

1 Improved Nozzle

2

3 The present invention relates to a nozzle. In particular,
4 but not exclusively, the present invention relates to a
5 nozzle for use with a pressurised water source as
6 typically used in the offshore environment.

7

8 During well completion, a surface well test package is
9 used to evaluate well reservoir parameters and
10 hydrocarbon properties. The evaluation of hydrocarbon
11 properties requires the flow of a hydrocarbon fluid to
12 the well test package from the well. Once the test has
13 been made it is necessary to dispose of the hydrocarbon
14 fluid. This is done by igniting the hydrocarbon fluid
15 and flaring it from drilling rig, Floating Production
16 Storage and Offloading vessels (FPSOs), Drillships,
17 platforms and land rig burner booms. The flaring
18 operation can cause temperatures to reach levels where
19 the intense heat can compromise the integrity of the
20 structure and rig safety equipment such as lifeboats,
21 lifecrafts etc and create a hazardous working environment
22 for personnel. One way of reducing the temperature
23 around the flaring hydrocarbons is to form a water wall

1 around the flare, known as a rig cooling system and/or
2 heat suppression and/or deluge system.

3
4 Systems of this type provide an outer wall of water
5 designed to surround the flare which mimics the flare
6 profile and/or shields the flare. The outer wall of
7 water can take the form of a solid flat or conical shield
8 or curtain and a central source which has a secondary
9 function of generating a very fine mist of water through
10 the central outlet of the dual nozzle design. The fine
11 mist of water is designed to remove energy from the
12 flare, and the outer wall of water is designed to create
13 a barrier which also removes energy and therefore
14 temperature from the flare.

15
16 In order to produce and shape a jet of water, it is
17 necessary to connect a nozzle to a high-pressure water
18 source and to engineer the nozzle such that an outer
19 (typically cone-shaped) wall of water is formed in
20 conjunction with a fine mist of water directed behind the
21 flare.

22
23 An example of this type of nozzle is provided in UK
24 Patent No. GB2299281. This document discloses a nozzle
25 attachable to a high-pressure water source in which a
26 narrow opening is positioned between a deflecting surface
27 which opposes the direction of flow of water, and a
28 guiding surface angled towards the direction of flow of
29 the water and which defines the shape of the outer wall
30 of water that is produced by this nozzle. It has been
31 found that the combined action of the deflecting surface
32 and guiding surface disrupts the water flow and causes
33 energy to be dissipated thus lowering the water pressure.

1 It is an object of the present invention to provide an
2 improved nozzle.

3

4 In accordance with a first aspect of the present
5 invention, there is provided a nozzle for a hose or fixed
6 pipework installation, the nozzle comprising:
7 a body;
8 a channel extending through the body of the nozzle; and
9 a fluid deflector arranged at or near the downstream end
10 of the channel, and wherein the fluid deflector
11 determines the direction of flow of the fluid as it
12 leaves the nozzle.

13

14 Fluid flowing along the channel may impinge upon the
15 fluid deflector and may travel along a surface of the
16 deflector and out of the nozzle, the direction of flow of
17 the fluid as it leaves the nozzle thereby determined by
18 the deflector. By this arrangement, the fluid deflector
19 may serve to direct the fluid whilst minimising energy
20 loss when compared to prior nozzles of the type where the
21 fluid is thrown backwards onto a second directing surface
22 which directs the fluid out of the nozzle.

23

24 The fluid deflector may be located in a fluid flow path
25 extending through the nozzle along the channel.

26

27 Preferably, the fluid deflector and the body of the
28 nozzle together define a width of the channel at or near
29 said downstream end. The fluid deflector may have a
30 deflecting surface positioned relative to the end of the
31 channel to define the width of the channel at or near the
32 downstream end of the channel. Accordingly, at least
33 part of the channel may be defined between the deflecting

1 surface and an outlet surface of the body. The deflecting
2 surface and the body outlet surface may be substantially
3 parallel.

