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(54) **Submarine wellhead anchor**

Anker für Unterwasser-Bohrlochkopf

Ancrage des têtes de puits sous-marines

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Description

[0001] The invention relates to an anchorage for a tubular line, such as a flowline or control umbilical, at a wellhead, such as to a spool or tree valve block of a wellhead.

[0002] Conventionally, such anchorages have been completed with diver assistance. The obvious dangers and operational complications of diver assistance, combined with increasing water depth at completion sites, have necessitated the development of diverless completion operations in the offshore oil and gas industry.

[0003] Previous diverless line connections have involved the use of expensive, complicated and time consuming, remotely activated pull-in and connection tool packages. In a typical example of such prior diverless connection, a pull-in tool, incorporating a sheave-carrying guide frame, is lowered to the guide base and is used to pull a head on the line into a guide sleeve, in which it is clamped. The pull-in tool shears the pull-in cable, and is then replaced by a connection tool which removes a pull-in nose on the line head, and a cap on a christmas tree hub, and advances the guide sleeve so that the line head is brought into sealing engagement with the hub and latched into engagement with the hub. The connection tool is then retracted to the surface.

[0004] US-A-3442540 discloses a submarine wellhead anchorage for a flexible tubular line comprising a head, which is, in use, attached to the end of the line, and a clamp, which is, in use, mounted at the wellhead; the clamp comprising a pair of jaws which are pulled together by tension studs to grip the head between them.

[0005] According to the present invention, such an anchorage is characterised in that each stud is surrounded by a sleeve which defines a pressure chamber effectively interposed between the two jaws; and by means for supplying hydraulic pressure to the pressure chambers whereby the jaws are parted and the studs are stretched elastically to allow insertion of the head between the jaws.

[0006] Although the line head may be inserted in the clamp with diver assistance, the system is particularly suitable for diverless operation. In that event the line head will normally be inserted into the clamp by being drawn in by means of a pull-in cable attached to a nose at the leading end of the head. The pull-in cable may pass around a sheave which forms a permanent component of the tree or other wellhead part, for tensioning by a ROV or from the surface. It follows that the line head will be drawn in and clamped in its final anchored position in a single movement with the minimum of parts.

[0007] Although hydraulic pressure may be applied to the pressure chambers when the clamp is to be opened to receive or release the line head, the tree or other wellhead part at which the clamp is mounted is preferably arranged to be run in with the pressure chambers pressurized so that the jaws are already parted to receive the line head. After the head has been pulled in, the

pressure would be released, for example by opening a ROV accessible needle or other valve, to release the pressure and hence impart the energy stored in the studs to grip the head in the clamp.

[0008] In order to improve the security of the line head in the clamp, one of the jaws preferably houses a locking key which is urged into engagement with the head to prevent withdrawal of the head from the clamp, the key being retractable by a piston which is responsive to the hydraulic pressure applied to the pressure chambers. If the tree or other wellhead part is run in with the hydraulic pressure applied, release of the pressure will not only allow the studs to contract elastically to close the clamp, but also depressurize the piston so that the locking key is moveable into engagement with the head, under, for example, spring action.

[0009] The securing of the line head in the clamp will normally be arranged automatically to complete a connection between the interior of the line and the wellhead part. In the case of a control line the connection might be by creation of at least one electrical connection and/or at least one hydraulic connection. However, in the case of a flowline anchorage, the head will incorporate a passage, one end of which in use is connected to the interior of the line, and the other end which terminates in a port aligned with a second port in one of the clamp jaws when the head is inserted into the clamp. The second port will then be in communication with a production fluid conduit from the well and will thus be immediately connected to the outlet flowline. In that case it will normally be desirable for the one jaw to be provided with an annular seal around the second port for engagement with, and sealing against, the head.

