

SHUT-OFF DEVICE FOR PIPE

The present invention relates to a shut-off device for pipe for use in a pipeline for operation in response to
5 ingress of water.

BACKGROUND OF THE INVENTION

Pipelines or pipe networks for transmission and supply of
10 gaseous fuels, such as town gas or natural gas, are often built underground. They are vulnerable to ingress of water in the case of accidents (e.g. leakage caused by nearby underground work and in particular damage by impinging water jets from burst water mains) or
15 unexpected circumstances (e.g. soil/earth movement, and cracking or faulty condition of pipe fittings). Underground water leaking into the system may find its way spreading very quickly over a long distance down the pipeline. Such water will take considerable time to clear,
20 subsequent to rectification of the leak or faulty condition. To worsen the problems, water carrying soil or dirt, etc. may reach and foul or cause damage to gas equipment/apparatus at the customers' premises.

25 As present, measures safeguarding or catering for the ingress of water into underground pipelines are rare or impractical.

The invention seeks to eliminate or at least to mitigate such a problem by providing a new or otherwise improved shut-off device for pipe for use in a pipeline for operation in response to ingress of water.

5

SUMMARY OF THE INVENTION

According to the invention, there is provided a shut-off device for pipe for use in a pipeline for operation in response to ingress of water, comprising at least two valves for installation in a pipe of a said pipeline. Each valve comprises a valve member supported for movement between an open position when the valve is open to permit passage through a said pipe and a closed position when the valve is closed to shut off the passage through a said pipe. Included is a buoyant member associated with the valve members for causing movement of the valve members to their closed position automatically in the presence of ingress water in the vicinity of the buoyant member. The valve members are arranged in their closed positions to act in respective upstream and downstream directions of the passage through a said pipe.

Preferably, at least one of the valve members is arranged, upon movement from the open position to the closed position, to move into the passage through a said pipe.

More preferably, at least one of the valve members is

arranged to stay clear of the passage through a said pipe when it is in the open position.

It is preferred that at least one of the valve members is
5 arranged to move initially along a linear path from the open position and subsequently along a non-linear path to reach the closed position.

It is preferred that at least one of the valve members
10 has a planar body and is arranged, in the open position, to extend transverse to the direction of the passage through a said pipe and, in the closed position, to extend transverse to the direction of the passage through a said pipe.

15 It is further preferred that the planar body of said at least one of the valve members is arranged to extend at a constant angle perpendicular to the direction of the passage through a said pipe.

20 Preferably, each valve member normally stays in the open position and is adapted to return automatically to the open position upon removal of said ingress water.

25 Preferably, at least one of the valve members is connected by means of a movable connector to the buoyant member and has its entire weight supported by the buoyant member.

In a preferred embodiment, the shut-off device includes a base below which the buoyant member is located for, upon floating on said ingress water, moving upwards to urge the connector against the base to cause movement of the connector and in turn movement of said at least one valve member to the closed position.

More preferably, said at least one valve member is arranged initially to move upwardly with the buoyant member from the open position and subsequently, upon the connector being urged against the base, to move outwardly relative to the buoyant member and to reach the closed position.

15

More preferably, the movable connector comprises at least one link pivotally connecting the valve member to the buoyant member for movement relative to the buoyant member.

20

Further more preferably, the movable connector includes two said links arranged to form a parallel linkage adapted to fix the angular position of the valve member in motion relative to the buoyant member.

25

Further more preferably, the link or at least one of the links has an actuating part arranged to be urged against the base to cause movement of the link or links and in

turn movement of the valve member relative to the buoyant member and to reach the closed position.

Yet further more preferably, the actuating part is
5 provided by an integral part of the link or said at least one of the links.

It is preferred that the base has an abutment against which the connector is to be urged by the buoyant member
10 floating on said ingress water, and includes a guide adapted to guide the movement of the buoyant member floating on said ingress water.

It is further preferred that the buoyant member is in
15 sliding engagement with the guide for guiding thereby.

It is further preferred that the buoyant member has a buoyant body including a mount with which the guide is in sliding engagement for guiding the buoyant member.

20

It is yet further preferred that the guide comprises a plurality of vertical rails, and the mount has respective parts in sliding engagement with the rails.