4
5 The deflector surface may be disposed at an obtuse angle
6 relative to a main axis of the body and is preferably
7 angled away from the body.

8
9 More preferably, said channel width is variable. This
10 may facilitate adjustment of a characteristic and/or
11 parameter of the fluid exiting the nozzle, including
12 velocity, fluid pressure, and/or the shape of a jet,
13 stream or cloud of fluid exiting the nozzle. The channel
14 width may be variable by adjusting a position of the
15 fluid deflector relative to a remainder of the nozzle, in
16 particular, relative to the nozzle body.

17
18 The fluid deflector may be movably mounted relative to
19 the body, to enable adjustment of a position of the
20 deflector relative to the body. This may facilitate
21 adjustment of the channel width.

22
23 Preferably, the channel is provided with a gap or space
24 suitable for accommodating a spacer to alter the position
25 of the fluid deflector relative to the end of the
26 channel, thereby varying the width of said channel.

27
28 Alternatively, the deflector may be threadably coupled to
29 the body, such that rotation of the deflector relative to
30 the body may advance and / or retract the deflector
31 relative to the body, thereby facilitating adjustment of
32 the channel width. The nozzle may include a retaining
33 member, such as a nut, clip or the like, for retaining

1 the deflector in a desired position relative to the body,
2 to fix the channel width.

3
4 The nozzle may comprise a mechanism for adjusting the
5 channel width, which may be a self-cleaning mechanism.
6 The mechanism may be hydraulic, electrical, electro-
7 mechanical or mechanical, and may comprise an actuator
8 for controlling a position of the deflector relative to
9 the body, for adjustment of the channel width. The
10 actuator may be adapted to be activated to move the
11 deflector to increase the channel width, in order to
12 facilitate flow of any debris such as particulate matter
13 trapped in the nozzle and impeding fluid flow. The
14 mechanism may comprise one or more sensors for detecting
15 the presence of trapped debris. For example, the nozzle
16 may include a pressure sensor or flowmeter for detecting
17 an increase in pressure or reduction in fluid flow rate
18 through the channel indicative of the presence of trapped
19 debris impeding fluid flow.

20
21 Preferably, the fluid deflector comprises the deflecting
22 surface and a central beam, shaft, boss or the like
23 extending from the deflecting surface into the body of
24 the nozzle, the central beam being attachable to the body
25 of the nozzle.

26
27 Preferably, the nozzle is further provided with pressure
28 sensing means.

29
30 Preferably, the channel extending through the body of the
31 nozzle is an annular channel, but may be of any
32 alternative, suitable shape.

33

1 Preferably, the nozzle further comprises a central
2 channel extending through the body of the nozzle.

3
4 Preferably, the central channel extends through the
5 central beam of the deflector.

6
7 The pressure sensing means may be located in the fluid
8 deflector.

9
10 Optionally, the pressure sensing means is located in the
11 body of the nozzle.

12
13 Preferably, the fluid deflector means further comprises
14 filter coupling means for coupling a filter to the
15 upstream end of the central channel.

16
17 Preferably, the fluid deflector means further comprises
18 nozzle-coupling means for coupling a nozzle to the
19 downstream end of the central channel.

20
21 More preferably, said nozzle coupling means is
22 connectable to a nozzle for producing a fine spray of
23 fluid.

24
25 Preferably, the fluid deflector means is frusto-conical
26 and is thus provided with a frusto-conical deflecting
27 surface, angled away from the direction of fluid flow.
28 Alternatively, the deflecting surface may be any other
29 suitable shape and the deflector may be frusto-conical
30 with an arcuate deflecting surface, in cross-section.

31

1 More preferably, the frusto-conical deflecting surface
2 extends beyond the maximum width of the channel to direct
3 the flow of fluid.

4

5 Preferably, the nozzle is generally cylindrical in shape.

6

7 Preferably, the nozzle is further provided with sensor
8 means attached thereto.

9

10 More preferably, the sensor means are attached to the
11 fluid deflector means.

12

13 More preferably, the sensor means are embedded in a front
14 surface of the fluid deflector means.

15

16 The sensor means can be temperature sensors, gas sensors,
17 or other suitable sensors and may be hardwired through
18 the nozzle to provide information on the temperature, gas
19 composition pressure or other information.

