United States Patent

[11] 3,603,393

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[54] HIGH PRESSURE WELL MANDREL

7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **166/242,** 166/224
[51] **Int. Cl.** **F04f 1/20**
[50] **Field of Search** ..... 166/117.5, 224, 242, ; 417/109-117; 137/155

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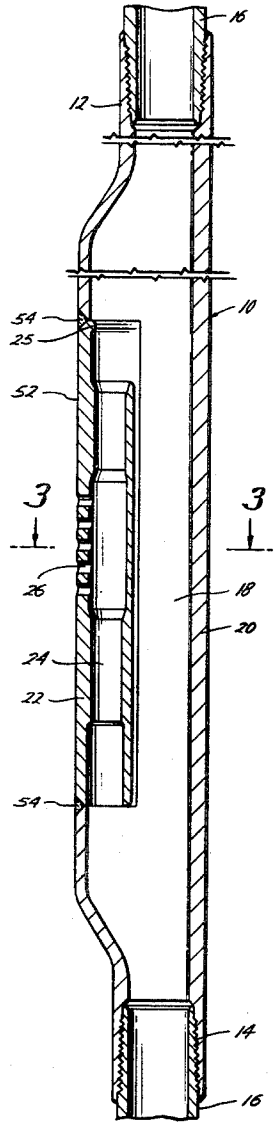
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ABSTRACT: A high pressure mandrel for use in a well tubing having an open bore for alignment with the well tubing and including a valve side pocket housing having an internal tubular valve pocket in which the bore is substantially circular in cross section and the valve pocket housing is welded to the mandrel body by axially extended seams which are laterally offset from the axis of the bore of the body a distance no greater acted upon the radius of the bore thereby reducing the total area acted upon by internal pressures and increasing the capability of the mandrel to withstand high pressures. The mass of the material in the valve pocket housing being sufficient to prevent warping of the valve pocket when the housing is welded to the body thereby allowing the housing to be finished before being welded to the body. The valve pocket housing including a valve latching clamp integrally formed therewith insuring accurate alignment of the latching clamp relative to the side pocket.



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Fig. 1

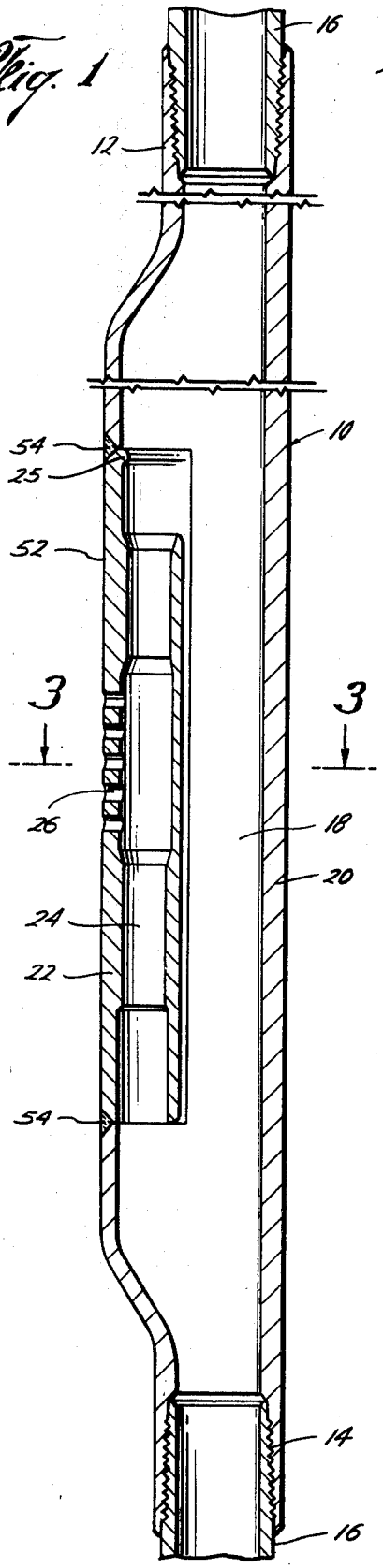
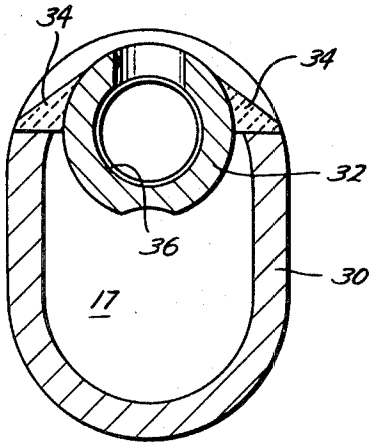