[0010] An example of a wellhead incorporating a flowline anchorage in accordance with the present invention is illustrated in the accompanying drawings, in which:-

Fig. 1 is a diagrammatic side elevation;
Fig. 2 is a diagrammatic side elevation taken at 90° from the view of Fig. 1;
Fig. 3 is schematic view as seen on the line A - A in Fig. 1 and to a larger scale and showing more detail; and,
Fig. 4 is a schematic hydraulic circuit diagram.

[0011] As shown in Figures 1 and 2, the wellhead is a typical mudline wellhead incorporating a guide base 5 with guide posts 6, and concentric casings 8, completed by a tree assembly including guide sleeves 7, a production bore 9, and a valve block 10. As illustrated the tree is a so-called spool tree, although the principles of the invention are equally applicable to conventional sub-sea christmas tree arrangements.

[0012] A flowline 11 for the outflow of production fluid, is connected via a swivel assembly 12 to an adaptor 13, which is secured by bolts 14, to a head 15. As shown in Figure 3, the interior of the flowline 11 communicates with an axial bore 16 in the head 15, the bore 16 com-

municating via transverse bore 17 with a port 18. A nose 19 at the leading end of the head is provided with an aperture 20 for connection of a pull-in cable 21, which is reeved around a sheave 22 connected to the tree.

[0013] A clamp for anchoring the head 15 is provided at the tree by means of two jaws, an upper one consisting of the lower part 23 of the valve block 10, and the lower one by a lower bed plate 24. The valve block 10 has a pair of horizontally extending lateral flanges 25. A row of four studs 26 extend through apertures in each respective flange 25, with the heads of the studs engaging the upper surface of the flange, the lower ends of the studs screwing into respective tapped holes in the bed plate 24. Around each stud is disposed with a clearance a respective sleeve 27 the upper end of each of which is screwed into the aperture through the respective flange 25 and the lower end of which is sealed to but axially slidable relatively to a machined pocket 28 in the bed plate 24.

[0014] The bed plate 24 is also provided with a square-shaped recess 29 containing a serrated key plate 30 fixed to a piston 31. Four compression springs 32, one in each corner of the recess, urge the plate 30 upwardly but the action of the springs may be overcome by the application of fluid pressure to a cylinder space 33 above the working part of the piston which slides in and is sealed to a cylinder 34.

[0015] A closed hydraulic circuit 35, shown schematically in Figure 4, interconnects the pressure chambers within the sleeves 27 with the chamber 33 within the cylinder 34, the circuit having a needle valve 36, separating the circuit from a marine outlet 37.

[0016] In use, during well completion, the hydraulic circuit 35 is pressurized so that the studs 26 are expanded elastically and the locking plate 29 is retracted within the bed plate 24. At this time the valve 36 is closed. The tree is run in and secured to the wellhead.

[0017] When it is desired to anchor the flowline 11 to the tree assembly, the cable 21 is threaded through the tree and around the sheave 22, by means of a ROV. Tension is applied to the cable 21 so that the head 15 of the flowline 11 is drawn up a ramp 38 and between the jaws 23 and 24 of the clamp, passing between the two rows of studs until advance of the head is arrested by an abutment 39 on the bed plate 24. At this time the port 18 is aligned with a downwardly facing outflow port 40 in the lower surface of the valve block 23. The two ports are brought closely together by virtue of the opposed faces of the jaws and the complementary faces of the head 15 converging in the direction of insertion of the head into the clamp. In the illustrated example this is achieved by a 4° taper on the upper surface of the bed plate 24 and on the lower surface of the head 15. The valve 34 is then opened, releasing the pressure within the sleeves 27 and cylinder space 33 so that the studs 26 contract elastically, whilst remaining under tension, to draw the jaws together and firmly grip the head 15 between them. The seal between the ports 18 and

40 is secured not only by this clamping pressure, but also by the provision of a metal V-seal 41 located in an annular groove 42 extending in the base of the valve block 23 around the port 40. The release of the hydraulic pressure also frees the locking plate 30 to move upwards under the action of the spring 32, so that its serrated face comes into engagement with a complementarily serrated undersurface of the head 15, thereby positively locking the head within the clamp against reverse withdrawal.