20

21 The nozzle may be constructed in a single piece.

22

23 It will be understood that the nozzle may be suitable for
24 use with a wide range of diameters of hoses or pipes of a
25 pipework installation, and may therefore be dimensioned
26 accordingly. However, embodiments of the invention may
27 be particularly suited for use with hoses/pipes having
28 diameters in the range of 1½" to 2" (approximately 38mm
29 to 51mm), whilst other embodiments may be particularly
30 suited for use with hoses/pipes having diameters of
31 around 6" (approximately 152 mm) or more.

32

1 In accordance with a second aspect of the invention there
2 is provided a kit of parts for a nozzle in accordance
3 with the first aspect of the invention, the kit of parts
4 comprising a body and a fluid deflector.

5

6 Preferably, the kit of parts further comprises a coupling
7 means adapted to connect the deflector to the body.

8

9 Further features of the nozzle are defined in relation to
10 the first aspect of the invention.

11

12 In accordance with a third aspect of the present
13 invention, there is provided a nozzle comprising:
14 a body having a fluid outlet;
15 a fluid flow channel extending through the body, the
16 channel in fluid communication with the body outlet; and
17 a fluid deflector located adjacent the body outlet and
18 positioned such that fluid flowing along the channel
19 impinges on the deflector and is directed out of the
20 nozzle by the deflector, the direction of flow of the
21 fluid exiting the nozzle thereby determined by the
22 deflector.

23

24 Further features of the nozzle are defined in relation to
25 the first aspect of the invention.

26

27 The present invention will now be described by way of
28 example only, with reference to the accompanying
29 drawings, in which:

30

31 Figure 1 is a longitudinal cross-sectional view of a
32 nozzle in accordance with an embodiment of the present
33 invention;

1 Figure 2 is a further, partial cross-sectional view of
2 the nozzle of Figure 1;

3

4 Figure 3 is another sectional view of the nozzle of
5 Figure 1 in which the fluid flow paths are shown;

6

7 Figure 4a shows the deflector of the present invention,
8 Figure 4b shows a coupling ring as used in the present
9 invention and Figure 4c shows a body of the nozzle of the
10 present invention;

11

12 Figure 5 shows a second embodiment of the present
13 invention in which sensors are embedded into the front
14 surface of the deflector means;

15

16 Figure 6 is a longitudinal cross-sectional view of a
17 nozzle in accordance with a third embodiment of the
18 present invention;

19

20 Figure 7 is an exploded perspective view of the nozzle of
21 Figure 6;

22

23 Figures 8 and 9 are end and sectional views,
24 respectively, of a deflector forming part of the nozzle
25 of Figure 6; and

26

27 Figures 10 and 11 are end and side views, respectively,
28 of a body forming part of the nozzle of Figure 6.

29

30 In the embodiment of the present invention shown in
31 Figure 1, the nozzle 1 is constructed from three separate
32 components. These are the nozzle body 3, the coupling
33 ring 5 and the deflector 7.

1 The deflector 7 is provided with a front surface 11, a
2 deflecting surface 9 which is angled away from the
3 direction of fluid flow and a central beam or projection
4 10 which extends into the nozzle body 3 and provides a
5 central channel 21.

6
7 The central channel 21 has a filter coupler 33 to which a
8 wire-mesh cone known as a Witch's Broom can be attached.
9 The purpose of this filter is to prevent particulates
10 from entering the central channel. A second coupler 13
11 is attached to the downstream end of the central channel
12 21. The second coupler 13 is used to attach a further
13 nozzle for shaping the water flow. Suitably, the nozzle
14 is designed to produce a fine spray or fog of water.

15
16 Typically, the water used will be filtered upstream of
17 the nozzle. Therefore, the size of particulates entering
18 the nozzle will have a maximum determined by the upstream
19 filter.