Fig. 2



PRIOR ART

Fig. 3

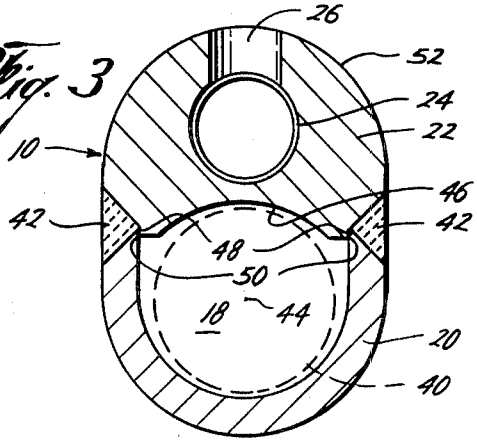
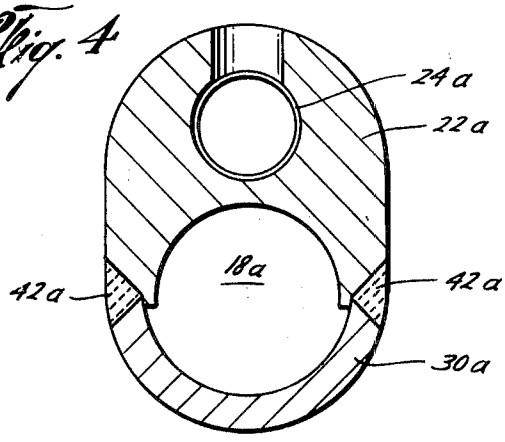


Fig. 4



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HIGH PRESSURE WELL MANDREL

BACKGROUND OF THE INVENTION

The present invention relates to retrievable valve mandrels for use in a well tubing in which the mandrels have a full opening tubing bore permitting wire line tools to be run therethrough and having a side pocket offset from the bore to receive a retrievable valve or flow control element. Generally, a mandrel is oval shaped in cross section and is made by separately welding a valve pocket housing and a valve latching clamp to one edge of the mandrel body. However, when the valve housing and latching clamp are welded to the mandrel body, the valve housing and latch are generally warped in the process. Because of the warping occuring in the welding process, the valve pocket must be finished after welding by inserting finishing tools into one end of the mandrel and thus close tolerances cannot be held which results in less than optimum sealing of the valve in the pocket. Also in the event that the coacting clamp is warped relative to the side pocket or is not welded in place in exact alignment with the side pocket housing, the valve will not be correctly latched into position in the side pocket. In addition, because of the internal configuration of the oval cross section such mandrels are limited in the pressures, for example 6,000 p.s.i., internally at which they are rated. The present invention is directed to providing improvements which not only provide a mandrel which will withstand high pressures, but which will be more economical in manufacture and more accurate in construction to better perform its intended functions.

SUMMARY

The present invention is directed to providing a high pressure well mandrel in which the valve pocket housing is welded to the mandrel body at a position to reduce the total area acted on by the internal pressures to increase the capability of the mandrel to withstand high internal pressures; providing the mass of material in the valve pocket housing of sufficient size to prevent warping of the valve pocket when the housing is welded to the body whereby the valve pocket housing may be machine finished prior to welding; and in which the valve pocket housing includes a valve latching clamp integrally formed therewith prior to welding to the housing to the body to insure accurate alignment of the latching clamp with the valve pocket housing.

It is one object of the present invention to provide a bore through the mandrel, which is substantially circular in cross section, to limit the total area acted upon by the internal pressures and wherein the valve pocket housing is welded to the mandrel body by axially extending seams laterally offset from the axis of the bore of the housing toward the valve pocket a distance of no more than the radius of the bore to reduce the force to which the welds are subjected.

It is a further object of the present invention to integrally force and machine the valve pocket housing and the latch clamp to insure a closely controlled valve latch engagement and to allow finishing the valve pocket interior to a fine finish prior to welding the housing to the body to provide better valve sealing.

