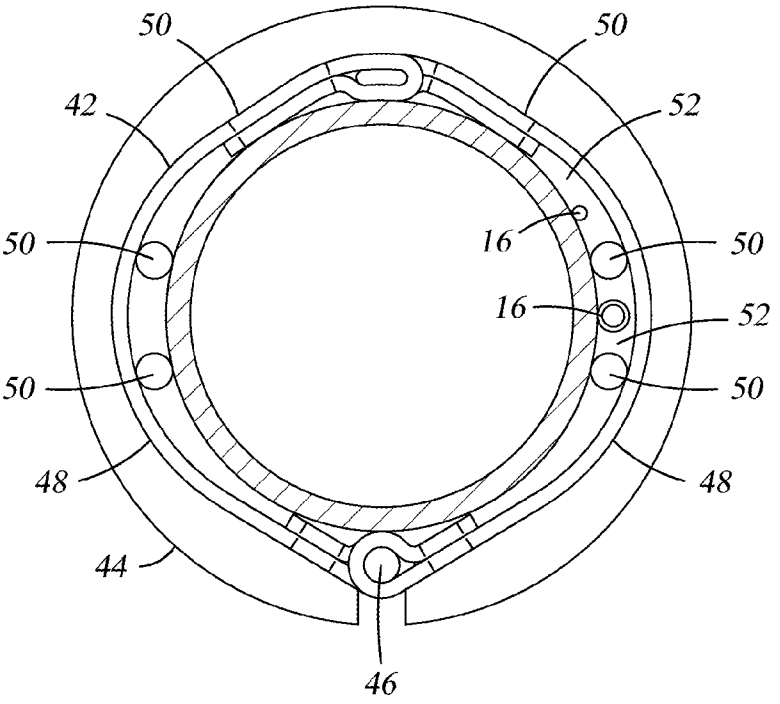

Fig. 6

ATTACHMENT OF CONTROL LINES TO OUTSIDE OF TUBULAR

BACKGROUND

[0001] In the drilling and completion arts, lengths of tubing known as a string is installed for various purposes such as drilling, injection, production, etc. The art in more recent years has become increasingly interested in monitoring and control of devices in the downhole environment. To accommodate this interest, lines such as fiber optic lines, electric lines, hydraulic lines, etc are installed adjacent the string. The lines may be installed in a number of positions relative to the string such as at the inside dimension of the string, somewhere within various concentric layers of the string or outside of the string, for example, on a surface thereof or spaced therefrom. Depending upon where the lines are run, they may or may not be subject to mechanically inflicted damage during running of the string in the hole. While various methods are known to protect lines at the outside dimension of the string such as channels, grooves, etc. the art is still interested in alternative means for protecting the lines that provides good protection at rapid speed and with minimal complexity of installation.

SUMMARY

[0002] A downhole apparatus includes a tubular and at least one support extending radially outwardly of an outer surface of a radially outward most member of the tubular. At least one cover is secured to the at least one support defining a protected space between the at least one cover and the outer surface.

[0003] A downhole tubular system includes at least two tubular apparatus, each tubular apparatus including at least one tubular and at least one support extending radially outwardly of an outer surface of a radially outward most member of the tubular. At least one cover is secured to the at least one support defining a protected space between the at least one cover and the outer surface. The system further includes at least one coupling clamp located at a coupling of the at least two tubular apparatus. The at least one coupling clamp includes at least two collars. At least one collar of the at least two collars is located at each side of the coupling. Each collar includes a coupling body extending around a circumference of the outer surface defining a coupling protected space between the coupling body and the outer surface. A coupling sleeve extends between the at least two collars.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Referring now to the drawings wherein like elements are numbered alike in the several Figures:

[0005] FIG. **1** is a perspective view of an embodiment of a downhole tubular apparatus;

[0006] FIG. **2** is another perspective view of the downhole tubular apparatus of FIG. **1**;

[0007] FIG. **3** is a cross sectional view of an embodiment of a downhole tubular apparatus;

[0008] FIG. **4** is a cross sectional view of another embodiment of a downhole apparatus;

[0009] FIG. **5** is an embodiment of a cross-coupling clamp of a downhole apparatus; and

[0010] FIG. **6** is a cross sectional view of an embodiment of a cross-coupling clamp.