25 Preferably, the buoyant member has a buoyant body including a mount with which the connector is pivotally connected for movement relative to the buoyant member.

It is preferred that the valves include respective valve seats from which the corresponding valve members disengage in the open position and with which the valve members engage in the closed position.

5

In a preferred embodiment, the valves include respective valve seats from which the corresponding valve members disengage in the open position and with which the valve members engage in the closed position, the valve seats
10 being connected with the base.

More preferably, the valve seats are connected at equiangular positions around the base.

15 More preferably, the valve seats are adapted to be connected with a said pipe at respective upstream and downstream positions thereof, to provide immovable support for the base and in turn sliding support for the buoyant member.

20

It is preferred that the valve member and the valve seat of each valve have respective sealing parts for inter-engagement to close the valve, and at least one of the sealing parts is provided with a magnet or magnets for
25 magnetic attraction with the other sealing part to hold the valve member in the closed position.

In a preferred embodiment, The shut-off device includes a

housing in which said at least two valves and the buoyant member are installed, the housing having at least two openings for connection in a said pipe to face upstream and downstream directions of the passage through a said pipe.

More preferably, the openings include or are provided with respective valve seats of the valves for co-operation with the valve members to control (shut off) the passage through each opening.

More preferably, each opening includes or is provided with respective pipe jointing means for connection in a said pipe.

More preferably, the housing has a main chamber for acting as part of the passage through a said pipe and includes a bottom chamber immediately underneath the main chamber, accommodating the buoyant member and at least part of the valve members and for collecting ingress water, and the buoyant member is arranged to float on collected ingress water initially to move the valve members out of the bottom chamber and finally to cause movement of the valve member to the closed position.

Further more preferably, the bottom chamber has a lower part which is openable for removal of ingress water collected in the bottom chamber.

It is preferred that the shut-off device is a self-contained unit for connection and use in a said pipe.

5 BRIEF DESCRIPTION OF DRAWINGS

The invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which:

10

Figure 1 is a perspective view of an embodiment of a shut-off device for pipe in accordance with the invention;

15

Figure 2 is a perspective view of the shut-off device of Figure 1, showing its major parts taken out from a housing;

Figure 3 is a side view of the shut-off device of Figure 1;

20

Figure 4 is a cross-sectional view of the shut-off device of Figure 3, taken along line IV-IV;

25

Figure 5 is a front view of the shut-off device of Figure 1;

Figure 6 is a cross-sectional view of the shut-off device of Figure 5, taken along line VI-VI;

Figure 7 is a perspective view of the shut-off device's major parts of Figure 2;

- 5 Figure 8 is an exploded perspective view of the shut-off device's major parts of Figure 7;

Figure 9 is another perspective view of the shut-off device's major parts of Figure 2;

10

Figure 10 is an exploded perspective view of the shut-off device's major parts of Figure 9;

- Figure 11 is a perspective view of a buoyant member and
15 base of the shut-off device of Figure 2;

Figure 12 is an exploded perspective view of the buoyant member and base of Figure 11;

- 20 Figures 13 and 14 are front and rear perspective views of a valve member of the shut-off device of Figure 2;

Figure 15 is an exploded perspective view of the valve member of Figures 13 and 14; and

25

Figures 16 to 20 are cross-sectional front views of the shut-off device of Figure 1, showing its sequential operating conditions from open to closed.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring initially to Figures 1 to 16 of the drawings,
5 there is shown a shut-off device 10 for pipe, embodying
the invention, for use in a pipeline for operation in
response to ingress of water into the pipeline. The
pipeline is laid for the supply of fuel gas from the gas
production plant and/or storage of a gas company to
10 customers at a specific supply location or zone protected
by the shut-off device 10. The shut-off device 10
includes at least two valves 100 installed in a pipe P of
the pipeline and a buoyant member 200 for operating the
valves 100.

15

The pipe P has two adjoining sections P1 and P2, between
which the shut-off device 10 is connected and ideally at
a lowermost position of the pipe P or preferably the
entire pipeline. The pipe P delivers fuel gas along a
20 passage Q therethrough in a direction from the first
section P1 to the second section P2, i.e. the downstream
direction, with the opposite direction being the upstream
direction.