[0018] The port 40 is at the end of a passage 43 leading through the valve block 10 to the production bore 9. Valving may now be actuated to connect the production bore to the flowline 11.

Claims

1. A submarine wellhead anchorage for a flexible tubular line comprising a head (15), which is, in use, attached to the end of the line (11), and a clamp, which is, in use, mounted at the wellhead; the clamp comprising a pair of jaws (23,24) which are pulled together by tension studs (26) to grip the head between them; characterised in that each stud is surrounded by a sleeve (27) which defines a pressure chamber effectively interposed between the two jaws; and by means (35) for supplying hydraulic pressure to the pressure chambers whereby the jaws are parted and the studs are stretched elastically to allow insertion of the head between the jaws.
2. An anchorage according to claim 1, in which one of the jaws (24) houses a locking key (30) which is urged into engagement with the head (15) to prevent withdrawal of the head from the clamp, the key being retractable by a piston (31) which is responsive to the hydraulic pressure applied to the pressure chambers.
3. An anchorage according to claim 1 or claim 2, in which the head incorporates a passage (16,17), one end of which in use is connected to the interior of the line, and the other end of which terminates in a port (18) aligned with a second port (40) in one of the clamp jaws (23) when the head is inserted into the clamp.
4. An anchorage according to claim 3, in which the one jaw (23) is provided with an annular seal (41) around the second port for engagement with, and sealing against, the head (15).
5. An anchorage according to any one of the preceding claims, in which the studs (26) are arranged in two rows, one on each side of the head.

6. An anchorage according to any one of the preceding claims, in which the opposed faces of the jaws (23,24) and the complementary faces of the head (15) converge in the direction of the insertion of the head into the clamp.
7. An anchorage according to any one of the preceding claims, in which a nose (19) at the leading end of the head is provided with means (20) for connecting a pull-in cable (21).
8. An anchorage according to any one of the preceding claims, wherein each sleeve (27) is screwed at one end to one of the jaws (25) and is slidable at its other end in, and sealed to, a pocket (28) in the other jaw.

Patentansprüche

1. Verankerung für einen Unterwasser-Bohrlochkopf für einen flexiblen Rohrstrang, umfassend einen Kopf (15), welcher in Gebrauchsstellung am Ende einer Leitung (11) befestigt ist, und eine Klemmeinrichtung besitzt, welche in Gebrauchsstellung mit dem Bohrlochkopf verbunden ist; wobei die Klemmeinrichtung ein Paar von Klemmbacken (23, 24) umfaßt, welche durch Spannbolzen (26) zusammengezogen werden, um den Kopf zwischen diesen einzuspannen, **dadurch gekennzeichnet, daß** jeder Bolzen von einer Buchse (27) umgeben ist, welche eine Druckkammer bildet, die zwischen den beiden Klemmbacken funktionell zwischengeschaltet ist; sowie eine Einrichtung (35) zur Zuführung von hydraulischem Druck in die Druckkammern, wodurch die Klemmbacken auseinandergedrückt und die Bolzen elastisch gedehnt werden, um das Einfügen des Kopfes zwischen den Klemmbacken zu ermöglichen.
2. Verankerung nach Anspruch 1, **dadurch gekennzeichnet, daß** eine der Klemmbacken (24) einen Verriegelungskeil (30) aufweist, welcher in Eingriff mit dem Kopf (15) gedrückt wird, um ein Herausziehen des Kopfes aus der Klemmeinrichtung zu verhindern, wobei der Keil durch einen Kolben (31) zurückziehbar ist, welcher auf den hydraulischen Druck anspricht, der auf die Druckkammern ausgeübt wird.
3. Verankerung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** der Kopf einen Durchgang (16, 17) aufweist, dessen eines Ende in Funktion mit dem Inneren der Leitung verbunden ist, und dessen anderes Ende an einer Öffnung (18) endet, die mit einer zweiten Öffnung (40) in einer der Klemmbacken (23) ausgerichtet ist, wenn der Kopf in die Klemmbacken eingefügt ist.

