

DESCRIPTION

UNINTERRUPTED FLOW CONSTRUCTION METHOD AND DEVICE

TECHNICAL FIELD

[0001] The present invention relates to an uninterrupted flow construction method (a flow-undisrupted process) and device (apparatus).

BACKGROUND ART

[0002] There are conventional processes well known in the art, in which flow-undisrupted boring and plug insertion are performed at two locations in order to install a bypass pipe on an existing pipeline.

[0003] As a flow-undisrupted boring process for installing a bypass pipe, there are processes well known in the art, in which a main body portion of a T-shaped pipe, which includes a main body portion and a branch pipe portion, is attached to an existing pipe, and a gate for opening/closing the branch pipe portion is opened/closed to bore the existing pipe with a hole saw.

On the other hand, as a plug insertion process, there are processes well known in the art, in which a case is attached to the existing pipe, and an endmill arranged in the case is rotated together with the case to form a cut groove that is cut open over generally half the circumference, so that a plug is inserted into

the existing pipe through the cut groove.

CITATION LIST

PATENT DOCUMENT

[0004] [FIRST PATENT DOCUMENT] US7,021,325 B2 (Front page)

SUMMARY OF INVENTION

[0005] The flow-undisrupted boring process requires one gate as an operation valve. When the bore diameter is large, the gate not only has a large valve body but also has an even larger valve box, thereby resulting in an excessive cost. This also requires a large space above the branch pipe portion.

[0006] On the other hand, the plug insertion process requires a gate as a plug and a butterfly valve. These gates and valves, and swivel joints, etc., that accompany them, are developed for each process of the manufacturer, and they are significantly more expensive compared with standard products. This results in an excessive cost.

[0007] Thus, it is an object of the present invention to reduce the cost for an operation valve and a plug in the two processes described above, and to reduce the cost for a gate as an operation valve in a flow-undisrupted process.

[0008] In a first aspect, the present invention is a flow-undisrupted process, including:

a boring step of attaching a main body portion **41** of a

T-shaped pipe **4**, which includes the main body portion **41** and a branch pipe portion **42**, to an existing pipe **1**, and boring the existing pipe **1** with a hole saw **H** by opening/closing a first gate **G1** for opening/closing the branch pipe portion **42**, in order to install a bypass pipe;

a plug insertion step of attaching a case **5** to the existing pipe **1**, rotating an endmill **E** arranged in the case **5** together with the case **5** to form a cut groove **10** that is cut open over generally half a circumference, and inserting a plug into the existing pipe **1** through the cut groove **10**;

prior to the boring step, a step of providing the T-shaped pipe **4** that has, in the branch pipe portion **42**, a half-circumference groove **20** that is cut open over half the circumference in a circumferential direction **R**;

after the boring step, a connection step of connecting a piping member **6** to the branch pipe portion **42** of the T-shaped pipe **4**; and

after the connection step, a step of pulling the first gate **G1**, which has been inserted into the half-circumference groove **20**, out of the branch pipe portion **42**,

wherein in the plug insertion step, the first gate **G1** or another first gate, which has the same shape and the same structure as the first gate **G1**, is inserted as the plug into the existing pipe **1** through the cut groove **10**.

[0009] In this aspect, an operation first gate used in the boring step or another first gate that can be used in the boring step is

inserted as the plug into the existing pipe **1**. Thus, a single first gate can be used as the gate for the boring step operation and as the gate for plugging. Therefore, it is possible to reduce the cost for the bypass pipe.

[0010] Particularly, it is possible not only to reduce the cost for developing, designing and storing first gates, but also to share the tank for accommodating the first gate, the second gate for inserting and retrieving the first gate, etc., resulting in a significant cost reduction.

[0011] In a second aspect, the present invention is a flow-undisrupted boring apparatus including a first gate **G1** in a branch pipe portion **42** of a T-shaped pipe **4**, wherein:

a half-circumference groove **20** that is cut open over half the circumference in a circumferential direction **R** is formed in the branch pipe portion **42** of the T-shaped pipe **4**;

the half-circumference groove **20** includes a pair of semicircular portions **21** that protrude downward at opposite ends, and a constant-width groove portion **22** that extends in the circumferential direction **R** and connects together the semicircular portions **21**;

the first gate **G1** includes a valve body **11** having a circular portion that is inserted into the branch pipe portion **42** through the half-circumference groove **20**, a pair of valve body-side portions **12** that protrude toward sides of the valve body **11**, a pair of guiders **13** that protrude downward from the valve body-side portion **12**, and a sealing rubber packing **14**;

the rubber packing **14** includes:

a pair of string-like upper portions **15** that are attached to an upper half portion of the circular portion and are in contact with a pair of parallel first end surfaces that define the groove portion **22**;