20
21 The gap between the central beam 10 and the nozzle body 3
22 defines an outer channel which is annular in shape.
23 Support means in the form of fins 30 extend between the
24 central beam 10 and the nozzle body 3 to secure the
25 deflector 7 in place. Grub screws are used to further
26 secure the deflector 9 in position. The nozzle may also
27 be provided with a pressure indicator switch (not shown)
28 located in the deflector surface or on the body of the
29 nozzle. Fixed rings 25 are also included to position the
30 deflector within the nozzle body 3.

31
32 The box section 26 provides abutting surfaces at either
33 end thereof, and further provides an adjustable gap 27

1 which can be reduced in size by the inclusion of further
2 spacer rings (not shown). Typically, an additional
3 spacer ring would be introduced at the downstream end of
4 the box section 26 thereby moving the deflector in an
5 upstream direction and therefore reducing the size of the
6 adjustable gap 27. This also reduces the width of the
7 end of the channel as defined by the distance between the
8 deflector surface 9 and the chamfered surface 15.

9
10 It will be noted that the deflector 7 is generally
11 frusto-conical or cone-shaped. The chamfered surface 15
12 provides a way of smoothing the flow of fluid at the
13 downstream end of channel 23, and as a consequence
14 creates a more laminar fluid flow.

15
16 Providing an adjustable gap between the deflector surface
17 9 and the chamfered surface 15 provides water flow having
18 different profiles. For example, where the gap between
19 the chamfered surface 15 and the deflector surface 9 is
20 small, the flow of water from the nozzle will be
21 disrupted and this will create a non-uniform flow to
22 produce a more diffuse wall of water. Where this
23 distance is larger the flow will be more laminar and the
24 wall of water will be less diffuse.

25
26 The chamfered surface 15 forms part of a coupling ring
27 which is attached to the nozzle body 3. The upstream end
28 of the nozzle body 3 is provided with a nozzle coupler
29 31, for coupling the nozzle 1 to a hose or pipework. The
30 nozzle 1 is dimensioned for coupling to a 6"
31 (approximately 152mm) diameter hose or pipe, although it
32 will be understood that the nozzle 1 may be provided for
33 a hose or pipe of any suitable diameter. In this example,

1 the coupler 31 is a screw thread. As the water has been
2 filtered upstream, the gap between surfaces 9 and 15 will
3 provide a flow path that is not restricted by the
4 presence of large particulates. Accordingly, this will
5 not block or inhibit the performance of the nozzle.

6 Figure 2 provides a further, partial cross-sectional view
7 of the present invention and shows the outer surface of
8 the central beam 10 and the fins 30. The features of
9 this drawing are identical to the features shown in
10 Figure 1.

11
12 Figure 3 shows the water flow path through the nozzle.

13
14 The water flows through the main channel 19 at the
15 upstream end of the nozzle in direction A. The flow is
16 then split into two portions which flow through the
17 central channel 21 in direction C and through the outer
18 channel 23 in direction B. A filter (not shown) is
19 attached to the filter coupler 33. This prevents
20 particulates from entering the central channel and
21 directs them out through the outer annular channel 23.
22 This is desirable because the purpose of the central
23 channel is to provide a fine mist of water by using a
24 fine nozzle (not shown). The use of a filter prevents
25 particulates from entering the fine nozzle, and thereby
26 blocking it.

27
28 As the water flows through the outer channel 23 in
29 direction B, the water is deflected from surface 9
30 outwards in a pre-determined direction. This direction
31 is determined by the angle of the deflection surface 9
32 with respect to the direction of bulk flow through the
33 channel 23. In this example, the surface 9 is at an

1 angle of approximately 105° with respect to the central
2 beam. Clearly, therefore, the deflector surface 9 is
3 angled away from the direction of flow B.