4. Verankerung nach Anspruch 3, **dadurch gekennzeichnet, daß** eine der Klemmbacken (23) mit einer ringförmigen Dichtung (41) um die zweite Öffnung, zwecks Zusammenwirken mit dem Kopf (15) und Abdichtung zu diesem, versehen ist.
5. Verankerung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die Bolzen (26) in zwei Reihen, eine Reihe auf jeder Seite des Kopfes, angeordnet sind.
6. Verankerung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die sich gegenüberliegenden Stirnseiten der Klemmbacken (23, 24) und die komplementären Stirnseiten des Kopfes (15) in Einfügerichtung des Kopfes in die Klemmbacken konvergieren.
7. Verankerung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** eine Nase (19) am Führungsende des Kopfes mit einer Einrichtung (20) zum Anschluß eines Einzugskabels (21) vorgesehen ist.
8. Verankerung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** jede Buchse (27) an einem Ende mit einer der Klemmbacken (25) verschraubt ist, und an ihrem anderen Ende in einer Sackbohrung in der anderen Klemmbacke verschieblich angeordnet und gegenüber dieser abgedichtet ist.

Revendications

1. Ancrage de tête de puits sous-marine pour une conduite tubulaire flexible comprenant une tête (15) qui est, en service, fixée à l'extrémité de la conduite (11), et un dispositif de serrage, qui est, en service, monté sur la tête de puits ; le dispositif de serrage comprenant une paire de mâchoires (23, 24) qui sont tirées ensemble par des vis de tension (26) pour saisir la tête entre elles ; caractérisé par le fait que chaque vis est entourée par un manchon (27) qui définit une chambre de pression effectivement intercalée entre les deux mâchoires ; et par des moyens (35) pour appliquer une pression hydraulique aux chambres de pression, grâce à quoi les mâchoires sont écartées et les vis étirées élastiquement pour permettre l'insertion de la tête entre les mâchoires.
2. Ancrage selon la revendication 1, dans lequel l'une des mâchoires (24) abrite une clavette de verrouillage (30) qui est poussée en prise avec la tête (15) pour empêcher le retrait de la tête du dispositif de serrage, la clavette pouvant être rétractée par un piston (31) qui répond à la pression hydraulique

appliquée aux chambres de pression.

3. Ancrage selon la revendication 1 ou la revendication 2, dans lequel la tête comprend un passage (16, 17), dont une extrémité est raccordée, en service, à l'intérieur de la conduite, et dont l'autre extrémité se termine dans un orifice (18) aligné avec un second orifice (40) dans une des mâchoires de serrage (23) lorsque la tête est insérée dans le dispositif de serrage. 5 10
4. Ancrage selon la revendication 3, dans lequel la première mâchoire (23) est pourvue d'un joint annulaire (41) autour du second orifice pour venir en contact et faire étanchéité avec la tête (15). 15
5. Ancrage selon l'une quelconque des revendications précédentes, dans lequel les vis (26) sont agencées en deux rangées, une de chaque côté de la tête. 20
6. Ancrage selon l'une quelconque des revendications précédentes, dans lequel les faces opposées des mâchoires (23, 24) et les faces complémentaires de la tête (15) convergent en direction de l'insertion de la tête dans le dispositif de serrage. 25
7. Ancrage selon l'une quelconque des revendications précédentes, dans lequel un nez (19) à l'extrémité avant de la tête est muni de moyens (20) pour raccorder un câble de remontée (21). 30
8. Ancrage selon l'une quelconque des revendications précédentes, dans lequel chaque manchon (27) est vissé sur une extrémité à l'une des mâchoires (25) et peut coulisser à son autre extrémité dans, et fait étanchéité avec, une poche (28) dans l'autre mâchoire. 35

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Fig.1.

