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(54) Dart launcher for well cementing operations

(57) Modular apparatus for remotely activating a wiper plug launching tool or other down-hole equipment by launching a dart (32) or other projectile along tubing to the subsea equipment. A dart is loaded into a dart sleeve or basket (34) prior to launch and subsequently loaded into a modular tool piece. The pre-loaded tool pieces are configurable prior to use dependent on operational requirement and furthermore may be independently removable from the remaining equipment facilitating maintenance and serving of individual tool pieces.

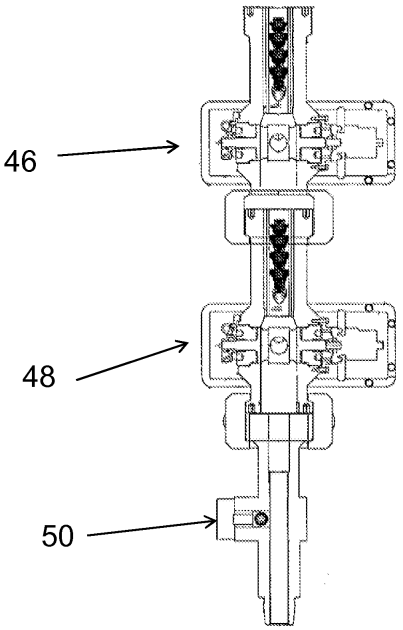

Figure 6

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Description

Technical field

[0001] This invention relates to systems for launching darts in well cementing operations which can be used to activate the launch of wiper plugs downhole to prevent contamination between different fluids during the operation. The invention finds particular application in the cementing of oil and gas wells or the like.

Background art

[0002] In the construction of oil and gas wells, it is occasionally necessary to cement a liner or casing in the well to provide stability and zonal isolation. In such processes, it is common to use plugs to separate different fluids pumped along the tubing or casing. Such plugs are usually installed in a basket located in cementing equipment lowered into the well. The plugs are launched from the basket by means of darts pumped from the surface.

[0003] A known dart launching tool is shown in Figure 1 (see also US 5890537) and comprises a dart launcher 90 including a generally tubular body 91 whose upper end is connected to a lifting sub 92 by which the body is suspended from the elevators of the rig. A swivel housing 93 that is rotatably mounted on the body 91 has several fluid inlets 94 that communicate with the bore of the body via radial ports 95. Upper and lower tubular receivers 96, 97 which temporarily house the darts 100, 101 are mounting in the body 91 above upper and lower rotatable plug valve elements 102, 103, respectively. The darts 100, 101 are each standard devices having several upwardly facing, elastomer swab cups that hold pressure from above. Each valve element 102, 103 has a passageway 104 that is large enough to pass a dart 100, 101 when the passageway is longitudinally aligned with the bore of a receiver. Suitable actuators 107, 108 are provided to selectively rotate the plug valve elements 102, 103.

[0004] The plug valve elements 102, 103 each have kidney-shaped external recesses on opposite sides of the passageways 104 which allow fluids to bypass outside the receivers 96, 97 when the passageways are at right angles to the receivers. This allows fluids to be pumped under pressure into the running string 22 with the darts 100, 101 caged. However when the bypass passages 104 are closed by rotating a valve element until its bore is in alignment with a receiver, pump pressure through inlets 94 forces a dart 100 or 101 out of its receiver, through a valve element and into the running string 22 where it travels down into the well to engage the plug launching tool (not shown).

[0005] One problem with this construction is that it is necessary to form all of the body and valve elements before the darts can be loaded. This makes assembly difficult and occupies rig time since it cannot be done remotely. It can be particularly time consuming to load the darts since the fins must be compressed when they are driven into position.

[0006] The present invention aims to overcome these problems by providing an apparatus in a modular form that can easily be assembled on site. In particular, the darts can be pre-loaded into sleeves for installation into the modules

Disclosure of the invention

[0007] A first aspect of this invention provides a dart launcher for use in well cementing operations, comprising:

- body having a bore which can be arranged to communicate with the well;
- a valve element located in the body and operable to open or close the bore;
- a dart receiver positioned in the body above the valve element for housing a dart that can be launched through the valve element into the well;

wherein
the dart receiver is dimensioned to receive a dart sleeve, into which the dart can be pre-loaded, the sleeve comprising formations on its outer surface which engage in corresponding formations in the inner surface of the receiver to prevent the sleeve from passing through the valve element when the dart is launched.

[0008] Preferably, the body, valve element and dart receiver form a launcher module, the launcher comprising several modules connected together one above the other such that the part of the body through which the dart is launched is connected to the top of the dart receiver of the module below. Each module can also comprise a sleeve loaded with a dart.