4

5 Advantageously, it has been found that the use of a
6 deflector surface in this configuration means that the
7 general bulk flow B loses energy only when it is
8 deflected from the surface 9. Therefore, it is possible
9 to produce a more efficient nozzle that requires a lower
10 water pressure to produce a wall of water that extends a
11 predetermined distance from the nozzle than would be
12 possible with the prior art nozzles. In addition, it is
13 possible to produce walls of water that extend further
14 with the same pressure than in the prior art.

15

16 It should be noted that in the prior art the exiting
17 water impinges on a first surface, and is thrown
18 backwards onto a second directing surface for directing
19 the water out from the nozzle. This causes the water to
20 lose energy and therefore causes a reduction in overall
21 pressure.

22

23 In addition, the present invention may also be provided
24 with means for altering the width of the gap between the
25 chamfered surface 15 and the deflector surface 9. In
26 order to alter this distance, a spacer ring (not shown)
27 is introduced into the nozzle body so as to reduce the
28 width of gap 27. A number of rings of different width
29 can be used to produce different gap sizes.

30

31 Figures 4a, 4b and 4c show the components from which an
32 embodiment of the present invention can be made. Figure
33 4a shows the deflector means 7, Figure 4b shows the

1 coupling ring 5 and Figure 4c shows the nozzle body 3.
2 It is convenient for the nozzle of the present invention
3 to be constructed in three parts in this manner as it
4 allows easy cleaning and maintenance of the nozzle.

5
6 Figure 5 shows a second embodiment of the present
7 invention in which sensors 112 are embedded into the
8 front surface 111 of a nozzle 101. The sensors can be
9 hard-wired and/or wirelessly and/or acoustically
10 connected through the central channel 121 to a position
11 upstream where data from the sensors can be analysed.
12 The sensors can be temperature sensor, gas composition
13 sensors or any other desired sensor.

14
15 In the examples of Figures 1-4 and 5, the fins 30 may be
16 shaped to affect the flow of water through the outer
17 channel 23.

18
19 Turning now to Figure 6, there is shown a longitudinal
20 cross-sectional view of a nozzle in accordance with a
21 third embodiment of the present invention, the nozzle
22 indicated generally by reference numeral 201. Like
23 components of the nozzle 201 with the nozzle 1 of figures
24 1-4c share the same reference numerals incremented by
25 200.

26
27 The nozzle 201 is dimensioned for coupling to a hose or
28 pipe of a diameter in the range of 1.5"-2" (approximately
29 38mm-51mm), although it will again be understood that the
30 nozzle 201 may be provided on a hose or pipe of any
31 suitable diameter, and thus dimensioned accordingly.

32

1 The nozzle 201 is similar to the nozzle 1 of Figures 1-
2 4c, except that the nozzle 201 comprises two main
3 components, a nozzle body 203 and a fluid deflector 207
4 which is coupled to the nozzle body 203. As will be
5 described below, the deflector 207 is secured to the
6 nozzle body 203 by a retaining member in the form of a
7 nut 35.

8
9 The nozzle 201 is shown in more detail in the exploded
10 perspective view of Figure 7. Also, the deflector 207 is
11 shown separately from the body 203 in the end and
12 sectional views of Figures 8 and 9, and the body 203 is
13 shown with the deflector 207 removed in the end and
14 sectional views of Figures 10 and 11.

15
16 Only the main differences between the nozzle 203 and the
17 nozzle 1 of figures 1-4c will be described herein in
18 detail.

19
20 The body 203 includes a central beam or a shaft 210 which
21 is located by fins 230 that are formed integrally with
22 the body 203. The beam 210 is threaded at 37 and the
23 deflector 207 includes a hub 39 which is internally
24 threaded for engaging the beam threads 37. In this
25 fashion, the deflector 207 may be coupled to the body 203
26 and the gap between the deflector surface 9 and a
27 chamfered surface 215 of the body 203 may be adjusted by
28 rotating the deflector 207, causing the deflector to
29 advance or retract along the beam 210 relative to a main
30 part of the body 203. The deflector 207 is locked in
31 position by a retaining member in the form of a threaded
32 nut 35 which engages the beam threads 37 and abuts the
33 deflector 207. If required, however, spacer rings (not

1 shown) may be provided between a shoulder 41 of the body
2 203 and the deflector 207.