a string-like lower portion **16** that is attached to a lower half portion of the circular portion and is in contact with an inner periphery surface of the branch pipe portion **42**; and

a pair of middle portions **17** that are attached respectively to opposite sides of the valve body **11**;

the pair of upper portions **15** extend from above to be continuous with the middle portions **17** and the lower portion **16** extend from below to be continuous with the middle portions **17**;

the middle portions **17** each include a semicylindrical portion **18** that fits into the circular portion; and

the middle portions **17** each include an upper surface **F0** that is bonded to a lower surface of the valve body-side portion **12**, a first side surface **F1** that is bonded to a side surface of the valve body **11**, and a second side surface **F2** that is bonded to the guider **13**.

[0012] In this aspect, the half-circumference groove **20** that is cut open over half the circumference in a circumferential direction **R** is formed in the branch pipe portion **42** of the T-shaped pipe **4**. This half-circumference groove **20** can have a similar shape to that of the cut groove **10** that is formed by cutting the existing pipe **1** with an endmill. Therefore, the first gate **G1** as an

operation valve for the boring operation can be used as the gate for plug insertion.

Note that the first gate **G1** may be used as the operation valve for the boring operation without using it as the gate for plug insertion.

[0013] The middle portions **17** of the sealing rubber packing **14** each have the semicylindrical portion **18** that fits into the semicircular portion **21** of the half-circumference groove **20**. While the semicircular portion **21** has a three-dimensionally complicated shape, the semicylindrical portion **18** has a simple shape and can be easily designed and manufactured. Thus, it is possible to realize a cost reduction for the first gate **G1**.

[0014] The middle portions **17** have a larger volume as compared with the string-like upper portions **15** and the string-like lower portion **16**, and therefore have a larger compression allowance, which enhances the sealing function of the first gate **G1**.

[0015] In a third aspect, the present invention is a flow-undisrupted boring apparatus including:

- a T-shaped pipe **4** and a first gate **G1**, wherein the T-shaped pipe **4** includes a main body portion **41** and a branch pipe portion **42**, wherein:

- a half-circumference groove **20** that is cut open over half a circumference in a circumferential direction **R** is formed in the branch pipe portion **42**;

- the first gate **G1** enters the branch pipe portion **42**

through the half-circumference groove **20** to stop a flow of a fluid in the branch pipe portion **42**;

a first tube portion **44** that extends toward directly above the half-circumference groove **20** and defines a first access passage **43** of the first gate **G1** is coupled to the branch pipe portion **42**;

a second gate **G2** is provided that advances/retracts parallel to a radial direction of the branch pipe portion **42** to open/close the first access passage **43**;

a sheath **2** is provided that accommodates the second gate **G2** therein while the second gate **G2** leaves the access passage **43** open;

the first tube portion **44** is provided with a first attachment flange **45**, to which the sheath **2** including the second gate **G2** is attached;

a first accommodating portion **46** for a small valve body **V** is provided in a portion of the first tube portion **44** that is on an inner side of the first attachment flange **45**; and

an operation portion **31** is provided, with which it is possible to open/close the small valve body **V** in the first accommodating portion **46** from outside the first tube portion **44**, thereby enabling attachment/detachment of the sheath **2**.

[0016] In this aspect, it is possible not only to retrieve the first gate **G1** for the boring operation, but also to remove the second gate **G2** and the sheath **2** for retrieving the first gate **G1** so that what is left is only the small valve body **V**. Therefore, it is

possible to realize a significant cost reduction for the boring operation.

Note that the present flow-undisrupted boring apparatus may also be used as an operation valve where only the boring operation is performed and the plug insertion is not performed.

[0017] Particularly, the second gate **G2** moves parallel to the radial direction of the branch pipe portion **42**, and therefore the second gate **G2** has a band-shaped plate shape with a small width. Thus, the small valve body **V** opens/closes a small opening corresponding to the small width and the small thickness of the band-shaped second gate **G2**. Therefore, the small valve body **V** that remains in the pipeline is significantly small, and it is possible to realize a cost reduction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. 1 is a schematic perspective view of a piping structure showing one embodiment of the present invention process.

FIG. 2 is a schematic perspective view of an apparatus used in a boring step.

FIG. 3 is a partially cross-sectional schematic perspective view of the apparatus used in the boring step.

FIGS. 4(a) and 4(b) are cross-sectional views showing the apparatus with a first gate being open.

FIGS. 5(a) and 5(b) are cross-sectional views showing the apparatus with the first gate being closed.

FIG. **6(a)** is a partially cross-sectional schematic perspective view showing a T-shaped pipe with the first gate being closed, and FIG. **6(b)** is a schematic perspective view of a rubber packing.