25 The two valves 100 preferably share the same construction,
each comprising a valve member 110 supported for movement
between an open position (Figure 7) in which the valve
100 is open to permit passage Q through the pipe, and a

closed position (Figure 9) in which the valve 100 is closed to shut off the passage Q. The buoyant member 200 is associated with the valve members 110 for causing movement of the valve members 110 to their closed
5 position automatically in the presence of ingress water in the vicinity of the buoyant member 200, when such water leaking into the pipe P builds up to a sufficient amount.

10 The valve members 110 are oriented in opposite directions and are arranged in their closed position to act in respective upstream and downstream directions of the passage Q through the pipe P, such that the shut-off device 10 will shut off the pipe P in opposite directions
15 and with the use of two valves 100. This will result in effective sealing.

The buoyant member 200 may be associated with the valve members 110 in a number of possible ways for relative
20 movement to cause or result in movement of the valve members 110. In this particular embodiment, each of the valve members 110 is connected by means of a respective movable connector 300 to the buoyant member 200 and, in particular, has its entire weight supported or borne by
25 the buoyant member 200.

The specific construction of the shut-off device 10 of this particular embodiment is now described in detail. It

has a housing 500 (made of any suitable material e.g. polyethylene or cast iron) in which the valves 100 and the buoyant member 200 are installed. The housing 500 has opposite right and left cylindrical openings 501 and 502 which act as inlet and outlet respectively, for connection in the pipe P to face upstream and downstream directions of the passage Q through the pipe P. The openings 501 and 502 include pipe jointing means in the form of respective integral rims 501R and 502R, by means of which the shut-off device 10 is to be connected or jointed in the pipe P between the pipe sections P1 and P2 for use. The housing 500 includes upper and lower openings 503 and 504 that are likewise cylindrical.

Internally, the housing 500 defines a main chamber 510, which acts as part of the passage Q through the pipe P, and a bottom chamber 520 immediately underneath the main chamber 510 and accommodating the buoyant member 200 and at least part of the valve members 110. The main chamber 510 has a generally cylindrical shape and is in axial alignment with, and of the same cross-sectional size or footprint as, the inlet/outlet or upstream/downstream openings 501 and 502 on opposite sides thereof, together forming a linear through passage Q. The bottom chamber 520 is situated immediately underneath the passage Q.

Each valve member 110 has a circular planar body with a connector 111 at the centre on the back. Each valve 100

includes a valve seat 120 for co-operation with the associated valve member 110, from which the valve member 110 disengages in the open position and with which the valve member 110 engages in the closed position. The
5 valve seat 120 is of an annular configuration and includes a short cylindrical base collar 121 which is connected with, by being inserted into, the respective upstream/downstream opening 501/502 on or within the inner side of the opening 501/502 facing the main chamber
10 510 of the housing 500.

Generally stated, the valve seats 120 are adapted to be connected with and inside the pipe P, at respective upstream and downstream positions thereof. The two valve
15 seats 120 face each other in opposite directions diametrically across the housing's main chamber 510. The upstream and downstream openings 501 and 502 include or are provided with the corresponding valve seats 120 of the valves 100 for co-operation with the valve members
20 110 to control, and in particular to shut off, the passage Q through each opening 501/502.

Each valve member 110 and the associated valve seat 120 have respective generally planar sealing parts or
25 surfaces for inter-engagement, i.e. bearing against each other, to close the associated valve 100. To enhance the sealing effect, at least one of the sealing parts or the sealing part of each valve member 110 in this particular

embodiment is provided with an annular series of magnets 112 (or a ring-shaped magnet). The magnets 112 provide magnetic attraction with the other sealing part of the valve seat 120 for holding or maintaining the valve member 110 more firmly in the closed position, when the valve 100 is closed.