3

4 In a variation, the deflector 207 may include a smooth
5 hub 39 and may be clamped in position between the
6 shoulder 41 of the body 203 and the nut 35. Spacer rings
7 may be located between the shoulder 41 and the deflector
8 207 to increase the spacing between the deflector surface
9 209 and the chamfered surface 215 on the body 203.

10

11 In a similar fashion to the nozzle 1, the nozzle 201
12 defines a central flow channel 221 whilst the body 203
13 defines an outer flow channel 223. In use, fluid flow is
14 split between the inner and outer channels 221, 223 and a
15 further nozzle may be provided coupled to a coupler 213
16 on the beam 210.

17

18 The nozzle 201 additionally includes a self-cleaning
19 mechanism (not shown) for adjusting the channel width at
20 the downstream end, that is the space or gap between the
21 deflector surface 209 and the chamfered surface 215 of
22 the body 203. The mechanism is typically hydraulic,
23 electrical, electro-mechanical or mechanical and includes
24 an actuator for controlling adjustment of the channel
25 width. For example, the mechanism may comprise a motor
26 for adjusting a position of the deflector 207 relative to
27 the body 203. This may be achieved by rotating the
28 deflector 207 to advance or retract the deflector along
29 the beam 210 either by direct rotation of the deflector
30 207 relative to the beam 210, or the beam 210 may be
31 provided as a separate component coupled to or integral
32 with the deflector 207, and may be rotatable relative to
33 the body 203.

1 The self-cleaning mechanism may be actuated to increase
2 the channel width between the deflector surface 209 and
3 the chamfered surface 215 of the body 203 in response to
4 the detection of the presence of trapped debris, such as
5 particulate matter in the nozzle 203. Such debris may
6 cause a reduction in the flow rate of fluid through the
7 nozzle and/or an increase in fluid pressure, which may be
8 detected by appropriate sensors. On detection of such a
9 situation, the self-cleaning mechanism may automatically
10 activate the actuator to adjust the position of the
11 deflector 207, increasing the channel width and allowing
12 clearance of the blockage.

13
14 The embodiments of the present invention described herein
15 show a nozzle designed for manufacture using a lathe
16 (Figures 1 to 5) and by casting (Figures 6 to 11).
17 Details of the component design may change where other
18 manufacturing techniques are used to make the nozzle.
19 Examples of alternative manufacturing techniques are lost
20 wax processing or a combination of techniques.

21
22 In addition, the nozzle may be made in modular form or as
23 a single component.

24
25 It is also envisaged that the present invention could be
26 used for escape route protection, well control and where
27 blowouts occur.

28
29 Improvements and modifications may be incorporated herein
30 without deviating from the scope of the invention.

1 CLAIMS

2 1. A nozzle for forming a water wall around a flare in a
3 hydrocarbon well-test operation, the nozzle comprising:

4 a body having a fluid outlet;

5 a fluid flow channel extending through the body, the
6 channel in fluid communication with the body outlet; and

7 a frusto-conical fluid deflector located adjacent the
8 body outlet and having a frusto-conical deflecting surface,
9 angled away from the direction of fluid flow and positioned
10 such that fluid flowing along the channel impinges on the
11 deflecting surface, the direction of flow of the fluid exiting
12 the nozzle thereby determined by the deflecting surface;

13 wherein the fluid deflector and the body of the nozzle
14 together define a width of the channel and the frusto-conical
15 deflecting surface extends beyond the maximum width of the
16 channel to direct the flow of fluid,

17 wherein at least a portion of the channel extending
18 through the body of the nozzle is an annular channel.

19

20 2. The nozzle as claimed in claim 1, wherein the frusto-
21 conical deflecting surface extends beyond the maximum width of
22 the body.