FIGS. **7(a)** and **7(b)** are an exploded perspective view of the first gate and a perspective view of the rubber packing, respectively.

FIG. **8** is a partially cross-sectional schematic perspective view showing a state where an upper tank and a second gate are attached to the T-shaped pipe.

FIG. **9** is a partially cross-sectional schematic perspective view showing a state where a butterfly valve is further attached to the T-shaped pipe.

FIG. **10** is a partially cross-sectional schematic perspective view showing a state where the upper tank and the first gate are removed from the T-shaped pipe.

FIG. **11(a)** is a partially cross-sectional schematic perspective view of the T-shaped pipe showing a state where a small valve body is closed, and FIG. **11(b)** is a schematic perspective view of a small valve body, etc.

FIG. **12** is a partially cross-sectional schematic perspective view of the T-shaped pipe showing a state where the second gate is removed from the T-shaped pipe.

FIG. **13** is a schematic perspective view of the T-shaped pipe showing a state where the second gate is removed from the T-shaped pipe.

FIG. 14 is a schematic perspective view showing a milling device for forming a cut groove.

FIG. 15 is a cross-sectional view showing the milling device while cutting.

FIG. 16 is a partially cross-sectional schematic perspective view of the piping structure while a cut groove is being formed.

FIG. 17 is a schematic perspective view showing a state where the first and second gates are attached to the case instead of a cutter.

FIGS. 18(a) and 18(b) are a cross-sectional view thereof and a cross-sectional view showing a joint portion of the case, respectively.

FIG. 19 is a schematic perspective view showing a state where the first gate has entered the existing pipe.

FIG. 20 is a schematic perspective view showing a state where the first gate is pulled out of the existing pipe.

FIG. 21 is a schematic perspective view of the pipeline showing the completed state.

[0019] Preferably, in the plug insertion step, the first gate **G1** is inserted as the plug into the existing pipe **1** through the cut groove **10**.

[0020] In this case, the first gate **G1** as an operation valve for flow-undisrupted boring is used as a plug for flow-undisrupted plug insertion. Therefore, it is possible to perform two operations, i.e., boring and plug insertion, using a single gate.

Thus, the operation cost is reduced.

[0021] Preferably, after the boring step, the connection step is performed by connecting a butterfly valve, as the piping member **6**, to the branch pipe portion **42**; and

a step of pulling the first gate **G1** out of the branch pipe portion **42** is performed with the butterfly valve closed.

[0022] In this case, a butterfly valve, instead of the first gate **G1**, can be connected to the branch pipe portion **42**, thereby making compact valves and valve chambers underground. It also makes small a portion of the branch pipe portion **42** that protrudes upward.

[0023] Preferably, the process includes:

a step of connecting a bypass pipe to the butterfly valve;
and

after connecting the bypass pipe, a step of stopping a flow of a fluid in the existing pipe **1** with the first gate **G1**.

[0024] Thus, after a fluid is allowed to flow through the bypass pipe, it is possible to stop the flow of a fluid in the existing pipe **1**.

[0025] Preferably, the branch pipe portion **42** includes a first tube portion **44** that extends toward directly above the half-circumference groove **20** and defines a first access passage **43** for the first gate **G1**;

the process further includes a step of installing a second gate **G2** in the branch pipe portion **42**, wherein the second gate **G2** advances/retracts horizontally and parallel to a radial direction of the branch pipe portion **42** to open/close the first access passage

43; and

the process includes a step of opening/closing the first access passage **43** by the second gate **G2**, and pulling the first gate **G1** out of the branch pipe portion **42**.

[0026] By thus pulling the first gate **G1** out of the branch pipe portion **42**, the first gate **G1** can be used repeatedly as an operation valve.

[0027] Preferably, the case **5** includes a second tube portion **54** that extends toward directly above the cut groove **10** and defines a second access passage **53** for the first gate **G1**;

the process further includes:

a step of removing the second gate **G2** from the first tube portion **44**;

a step of installing the second gate **G2** in the second tube portion **54**, wherein the second gate **G2** advances/retracts horizontally and parallel to a radial direction of the case **5** and opens/closes the second access passage **53**; and

a step of opening/closing the second access passage **53** by the second gate **G2**, and pulling the first gate **G1**, which has been inserted into the existing pipe **1**, out of the existing pipe **1**.

[0028] In this case, flow-undisrupted boring and flow-undisrupted plug insertion can be performed using a single first gate **G1**, and the first gate **G1** can be used in subsequent operations, thereby realizing a significant reduction of cost and delivery times.