[0009] A ball dropper can be positioned below the lowermost module.

[0010] A second aspect of the invention provides a dart sleeve for use in a dart launcher according to the first aspect of the invention, comprising a sleeve for housing a dart in a compressed form, wherein formations are provided on the outer surface of the sleeve which can engage in corresponding formations in the inner surface of the dart receiver to hold the sleeve in place as the dart is launched.

[0011] The dart sleeve preferably further comprises a dart in compressed form housed inside the sleeve.

[0012] A third aspect of the invention provides a dart for use with a dart sleeve according to the second aspect of the invention, comprising an elongate core with a series of flexible fins projecting therefrom, and a head section for engaging a plug launching tool, the head section being connected to the shaft by means of a resilient damping system to reduce the shock of impact in use.

[0013] The resilient damping system typically comprises a spring.

[0014] A fourth aspect of the invention provides a method of providing a dart launching assembly on a well

in a cementing operation, comprising:

- installing a number of darts in compressed form, each in an associated sleeve;
- installing the sleeves in respective dart receivers of dart launchers as according to the first aspect of the invention;
- connecting the dart launchers together in an end to end fashion to form an assembly; and
- connecting the assembly to the tope of the well to be cemented.

[0015] Further aspects of the invention will be apparent from the following description.

Brief description of the drawings

[0016]

Figure 1 shows a prior art dart launching system;
Figure 2 shows a dart launching system according to a first embodiment of the invention;
Figure 3 shows a dart being loaded into a basket for use in the embodiment of Figure 2;
Figure 4 shows a pre-loaded basket;
Figure 5 shows the embodiment of Figure 2 loaded with a pre-loaded dart prior to launch; and
Figure 6 shows a second embodiment of the invention comprising two module corresponding to Figure 5.

Mode(s) for carrying out the invention

[0017] Figure 2 shows a dart launcher according to a first embodiment of the invention. The launcher comprises a body 10 defining a central bore 12 though which a drat can pas and which can be placed in communication with a well to be cemented. A valve section 14 is positioned part way down the body 10 and comprises a rotary valve element 16 with a bore 18, and an actuator 20. The valve element 16 can be rotated between an open position in which the bore 18 is aligned with the central bore 12 to provide a through passage, and a closed position in which the bore is at right angles to the central bore 12.

[0018] The upper part 24 of the body 10 is formed with slots 26 (only one shown) for anchoring a dart sleeve or basket as will be described below.

[0019] Upper and lower connections 28, 30 are provided on the body, allowing it to be connected to another such body, to a ball dropper module (described below) or to a drill pipe (not shown) for communication with the well.

[0020] Unlike previous dart launching systems, this invention is characterised by pre-loading the dart into a sleeve or basket. Figure 3 shows the dart 32 and basket 34. The dart 32 comprises a solid core 36 with a series of flexible rubber fins 38. A head portion 40 is provided to engage downhole equipment when the dart is pumped through the well. The head 40 is connected to the core 36 by means of a damping system 42 to minimise impact force when the dart reaches the downhole equipment. The damping system 42 can comprise a spring, a resilient rubber body or the like.

[0021] The basket 34 defines a sleeve that is dimensioned to fit into the upper section 24 of the body 10, lugs 44 being provided around the upper part of the basket for engagement into the slots 26.

[0022] The dart 32 can be forced into the basket 34 by compressing the fins 38 so that the whole dart is held in a compressed state inside the basket as is shown in Figure 4. Thus the basket with the pre-loaded dart can be easily installed in the upper part 24 of the launching system (see Figure 5). This avoids the need to overcome the resistance of the fins 38 when loading the dart into the body 10 as is encountered in previous systems. This arrangement also has the advantage that darts can be pre-loaded into baskets away from the rig site, the pre-loaded baskets being provided at the rig site when the system is assembled. In use, the system operates in a similar way to previous systems: the valve element 16 is rotated to the open position and the dart pumped through the bore by fluid pressure. The engagement of the lugs 44 is the slots 26 prevents the basket 34 from being pumped with the dart. When the dart has been pumped and the system removed, the basket 34 can be retrieved from the body 10 an reloaded with another dart for use again at a later date.

[0023] The embodiment of Figure 5 essentially provides a dart launcher module. Such modules can be connected together easily to provide a system for launching multiple darts. Figure 6 shows one such system.