The bottom chamber 520 accommodates the buoyant member 200, and is arranged to collect water that leaks into the pipe P. The main chamber 510 is accessible from outside the housing 500 via the upper opening 503, which is normally closed or sealed off by means of a round cap (not shown). The bottom chamber 520 is provided by the space within the lower opening 504 and, to a much larger extent, by the cavity of a cylindrical cap 521 that is the lowest part and closes the lower opening 504 from below. The cap 521 may be secured with the lower opening 504 by being screwed on or by bolts or by welding (as in the described embodiment) or epoxy resin. The cap 521 may, if desired, be detachable or removable for draining of water collected in the bottom chamber 520, or for maintenance purposes.

The bottom chamber 520 is the lowermost part of the housing 500 and is located at the lowermost position of the pipe P or preferably the entire pipeline, with the result that water leaking into the pipeline at any positions will flow into the pipe P and be collected in

the bottom chamber 520. The buoyant member 200 is arranged to float on ingress water collected in the bottom chamber 520 initially to move the valve members 110 out of the bottom chamber 520 and finally to cause
5 movement of the valve members 110 to the closed position.

The buoyant member 200 has a generally cylindrical buoyant body 210 and includes a mount 220 fixed on the buoyant body 210. The buoyant body 210 may be a hollow
10 plastic structure or made of polystyrene material. The mount 220 has a vertical shaft 221 projecting up coaxially from the buoyant body 210 and includes a horizontal beam 223 that intersects with the shaft 221. The upper end of the shaft 221 is formed with a pair of
15 upper and lower horizontally-extending holes 222 for pivotally connecting the movable connectors 300 such that the movable connectors 300 are movable relative to the buoyant member 200. Opposite left and right ends of the beam 223 are each made to be in the form of a vertically-
20 extending small tube 224 for use in guiding of the vertical movement of the buoyant member 200.

Each movable connector 300 comprises two, first and second links 310 and 320, both pivotally connecting the
25 respective valve member 110 to the buoyant member 200 for movement relative to the buoyant member 200. The links 310 and 320 are connected with their inner ends hinged to the upper and lower holes 222 respectively of the mount

220 and their outer ends hinged to respective upper and lower holes in the central back connector 111 of the valve member 110.

5 The two links 310 and 320 are arranged and connected to form a parallel linkage (or parallelogram linkage) adapted to fix the angular position of the valve member 110 in motion relative to the buoyant member 200. By being a parallel linkage, the two links 310 and 320 are
10 of equal length and extend in parallel with each other, such that the valve member 110 is pivotable at a constant angular position relative to the buoyant member 200.

With the buoyant member 200 placed upright i.e. having a
15 vertical central axis, both valve members 110 are kept during movement by the buoyant member 200 to stay constantly at a vertical position relative to the buoyant member 200. Generally stated, all these three members 200 and 110 extend upright during operation or at rest, when
20 installed for use.

In passing, the first link 310 of each movable connector 300 has, at its upper end, an integral extension which projects at an angle of about 70° from the main body of
25 the link 310 and acts as an actuating part 311 by means of which the movable connector 300 is set into movement or motion, as described below.

The shut-off device 10 further includes a base 400 having a horizontal rectangular frame-like body 410, below which the buoyant member 200 is located. Upon floating on ingress water being collected in the bottom chamber 520 of the housing 500, the buoyant member 200 will gradually move upwards to eventually urge the movable connectors 300 against the base 400 to thereby cause movement of the connectors 300 and in turn movement of the valve members 110 to the closed position.

10

The base 400 has two horizontal pins 420 at opposite ends of and extending across the plane of the body 410. Each pin 420 acts as an abutment against which the respective movable connector 300 is to be urged by the buoyant member 200 upon floating and rising on the ingress water in the housing's bottom chamber 520.

15

The base 400 includes a guide as provided by a pair of vertical rails 430, which extend downwardly from opposite sides of the body 410 and are adapted to guide the up and down movement of the buoyant member 200. More specifically, the rails 430 extend through respective tubes 224 of the mount 220, such that the tubes 224 are in sliding engagement with and along the respective rails 430. With this arrangement, the overall buoyant member 200 is in sliding engagement with the rails 430 for guiding by the rails 430, i.e. the guide, to rise on the ingress water being collected or fall with the ingress

20

25

water as the latter is being drained.

The base 400 is connected between and across the valve seats 120, such that the valve seats 120 are connected
5 with the base 400 at equiangular positions (i.e. diametrically opposite positions in the present case) around the base 400.