23

24 3. The nozzle as claimed in claim 1 or claim 2, wherein at
25 least part of the channel is defined between the deflecting
26 surface and an outlet surface of the body.

27

1 4. The nozzle as claimed in claim 3, wherein the deflecting
2 surface and the outlet surface of the body are substantially
3 parallel.

4

5 5. The nozzle as claimed in any one of claims 1 to 4,
6 wherein the deflector surface is disposed at an obtuse angle
7 relative to a main axis of the body.

8 6. The nozzle as claimed in claim 5, wherein the fluid
9 deflector comprises a deflector surface disposed at an angle
10 of approximately 105 degrees relative to the main axis of the
11 body.

12

13 7. The nozzle as claimed in any preceding claim, wherein
14 said channel width is variable by adjusting a position of the
15 deflector relative to the nozzle body.

16

17 8. The nozzle as claimed in claim 7, wherein the fluid
18 deflector is movably mounted relative to the body, to enable
19 adjustment of a position of the deflector relative to the
20 body, to facilitate adjustment of the channel width.

21

22 9. The nozzle as claimed in claim 7 or claim 8, wherein the
23 channel is provided with a gap or space suitable for
24 accommodating a spacer to alter the position of the fluid
25 deflector relative to the end of the channel, thereby varying
26 the width of said channel.

27

1 10. The nozzle as claimed in any one of claims 7 to 9,
2 wherein the deflector is threadably coupled to the body, such
3 that rotation of the deflector relative to the body advances
4 and/or retracts the deflector relative to the body, thereby
5 facilitating adjustment of the channel width.

6

7 11. The nozzle as claimed in any one of claims 7 to 10,
8 wherein the nozzle comprises a mechanism for adjusting the
9 channel width, which is a self-cleaning mechanism.

10

11 12. The nozzle as claimed in claim 11, wherein the mechanism
12 comprises an actuator and one or more sensors, the actuator
13 moving the deflector in response to a detected increase in
14 fluid flow rate indicative of trapped debris in the nozzle.

15 13. The nozzle as claimed in any preceding claim, wherein the
16 fluid deflector comprises the deflecting surface and a central
17 beam, shaft, boss or the like extending from the deflecting
18 surface into the body of the nozzle, the central beam being
19 attachable to the body of the nozzle.

20

21 14. The nozzle as claimed in any preceding claim, wherein the
22 nozzle further comprises a central channel extending through
23 the body of the nozzle.

24

25 15. The nozzle as claimed in claim 14, wherein the central
26 channel extends through the central beam of the deflector.

27

1 16. The nozzle as claimed in any preceding claim, wherein the
2 nozzle is further provided with sensor means.

3

4 17. The nozzle as claimed in claim 16, wherein the sensor
5 means is located in the fluid deflector.

6

7 18. The nozzle as claimed in claim 17, wherein the sensor
8 means are embedded in a front surface of the fluid deflector.

9

10 19. The nozzle as claimed in claim 17, wherein the sensor
11 means is located in the body of the nozzle.

12

13 20. The nozzle as claimed in any one of claims 14 to 19,
14 wherein the nozzle further comprises filter coupling means for
15 coupling a filter to the upstream end of the central channel.

16

17 21. The nozzle as claimed in any one of claims 14 to 20,
18 wherein the nozzle further comprises nozzle-coupling means for
19 coupling a nozzle to the downstream end of the central
20 channel.

21

22 22. A hydrocarbon well test deluge system comprising the
23 nozzle as claimed in any preceding claim.

24

25 23. A nozzle for forming a water wall around a flare in a
26 hydrocarbon well-test operation, the nozzle comprising:

27 a body having a fluid outlet;

1 a fluid flow channel extending through the body, the
2 channel in fluid communication with the body outlet; and

3 a fluid deflector located adjacent the body outlet and
4 positioned such that fluid flowing along the channel impinges
5 on the deflector and is directed out of the nozzle by the
6 deflector, the direction of flow of the fluid exiting the
7 nozzle thereby determined by the deflector;

8 wherein the fluid deflector comprises a deflector surface
9 disposed at an angle of approximately 105 degrees relative to
10 a main axis of the body, and at least a portion of the channel
11 extending through the body of the nozzle is an annular
12 channel.