DETAILED DESCRIPTION

[0011] Shown in FIG. **1** a portion of a string **10**. The string **10** is a length of tubing installed in a downhole environment for various purposes such as drilling, injection and/or production. In some embodiments, the string **10** includes a plurality of centralizers **12** which extend outwardly from an outer surface **14** of the string **10** to prevent damage to the string **10** when the string **10** is run into or removed from the downhole environment. The plurality of centralizers **12** are disposed along a length of the string **10** and also around a perimeter of the string **10**. The plurality of centralizers **12** may be secured to the string **10** by any conventional means, including welding and/or one or more mechanical fasteners such as bolts, or may be formed integral to the string **10**. While the embodiment shown in FIG. **1** includes a plurality of centralizers **12**, it is to be appreciated that in some embodiments, centralizers **12** may be absent from the string **10**.

[0012] To monitor and/or control one or more devices downhole, one or more monitoring or control lines **16** extend along the outer surface **14** of the string **10**. The lines may be, for example, electrical lines, hydraulic lines, and/or fiber optic lines, or the like. Further, while four lines **16** are shown in FIG. **1**, it is to be appreciated that other quantities of lines **16**, for example one, two, or ten lines **16** are contemplated herein. As shown in FIG. **2**, at least one cover **18** is utilized to protect the one or more lines **16** from damage via, for example, impact while installing the string **10** in a hole. As shown, the cover **18** may be curved in a circumferential direction but it is to be understood that a cover without curvature is also contemplated. The cover **18** may extend substantially the length of a joint of the string **10**. In some embodiments, perhaps because of the length of cover **18** necessary to protect the lines **16**, it may be desired to utilize a quantity of covers **18** arranged axially along the string **10** instead of a single continuous cover **18**. In some embodiments, the covers **18** may substantially abut, while in other embodiments, the covers **18** may have a gap between the covers to facilitate removal or opening of the covers **18**. In one embodiment, each cover **18** will extend about 10 feet. The cover **18** may be affixed to one or more supports **20** extending outwardly from the outer surface **14**. The supports **20** may be affixed to the outer surface **14** by welding or by other means including, for example, bolts.

[0013] As shown in FIG. **1**, the supports **20** may be arranged so the lines **16** are located between two supports **20**. The supports **20** are tall enough so that when the cover **18** is in a closed position as shown in FIG. **2**, a protected space **22** between the cover **18** and the outer surface **14** of the string **10** is of sufficient dimensions for the lines **16** to be received therein and protected. In some embodiments, the cover **18** is located circumferentially between two centralizers **12**. The cover **18** may be attached to the one or more supports **20** via a hinge **24** at a hinge side **26** of the cover **18**. The hinge **24** allows the cover **18** to be opened and closed while remaining attached to the string **10**. To ensure the cover **18** remains closed when desired, a non-hinge side **28** of the cover **18** includes a securement configuration to secure the cover **18** in a closed position. The securement configuration may be, for example, a fastener **30** (threaded, rivet, etc) extending through a cover hole **32** in the cover **18** into the support **20**. Further, the securement configuration may be a clip, pin,

magnet, or other suitable closure means. In one embodiment, as shown in FIG. **3**, the cover **18** includes a retaining hook **34** which may be a substantially U-shaped bend in the non-hinge side **28** of the cover **18**. The retaining hook **34** is configured to engage with a detent **36** which is, for example, formed into the support **20** disposed at the non-hinge side **28**. When the cover **18** is moved from an open position towards a closed position, the retaining hook **34** slides along a ramp portion **38** of the support **20** until engaging the detent **36**. While the detent **36** is illustrated with flat surfaces and sharp angles, a more rounded cross section is also contemplated.

[0014] In some embodiments, the cover **18** is secured to the supports **20** without a hinge **24**, and has screws **30**, retaining hooks **34** or other mechanisms to secure the cover **18** to the supports **20**. For example, as shown in FIG. **4**, the cover **18** includes retaining hooks **34** at each circumferential end of the cover **18**, which engage to detents **36** on each support **20**. In this embodiment, the cover **18** is installed by, for example, urging the cover **18** in a radially inward direction to engage the retaining hooks **34** to the detents **36**.