By being located fixedly in the upstream and downstream
10 openings 501 and 502 of the housing 500, at respective upstream and downstream positions of the pipe P relative to the overall shut-off device 10, the valve seats 120 provide immovable support for the base 400 connected therebetween and in turn sliding support for the buoyant
15 member 200.

The operation of the shut-off device 10 is now described with reference to Figures 16 to 20 of the drawings.

20 In the initial, normal condition (Figure 16), the buoyant member 200 together with the valve members 110 is in the lowest position under the action of gravity. Both valve members 110 are in the open position, and stay completely below and clear of the main chamber 510 of the housing
25 500 and hence present no obstruction to the flow of fuel gas along the passage Q through the pipe P.

In the case of accidental or unintended ingress of water,

which may be caused by for example impinging water jets from burst underground water mains damaging a part of the pipeline nearby, water leaking or seeping into the pipeline will make its way to the shut-off device 10 and
5 be collected in the bottom chamber 520 of the housing 500. As water builds up in the bottom chamber 520, the buoyant member 200 will be reached and displaced by the rising water, thereby floating on and rising with the ingress water being collected in the bottom chamber 520.

10

In this situation (Figure 17), upon ingress of water W into the pipe P and being collected in the housing's bottom chamber 520, the buoyant member 200 starts to rise upon floating on the rising ingress water W and hence
15 lift both valve members 110 supported thereon into the main chamber 510. Upon continual rising, the movable connectors 300, which connect the valve members 110 to the buoyant member 200, will have the actuating parts 311 of their first links 310 engage the abutment pins 420 of
20 the base 400 above (Figure 18).

Starting from this moment, the connectors 300 are being urged against the base 400 by the buoyant member 200. This results in upward pivotal movement of the connectors
25 300 to in turn move or pivot the valve members 110 outwardly relative to the buoyant member 200 and towards the closed position (Figure 19).

Finally, both valve members 110 will press tight against the respective valve seats 120 and reach their closed position, thereby shutting off the passage Q through the pipe P (Figure 20) to terminate the flow of fuel gas as well as propagation of ingress water along the pipe P or the pipeline.

The supply of fuel gas via the passage Q is terminated. More importantly, the customers' side of the pipeline downstream of the tripped shut-off device 10 is sealed off by the closed valves 100 and hence protected against invasion by the water leaking into the pipeline on the gas supply side.

The shut-off device 10 is designed such that the valve members 110 will reach and bear against the corresponding valve seats 120, i.e. both valves 100 will be closed, before the bottom chamber 520 is completely filled up with the ingress water. This design avoids or minimizes spreading of the ingress water from the leaking side of the shut-off device 10 across to the opposite, non-leaking side.

Under the action of gravity, the valve members 110 normally stay in the open position and, subsequent to operation, will automatically return to the open position upon removal of the ingress water.

Throughout the operation, the valve members 110 are arranged, in the open position, to extend transverse to the direction of the passage Q through the pipe P and, in the closed position, also to extend transverse to the direction of the passage Q. The planar bodies of the valve members 110 are arranged to extend at a constant angle, i.e. to stay in a vertical position, perpendicular to the horizontal direction of the passage Q through the pipe P, either during operation or at rest.

10

In a nutshell, the valve members 110 are arranged initially to move upwardly with the buoyant member 200, as they are supported or carried by the buoyant member 200, from the open position and subsequently, upon their connectors 300 being urged against the base 400, to move outwardly relative to the buoyant member 200 and to reach the closed position. The connectors 300 are arranged to have their actuating parts 311 urged against the base 400 to cause angular movement of the links 310 and 320 and in turn pivotal movement of the valve members 110 relative to the buoyant member 200 and to reach the closed position. It is noted that the valve members 110 are arranged to move initially along a linear path, i.e. vertically upwards, from the open position and subsequently along a non-linear path, as they are being pivoted upwards and outwards, to reach the closed position.

The shut-off device 10 should be reset in order to prepare for resuming of the supply of gas via the passage Q after the leakage has been rectified, for example a damaged pipe section and/or fitting (e.g. joint) of the pipeline having been repaired or replaced. To reset the shut-off device 10, the water collected inside should be drained and the valve 100 re-opened.