13

14 24. The nozzle as claimed in claim 23, wherein the deflector
15 surface is a frusto-conical deflecting surface, angled away
16 from the direction of fluid flow.

17

18 25. The nozzle as claimed in claim 24, wherein the frusto-
19 conical deflecting surface extends beyond the maximum width of
20 the channel to direct the flow of fluid.

21

22 26. The nozzle as claimed in claim 25, wherein the frusto-
23 conical deflecting surface extends beyond the maximum width of
24 the body.

25

26 27. The nozzle as claimed in any of claims 23 to 26, wherein
27 the fluid deflector and the body of the nozzle together define
28 a width of the channel and at least part of the channel is

1 defined between the deflecting surface and an outlet surface
2 of the body.

3

4 28. The nozzle as claimed in claim 27, wherein the deflecting
5 surface and the body outlet surface are substantially
6 parallel.

7

8 29. The nozzle as claimed in claim 27 or claim 28, wherein
9 said channel width is variable by adjusting a position of the
10 fluid deflector relative to the nozzle body.

11

12 30. The nozzle as claimed in claim 29, wherein the fluid
13 deflector is movably mounted relative to the body, to enable
14 adjustment of a position of the deflector relative to the
15 body, to facilitate adjustment of the channel width.

16

17 31. The nozzle as claimed in claim 29 or claim 30, wherein
18 the channel is provided with a gap or space suitable for
19 accommodating a spacer to alter the position of the fluid
20 deflector relative to the end of the channel, thereby varying
21 the width of said channel.

22

23 32. The nozzle as claimed in any one of claims 29 to 31,
24 wherein the deflector is threadably coupled to the body, such
25 that rotation of the deflector relative to the body advances
26 and/or retracts the deflector relative to the body, thereby
27 facilitating adjustment of the channel width.

28

1 33. The nozzle as claimed in any one of claims 29 to 32,
2 wherein the nozzle comprises a mechanism for adjusting the
3 channel width, which is a self-cleaning mechanism.

4
5 34. The nozzle as claimed in claim 33, wherein the mechanism
6 comprises an actuator and one or more sensors, the actuator
7 moving the deflector in response to a detected increase in
8 fluid flow rate indicative of trapped debris in the nozzle.

9
10 35. The nozzle as claimed in any one of claims 23 to 34,
11 wherein the fluid deflector comprises the deflecting surface
12 and a central beam, shaft, boss or the like extending from the
13 deflecting surface into the body of the nozzle, the central
14 beam being attachable to the body of the nozzle.

15
16 36. The nozzle as claimed in any of claims 23 to 35, wherein
17 the nozzle further comprises a central channel extending
18 through the body of the nozzle.

19
20 37. The nozzle as claimed in claim 36, wherein the central
21 channel extends through the central beam of the deflector.

22
23 38. The nozzle as claimed in any of claims 23 to 37, wherein
24 the nozzle is further provided with sensor means.

25
26 39. The nozzle as claimed in claim 38, wherein the sensor
27 means is located in the fluid deflector.

28

1 40. The nozzle as claimed in claim 39, wherein the sensor
2 means are embedded in a front surface of the fluid deflector.

3

4 41. The nozzle as claimed in claim 38, wherein the sensor
5 means is located in the body of the nozzle.

6

7 42. The nozzle as claimed in any one of claims 23 to 41,
8 wherein the nozzle further comprises filter coupling means for
9 coupling a filter to the upstream end of the central channel.

10

11 43. The nozzle as claimed in any one of claims 23 to 42,
12 wherein the nozzle further comprises nozzle-coupling means for
13 coupling a nozzle to the downstream end of the central
14 channel.

15

16 44. A hydrocarbon well test deluge system comprising the
17 nozzle as claimed in any of claims 23 to 43.