A still further object is to shape the valve pocket housing to conform to the external shape of the body thereby reducing chances of sticking in the well and allowing the use of automatic welding machines to provide a more uniformly controlled weld.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary elevational view, in cross section, illustrating the mandrel of the present invention in a well tubing,

FIG. 2 is a cross-sectional view of a prior art mandrel,

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1; and

FIG. 4 is a cross-sectional view similar to FIG. 3 illustrating a modified form of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, the numeral **10** generally indicates the mandrel of the present invention which includes a connection at each end such as threads **12** and **14** for connecting the mandrel **10** in a well tubing **16**.

The mandrel **10** includes a full open tubing bore **18** therein which is aligned with the well tubing **16** permitting well tools to freely pass through the mandrel **10**. Furthermore, the mandrel **10** includes a valve pocket housing **22** having an internal tubular valve pocket **24** for receiving a conventional valve or other flow control means which controls the flow through openings **26** to and from the tubular valve pocket **24** and thus the bore **18**. The mandrel **10** also includes a valve latching clamp **25** above the side pocket **24** to coact with a latching means on a valve (not shown) to be inserted into the side pocket **24**.

Referring now to FIG. **2**, which illustrates a cross-sectional area of a prior art mandrel, it is noted that the mandrel body **30** is generally oval in shape and the side pocket housing **32** is connected to the body **30** by welds **34**. However, such prior art mandrels are generally rated at 6,000 p.s.i. internal pressure in burst and 5,000 p.s.i. external pressure in collapse. Further, it has been noted that failure normally occurs across the welds **34**.

In the prior art mandrel of FIG. **2**, connection of the side pocket housing **32** to the body **30** by the welds **34** causes the side pocket **32** to warp thereby requiring that the interior **36** be finished after the housing **32** was welded by inserting tools through the end connection **12** of the mandrel. Such finishing operations were difficult to perform in order to provide the desirable sealing surface with the valve inserted therein.

Referring now to FIG. **3**, the preferred embodiment of the mandrel of the present invention is provided in which the total area in the bore **18** is reduced as compared with the bore **17** of the prior art thereby limiting the internal forces in the interior of the mandrel **10** acting against the body **20**. However, the bore **18** is still open to provide a full opening in alignment with the well tubing to permit the passage of well tools upwardly and downwardly through the mandrel **10**. Thus, the dotted outline **40** indicates the full opening bore. The valve pocket housing **22** is welded to the mandrel body **20** by the axially extending weld seams **42**. In order to reduce the forces acting on the welds **42**, welds **42** are laterally offset from the axis **44** of the bore **18** of the body **20** towards the valve pocket **24** a distance no greater than the radius of the bore **18**. Thus, even with the same internal pressure, the total force acting against the welds **42** is less than the total force acting against the welds **34** of the prior art shown in FIG. **2**. In addition, the internal portion **46** of the valve pocket housing **22** which is adjacent the bore **18** extends substantially around the circumference of the circular bore **18** to where the housing **22** is welded to the wall of the body **20** thereby reducing the area in the mandrel **10** to the most efficient geometric shape, that is, a circle, for withstanding internal pressures.

In addition, the mass of the material in the valve pocket housing **22** about the valve pocket **24** is made sufficiently great to prevent wraping of the valve housing **22** and pocket **24** when the housing **22** is welded to the body **20** by the welds **44**. This allows complete machining of the housing **22** before welding to the body **20** and before any heat treating operations. Thus, the valve pocket **24** may be finished to very close tolerances and to a fine finish which insures a better seal with the packing seal of the valve (not shown) to be inserted in the side pocket **24**. This cannot be accurately accomplished in the prior art mandrel of FIG. **2** since the housing **32** warps when welded to the body **30** by the welds **34** and therefore the finishing must be completed after welding and through the ends of the mandrel body **30**.

It is to be noted that the housing **22** and the body **20** include axially extending mating surfaces **48** and **50**. These mating surfaces align the housing **24** and body **20** relative to each other for welding.

The valve pocket housing **22** is externally shaped at its outer surface **52** to conform to the external shape of the body **20**. Thus, the welds **42** which are axially extending seams and the transverse welds **54** (FIG. **1**) may be made by the use of automatic welding machines in the assembly whereby more uniformly controlled well beads are achieved. Also, since the outside diameter and exterior surface of the valve pocket housing **24** conforms to the outside diameter and configuration of the body **20** grinding and finishing operations are reduced and a smooth continuous surface is presented thereby allowing the mandrel **10** to be freely moved through a well bore with less likelihood of being struck.