[0024] Figure 6 shows a system for launching two darts. In this case, first and second modules 46, 48, each essentially comprising a module as shown in Figure 5, are connected together in an end to end arrangement. A ball dropper module is connected below the lower module 48 above the connection to the drill pipe (not shown). In use, the darts can be pumped sequentially in the usual manner and the ball dropped at the end of the operation. Once the operation is complete, the various modules can be removed from the rig site disassembled, reconditioned and reassembled. Thus the amount of rig time needed for system assembly can be reduced.

[0025] Further changes can be made within the scope of the invention. For example, the number of modules connected can be varied to meet requirements. Also the type and size of darts can be selected accordingly.

Claims

1. A dart launcher for use in well cementing operations, comprising:

- body having a bore which can be arranged to communicate with the well;

- a valve element located in the body and operable to open or close the bore;
- a dart receiver positioned in the body above the valve element for housing a dart that can be launched through the valve element into the well;

wherein
the dart receiver is dimensioned to receive a dart sleeve, into which the dart can be pre-loaded, the sleeve comprising formations on its outer surface which engage in corresponding formations in the inner surface of the receiver to prevent the sleeve from passing through the valve element when the dart is launched.

2. A dart launcher as claimed in claim 1, wherein the body, valve element and dart receiver form a launcher module, the launcher comprising several modules connected together one above the other such that the part of the body through which the dart is launched is connected to the top of the dart receiver of the module below.

3. A dart launcher as claimed in claim 2, wherein each module also comprises a sleeve loaded with a dart.

4. A dart launcher as claimed in claim 2 or 3, further comprising a ball dropper positioned below the lowermost module.

5. A dart sleeve for use in a dart launcher as claimed in any of claims 1-4, comprising a sleeve for housing a dart in a compressed form, wherein formations are provided on the outer surface of the sleeve which can engage in corresponding formations in the inner surface of the dart receiver to hold the sleeve in place as the dart is launched.

6. A dart sleeve as claimed in claim 5, further comprising a dart in compressed form housed inside the sleeve.

7. A dart for use with a dart sleeve as claimed in claim 5 or 6, comprising an elongate core with a series of flexible fins projecting therefrom, and a head section for engaging a plug launching tool, the head section being connected to the shaft by means of a resilient damping system to reduce the shock of impact in use.

8. A dart as claimed in claim 7, wherein the resilient damping system comprises a spring.

9. A method of providing a dart launching assembly on a well in a cementing operation, comprising:

- installing a number of darts in compressed form, each in an associated sleeve;
- installing the sleeves in respective dart receivers of dart launchers as claimed in claim 1;
- connecting the dart launchers together in an end to end fashion to form an assembly; and
- connecting the assembly to the tope of the well to be cemented.