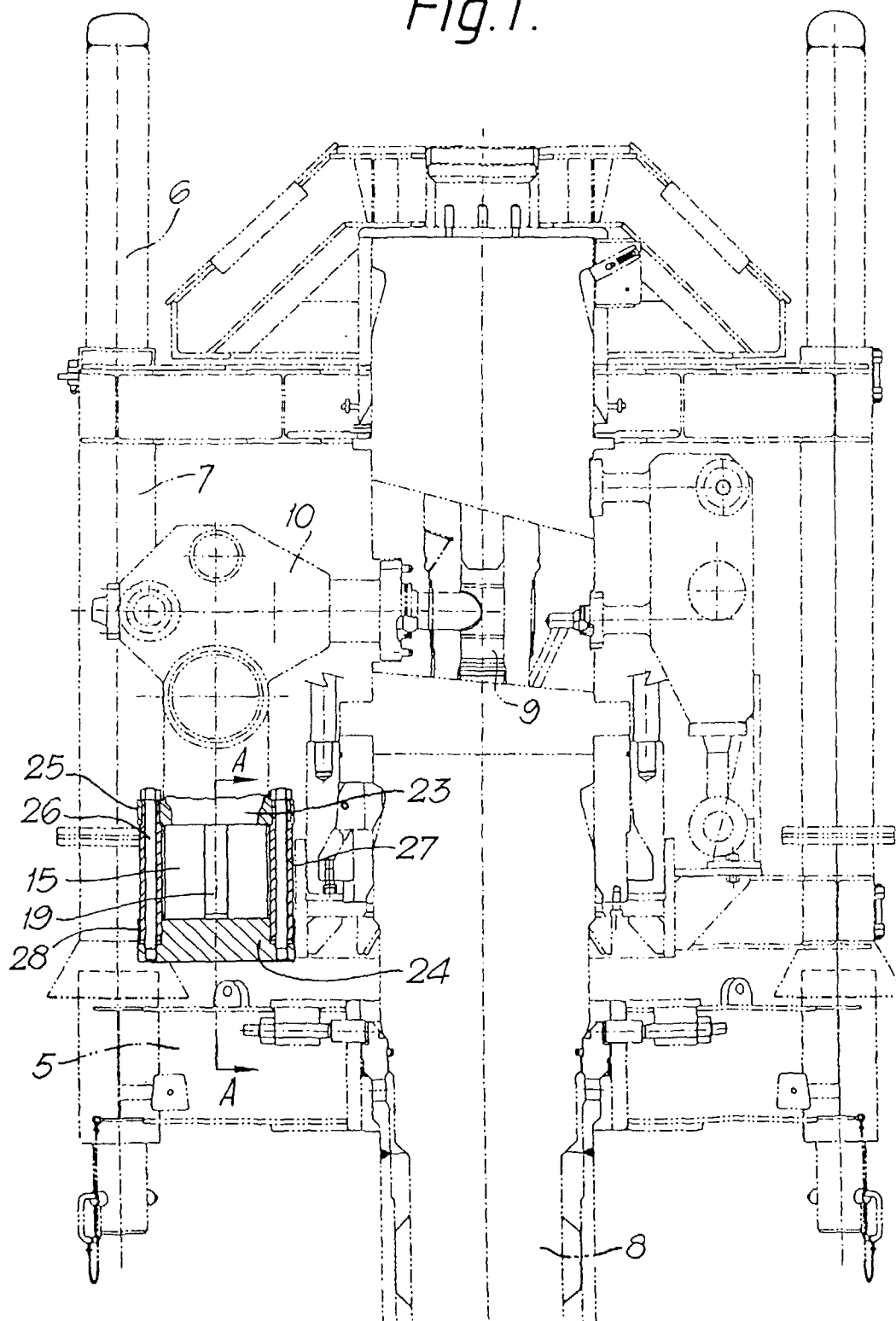


Fig. 2.