Referring again to FIG. **1**, it is noted that the valve latching clamp **25** of the present invention is made integrally with the valve pocket housing **24** thereby insuring that the clamp **25** is correctly positioned relative to the valve pocket **24** so that the valve inserted in the valve seat will be correctly locked therein.

Of course, other modifications may be made such as the modification shown in FIG. **4** wherein like parts are similarly marked corresponding to those parts of FIGS. **1** and **3** with the addition of the suffix "a". In this modification, the axially extending well seams **42***a* are diametrically opposed to each other adjacent the outer circumference of the bore **18***a* and the mass of material in the housing **22***a* is still greater than that shown in FIG. **3**, all of which contributes to provide a mandrel capable of withstanding still greater pressures.

In manufacture, the mandrel body **30** is made as is conventional and a window cut therein for insertion and welding of the valve pocket housing **22**. The housing **22** is integrally forged or machined and contains both the valve pocket **24** and the valve latching clamp **25**. The housing **22** is then completely machined by finishing the pocket **24** to close tolerances and the desired finish since the welding operation will not warp the housing **22**. Thereafter, the finished housing **22** is put in place against the body **20** with the coacting mating surfaces **48** and **50** acting to accurately align the housing **22** and body **20**. The housing **22** may then be welded along the weld seams **42** and **54** by an automatic welding machine to obtain a uniformly controlled well bead. The mandrel **10** may then be treated or further finished without requiring any further finishing of the valve housing **22**. A mandrel **10** of the cross-sectional shape shown in FIG. **3** has been successfully tested to withstand internal pressures of 15,000 p.s.i.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as others inherent therein.

What is claimed is:

1. In a mandrel for use in a well tubing in which the mandrel body has an open bore for alignment with the well tubing and includes a valve pocket housing having an internal tubular valve pocket and in which the outer surface of the valve pocket housing remote from the bore is positioned to form a portion of the body exterior and the outer surface of the valve housing nearest to the bore axis defines a portion of the circumference of the bore wherein the improvement comprises,

the bore being substantially circular in cross section and the valve pocket housing being welded to the mandrel body by axially extending seams laterally offset from the axis of the bore of the body towards the valve pocket a distance no greater than the radius of the bore,

the mass of the material in the valve pocket housing about the valve pocket being sufficient to prevent warping of the valve pocket when the housing is welded to the body,

said valve pocket housing being externally shaped to conform to the external shape of the body, and the portion of the valve pocket housing adjacent the bore extending substantially around the circumference of the bore to where the housing is joined to the wall of the body,

said valve pocket housing including a valve latching clamp integrally formed therewith prior to welding the housing to the body, and

said housing and the body including axially extending mating surfaces for aligning the housing and body for welding.

2. In a mandrel for use in a well tubing in which the mandrel body has an open bore for alignment with the well tubing and includes a valve pocket housing having an internal tubular valve pocket and in which the outer surface of the valve pocket housing is remote from the bore and is positioned to form a portion of the body exterior and the outer surface of the valve housing nearest to the bore axis defines a portion of the circumference of the bore wherein the improvement comprises,

said bore being substantially circular in cross section and the valve pocket housing being welded to the mandrel body by axially extending seams laterally offset from the axis of the bore of the body towards the valve pocket a distance no greater than the radius of the bore,

said valve pocket housing being externally shaped to conform to the external shape of the body,

said valve pocket being finished prior to welding, and

the mass of the material in the valve pocket housing about the valve pocket and between the valve pocket and outer surfaces and said welds being sufficient to prevent warping of the valve pocket when the housing is welded to the body.

3. The apparatus of claim **2** wherein the portion of the valve pocket housing adjacent the bore extends substantially around the circumference of the bore to where the housing is joined to the wall of the body.

4. The apparatus of claim **2** wherein the housing and the body include axially extending mating surfaces for aligning the housing and body for welding.

5. The apparatus of claim **2** wherein the valve pocket housing includes a valve latching clamp integrally formed therewith prior to welding the housing to the body.

6. The apparatus of claim **2** wherein said axially extending seams are positioned at diametrically opposed positions adjacent the outer circumference of the bore and are equally spaced from the axis of the valve pocket.

7. The apparatus of claim **2** wherein the mandrel is oval in cross section.