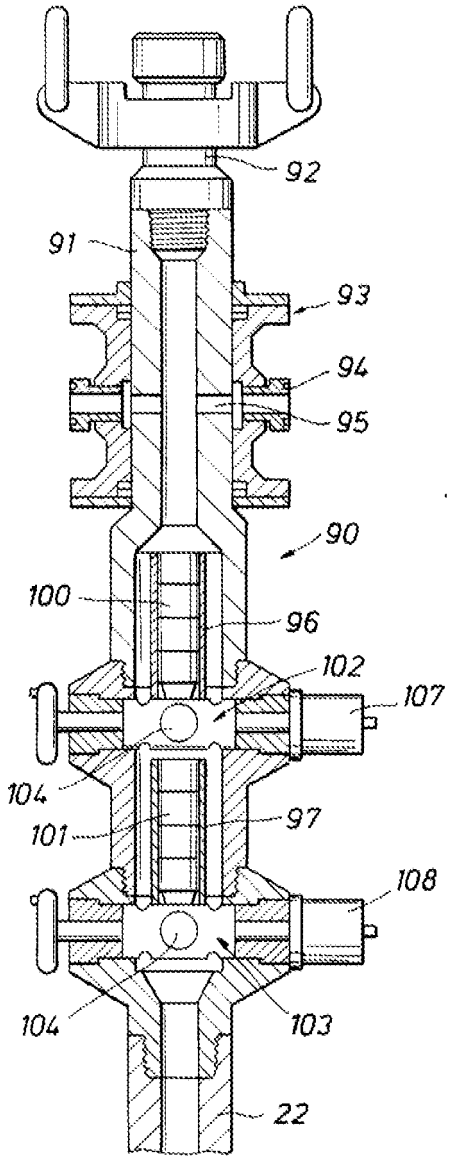

Figure 1

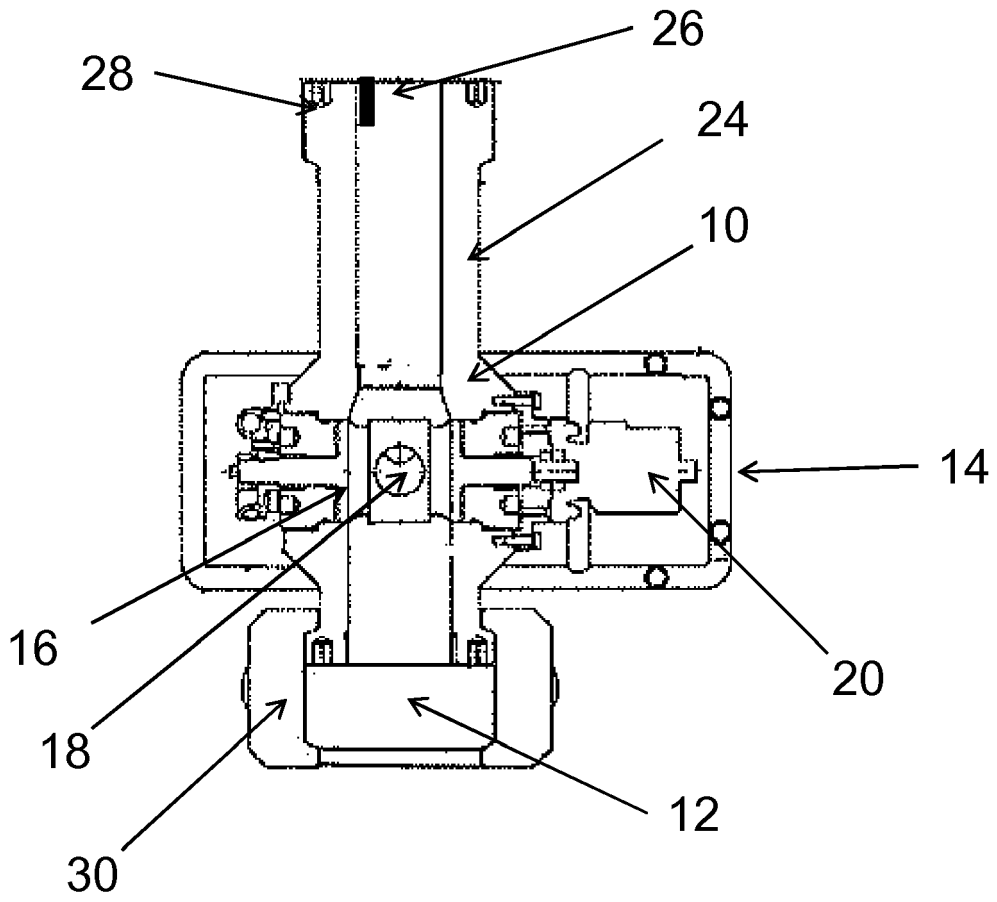

Figure 2

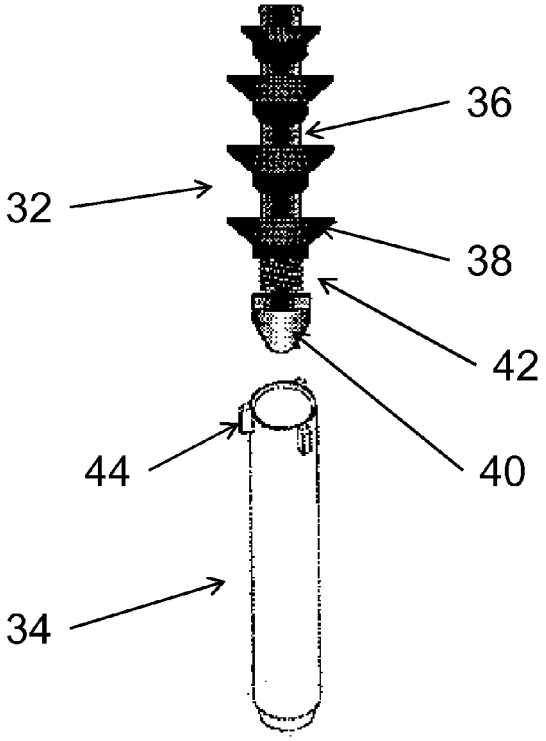

Figure 3

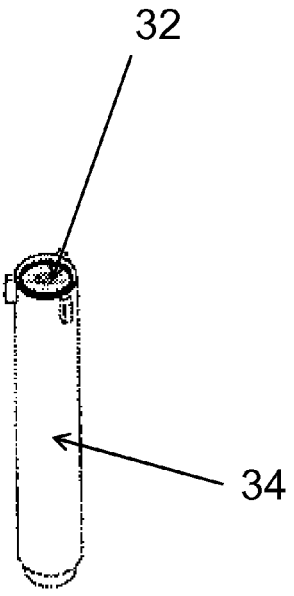

Figure 4

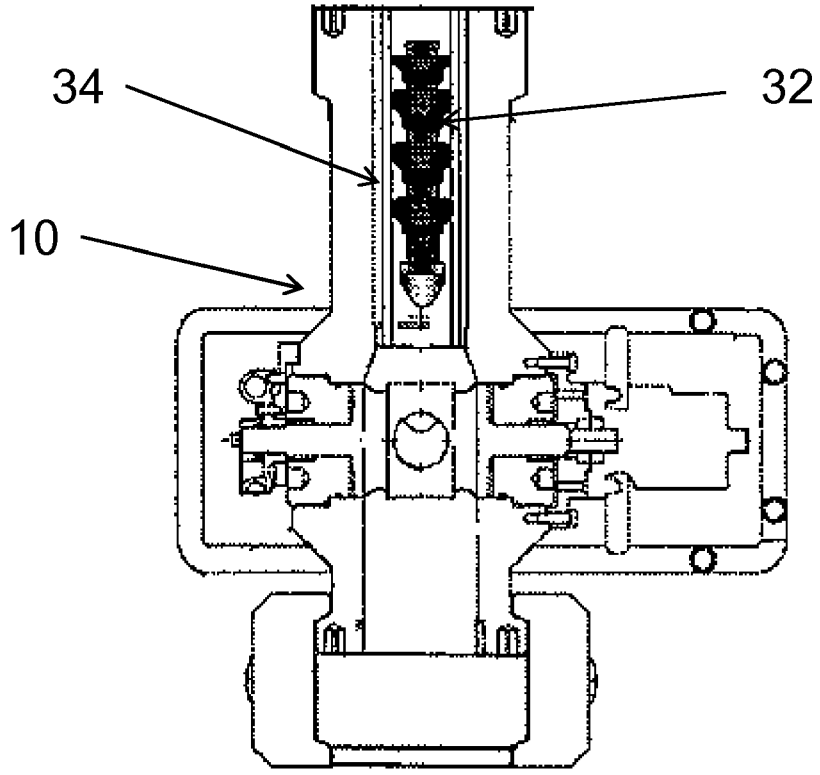

Figure 5

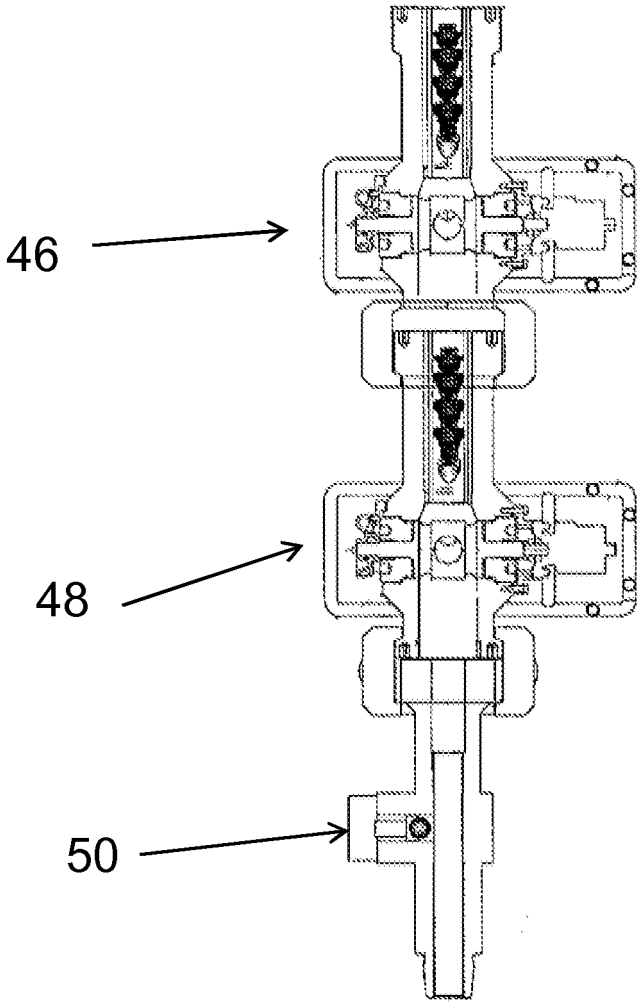

Figure 6

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EUROPEAN SEARCH REPORT

Application Number
EP 08 17 2646

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 May 2009	van Berlo, André

CATEGORY OF CITED DOCUMENTS

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