[0015] In some embodiments, it is desirable to have lines **16** installed along the length of the string **10**, across couplings of adjacent joints of the string **10**. Referring to FIG. **5**, a cross-coupling clamp **40** may be disposed at the coupling of two joints of string **10**. The cross-coupling clamp **40** axially overlaps each joint of string **10** and circumferentially surrounds the string **10**. The cross-coupling clamp **40** includes a collar **42** disposed at each end and a sleeve **44** extending axially between the two collars **42** across a coupling between the joints of the string **10**. Referring to FIG. **6**, each collar **42** includes at least one coupling hinge **46** and two coupling arms **48** extending from the coupling hinge **46**. Each coupling arm **48** may include at least one coupling spacer **50** that, when the collar **42** is closed around the string **10** defines a coupling protected space **52** between the outer surface **14** and the coupling arm **48**. The size of coupling spacer **50** used determines a height of the coupling protected space **52**, and different sized coupling spacers **50** may be utilized depending on a size of lines **16** and/or desired height of the coupling protected space **52**. In some embodiments, the coupling protected space **52** height is greater than a thickness of lines **16** that are disposed in the coupling protected space **52**. This provides a coupling protected space **52** that extends around the circumference of the string **10** and allows for a helical arrangement of the lines **16** in the coupling protected space **52** to, for example, compensate for any variation in circumferential alignment of adjacent string joints **10** at the coupling. Referring again to FIG. **5**, each coupling arm **48** includes a plurality of coupling fingers **54** configured to interlock with coupling fingers **54** of the other coupling arm **48** when the collar **42** is closed around the string **10**. With the coupling fingers **54** interlocked, the cross-coupling clamp **40** is secured in the closed position by, for example, a coupling pin (not shown) installed through a plurality of coupling finger holes (not shown) in the plurality of coupling fingers **54** to prevent the cross-coupling clamp **40** from opening unexpectedly.

[0016] Referring again to FIG. **2**, in some embodiments, the string **10** includes a screen **56** at the outer surface **14** to filter flow entering the string **10** for undesired materials. In some embodiments, the outer surface **14** may be a flow through tubular **58** having at least one line **16** attached thereto. The line **16** attached to the flow through tubular **58** may be a control line or monitoring line that is, for example, an electric line, hydraulic line, fiber optic line or the like.

[0017] While one or more embodiments have been shown and described, modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

1. A downhole apparatus comprising:
a tubular;
at least one support extending radially outwardly of an outer surface of a radially outward most member of the tubular; and
at least one cover secured to the at least one support defining a protected space between the at least one cover and the outer surface.

2. The downhole apparatus of claim **1** wherein the at least one cover is secured to a first support of the at least one support via at least one hinge.

3. The downhole apparatus of claim **1** wherein the at least one support includes at least one detent to secure the at least one cover.

4. The downhole apparatus of claim **3** wherein the at least one cover is secured to the at least one detent via at least one retaining hook.

5. The downhole apparatus of claim **1** wherein the at least one cover is secured to the at least one support via at least one of a threaded fastener.

6. The downhole apparatus of claim **1** wherein the at least one cover is secured to the at least one support via at least one clip.

7. The downhole apparatus of claim **1** comprising a plurality of centralizers extending outwardly from the outer surface.

8. The downhole apparatus of claim **7** wherein the at least one cover is disposed circumferentially between two adjacent centralizers of the plurality of centralizers.

9. The downhole apparatus of claim **1** wherein the at least one cover is at least two covers disposed axially along a length of the tubular.

10. The downhole apparatus of claim **1** wherein a plurality of lines are disposed in the protected space.

11. The downhole apparatus of claim **1** wherein the tubular is a screen segment.

12. The downhole apparatus of claim **1** wherein the tubular is a flow through tubular with one or more lines attached thereto.

13. A downhole tubular system comprising:
at least two tubular apparatus, each tubular apparatus including;
at least one tubular;
at least one support extending radially outwardly of an outer surface of a radially outward most member of the tubular; and
at least one cover secured to the at least one support defining a protected space between the at least one cover and the outer surface;
at least one coupling clamp disposed at a coupling of the at least two tubular apparatus including:
at least two collars, at least one collar of the at least two collars disposed at each side of the coupling, each collar including a coupling body extending around a circumference of the outer surface defining a coupling protected space between the coupling body and the outer surface; and

a coupling sleeve extending between the at least two collars.

14. The downhole system of claim **13** comprising at least one line disposed in the coupling protected space.

15. The downhole system of claim **14** wherein the at least one line is at least one control line.

16. The downhole system of claim **14** wherein the at least one line is at least one fiber optic line.

17. The downhole system of claim **14** wherein the coupling protected space is configured to allow for helical arrangement of the at least one line.

18. The downhole system of claim **13** wherein the coupling collar comprises at least one coupling hinge.

19. The downhole system of claim **18** including at least two coupling arms extending from the at least one coupling hinge circumferentially around the outer surface.

20. The downhole system of claim **13** including at least one coupling spacer disposed between the coupling body and the outer surface to define the coupling protected space therebetween.

21. The downhole system of claim **13** wherein the coupling protected space extends substantially around the entire circumference of the outer surface.

22. The downhole system of claim **13** wherein the at least one tubular is at least one screen segment.

23. The downhole system of claim **13** wherein the at least one tubular is at least one flow through tubular with one or more lines attached thereto.

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