The shut-off device 10 of the described embodiment is bi-directional, in that the two valve members 110 are installed in opposite directions to shut off the respective upstream and downstream directions or paths of the passage Q through the pipe P. The supply of fuel gas may be switched to come in either one of the two opposite directions, e.g. in the direction opposite to the passage Q (i.e. opposite to direction Q), without affecting the operation of the shut-off device 10.

By shutting off the pipe P in opposite directions and with the use of two valves 100, the shut-off device 10 is capable of providing an effective water blockage.

In the situation where the pressure of the ingress water is excessively high, the valve member 110 facing the inflow direction may not hold up well but the other valve member 110, which faces back, should hold up the shut-off such that the ingress water will be stopped at the housing 500. Since the ingress water is coming from the

back of the other valve member 110, its pressure will act upon the back of that other valve member 110 and make it press harder against the associated valve seat 120. This is one major advantage of the shut-off device of the
5 subject invention.

The shut-off device of the present invention incorporates more than one valve, or at least two valves, to shut off all the passages, paths or branches (i.e. pipe sections)
10 extending to or extending from the location, which is a junction, at which the shut-off device 10 is installed. Each junction should have at least two branches, i.e. an upstream branch for the flow running to the junction and a downstream branch for the flow running from the
15 junction. This is the simplest system, as in the case of the preferred embodiment as described above. In the situation where there are more than two branches, for example three branches comprising two upstream branches merging into one downstream branch, a shut-off device
20 suitable for use according to the invention may include three valves. The first and second valves are installed to shut off the two upstream branches (i.e. pipe sections) respectively, and the third valve installed to shut off the downstream branch.

25

In closing, the shut-off device 10 is a self-contained unit for connection and use in the pipe P.

The invention has been given by way of example only, and various other modifications of and/or alterations to the described embodiment may be made by persons skilled in the art without departing from the scope of the invention
5 as specified in the appended claims.

CLAIMS

1. A shut-off device for pipe for use in a pipeline
5 for operation in response to ingress of water, comprising:
at least two valves for installation in a pipe of said
pipeline, each valve comprising a valve member supported
for movement between an open position when the valve is
open to permit passage through said pipe and a closed
10 position when the valve is closed to shut off the passage
through said pipe, wherein at least one of the valve
members has a planar body and is arranged, in the open
position, to extend transverse to the direction of the
passage through said pipe and, in the closed position, to
15 extend transverse to the direction of the passage through
said pipe; and
a buoyant member associated with the valve members for
causing movement of the valve members to their closed
position automatically in the presence of ingress water in
20 the vicinity of the buoyant member;
wherein the valve members are arranged in their closed
positions to act in respective upstream and downstream
directions of the passage through said pipe.
- 25 2. The shut-off device as claimed in claim 1,
wherein at least one of the valve members is arranged, upon
movement from the open position to the closed position, to
move into the passage through said pipe.
- 30 3. The shut-off device as claimed in claim 2,
wherein at least one of the valve members is arranged to
stay clear of the passage through said pipe when it is in
the open position.

- 26 -

4. The shut-off device as claimed in any one of claims 1 to 3, wherein at least one of the valve members is arranged to move initially along a linear path from the open position and subsequently along a non-linear path to reach the closed position.

5. The shut-off device as claimed in claim 1, wherein the planar body of said at least one of the valve members is arranged to extend at a constant angle perpendicular to the direction of the passage through said pipe.

6. The shut-off device as claimed in any one of claims 1 to 5, wherein each valve member normally stays in the open position and is adapted to return automatically to the open position upon removal of said ingress water.

7. The shut-off device as claimed in any one of claims 1 to 6, wherein at least one of the valve members is connected by means of a movable connector to the buoyant member and has its entire weight supported by the buoyant member.

8. The shut-off device as claimed in claim 7, including a base below which the buoyant member is located for, upon floating on said ingress water, moving upwards to urge the connector against the base to cause movement of the connector and in turn movement of said at least one valve member to the closed position.

9. The shut-off device as claimed in claim 8, wherein said at least one valve member is arranged

- 27 -

initially to move upwardly with the buoyant member from the open position and subsequently, upon the connector being urged against the base, to move outwardly relative to the buoyant member and to reach the closed position.

5

10. The shut-off device as claimed in claim 8 or claim 9, wherein the movable connector comprises at least one link pivotally connecting the valve member to the buoyant member for movement relative to the buoyant member.

10

11. The shut-off device as claimed in claim 10, wherein the movable connector includes two said links arranged to form a parallel linkage adapted to fix the angular position of the valve member in motion relative to the buoyant member.

15

12. The shut-off device as claimed in claim 10 or claim 11, wherein the link or at least one of the links has an actuating part arranged to be urged against the base to cause movement of the link or links and in turn movement of the valve member relative to the buoyant member and to reach the closed position.

20

13. The shut-off device as claimed in claim 12, wherein the actuating part is provided by an integral part of the link or said at least one of the links.

25

14. The shut-off device as claimed in any one of claims 8 to 13, wherein the base has an abutment against which the connector is to be urged by the buoyant member floating on said ingress water, and includes a guide adapted to guide the movement of the buoyant member floating on said ingress water.

30

- 28 -

15. The shut-off device as claimed in claim 14, wherein the buoyant member is in sliding engagement with the guide for guiding thereby.

5

16. The shut-off device as claimed in claim 14 or claim 15, wherein the buoyant member has a buoyant body including a mount with which the guide is in sliding engagement for guiding the buoyant member.

10

17. The shut-off device as claimed in claim 16, wherein the guide comprises a plurality of vertical rails, and the mount has respective parts in sliding engagement with the rails.

15

18. The shut-off device as claimed in any one of claims 7 to 15, wherein the buoyant member has a buoyant body including a mount with which the connector is pivotally connected for movement relative to the buoyant member.

20

19. The shut-off device as claimed in any one of claims 1 to 18, wherein the valves include respective valve seats from which the corresponding valve members disengage in the open position and with which the valve members engage in the closed position.

25

20. The shut-off device as claimed in any one of claims 8 to 17, wherein the valves include respective valve seats from which the corresponding valve members disengage in the open position and with which the valve members engage in the closed position, the valve seats being connected with the base.

30

- 29 -

21. The shut-off device as claimed in claim 20, wherein the valve seats are connected at equiangular positions around the base.

5

22. The shut-off device as claimed in claim 20 or claim 21, wherein the valve seats are adapted to be connected with said pipe at respective upstream and downstream positions thereof, to provide immovable support
10 for the base and in turn sliding support for the buoyant member.

23. The shut-off device as claimed in any one of claims 19 to 22, wherein the valve member and the valve
15 seat of each valve have respective sealing parts for inter-engagement to close the valve, and at least one of the sealing parts is provided with a magnet or magnets for magnetic attraction with the other sealing part to hold the valve member in the closed position.

20

24. The shut-off device as claimed in any one of claims 1 to 23, including a housing in which said at least two valves and the buoyant member are installed, the housing having at least two openings for connection in said
25 pipe to face upstream and downstream directions of the passage through said pipe.

25. The shut-off device as claimed in claim 24, wherein the openings include or are provided with
30 respective valve seats of the valves for co-operation with the valve members to control (shut off) the passage through each opening.

- 30 -

26. The shut-off device as claimed in claim 24 or claim 25, wherein each opening includes or is provided with respective pipe jointing means for connection in said pipe.

5 27. The shut-off device as claimed in any one of claims 24 to 26, wherein the housing has a main chamber for acting as part of the passage through said pipe and includes a bottom chamber immediately underneath the main chamber, accommodating the buoyant member and at least part
10 of the valve members and for collecting ingress water, and the buoyant member is arranged to float on collected ingress water initially to move the valve members out of the bottom chamber and finally to cause movement of the valve member to the closed position.

15

28. The shut-off device as claimed in claim 27, wherein the bottom chamber has a lower part which is openable for removal of ingress water collected in the bottom chamber.

20

29. The shut-off device as claimed in any one of claims 24 to 28, being a self-contained unit for connection and use in said pipe.