[0029] Any feature illustrated and/or depicted in conjunction

with one of the aspects described above or the following embodiments may be used in the same or similar form in one or more of alternative aspects or alternative embodiments, and/or may be used in combination with, or in place of, any feature of the alternative aspects or embodiments.

[0030] The present invention will be understood more clearly from the following description of preferred embodiments taken in conjunction with the accompanying drawings. However, the embodiments and the drawings are merely illustrative, and shall not be relied upon in defining the scope of the present invention. The scope of the present invention shall be defined only by the appended claims. In the accompanying drawings, like reference numerals denote like components throughout the plurality of figures.

EMBODIMENTS

[0031] One embodiment of the present invention will now be described with reference to drawings.

The present example illustrates a case where the existing pipe **1** is a steel pipe.

[0032] As shown in FIG. 1, the present process is a flow-undisrupted process of installing a bypass pipe by performing a boring step and a plug insertion step without disrupting the flow (without disrupting the water supply). In the present process, a first gate **G1** as an operation gate used in the boring step is inserted into an existing pipe **1** through a cut

groove **10** as a plug.

[0033] The boring step shown in FIG. **2** and FIG. **3** is a step of attaching a main body portion **41** of a T-shaped pipe **4**, which includes the main body portion **41** and a branch pipe portion **42**, to the existing pipe **1**, and boring the existing pipe **1** with a hole saw **H** without disrupting the water supply by using the first gate **G1** for opening/closing the branch pipe portion **42**, in order to install a bypass pipe.

[0034] On the other hand, the plug insertion step of FIG. **14** to FIG. **21** is a step of attaching a case **5** to the existing pipe **1**, rotating an endmill **E** arranged in the case **5** together with the case **5** along the outer circumference of the existing pipe **1** to form the cut groove **10** that is cut open over generally half the circumference, and inserting a plug into the existing pipe **1** through the cut groove **10**.

[0035] Before detailed description of the present process, a flow-undisrupted boring apparatus including the T-shaped pipe **4** and the first gate **G1** to be used in the present process will be described.

[0036] As shown in FIG. **2** and FIG. **3**, the flow-undisrupted apparatus includes the T-shaped pipe **4**, which includes the main body portion **41** and the branch pipe portion **42**, and the first gate **G1**.

[0037] The branch pipe portion **42** uses a steel pipe that has the same inner diameter and the same outer diameter as the existing pipe **1**. The branch pipe portion **42** includes a half-circumference

groove **20** formed in advance that is cut open over half the circumference in the circumferential direction **R**. The first gate **G1** enters the branch pipe portion **42** through the half-circumference groove **20** to stop the flow of a fluid in the branch pipe portion **42**.

[0038] A first tube portion **44** that extends toward directly above the half-circumference groove **20** and defines a first access passage **43** for the first gate **G1** is coupled to the branch pipe portion **42**.

[0039] The present apparatus is provided with a second gate **G2**, a sheath **2** and a first attachment flange **45**.

[0040] That is, the second gate **G2** advances/retracts horizontally and parallel to the radial direction of the branch pipe portion **42** to open/close the first access passage **43**. The sheath **2** accommodates the second gate **G2** therein while the second gate **G2** leaves the access passage **43** open. The first tube portion **44** is provided with the attachment flange **45** to which the sheath **2** including the second gate **G2** is attached.

[0041] A first accommodating portion **46** for a small valve body **V** is provided in a portion of the first tube portion **44** that is on the inner side of the attachment flange **45**. An operation portion **31** is provided, with which it is possible to open/close the small valve body **V** in the first accommodating portion **46** from outside the tube portion **44** to prevent a fluid from flowing out, thereby enabling attachment/detachment of the sheath **2** without disrupting the water supply.

[0042] As shown in FIG. 3 to FIG. 5, the half-circumference groove **20** that is cut open over half the circumference in the circumferential direction **R** is formed in the branch pipe portion **42** of the T-shaped pipe **4**. The half-circumference groove **20** of FIG. 4 includes a pair of semicircular portions **21** that protrude downward at the opposite ends, and a constant-width groove portion **22** that extends in the circumferential direction **R** and connects together the semicircular portions **21**.

[0043] The first gate **G1** of FIG. 6 and FIG. 7 includes a valve body **11** having a circular portion **11c** that is inserted into the branch pipe portion **42** through the half-circumference groove **20**, a pair of valve body-side portions **12** that protrude toward the sides of the valve body **11**, a pair of guiders **13** that protrude downward from the valve body-side portion **12**, and a sealing rubber packing **14**.

[0044] The rubber packing **14** includes a pair of upper portions **15**, a lower portion **16** and a pair of middle portions **17**.

Note that portions of the rubber packing **14** are shown in gray in some figures.

[0045] The pair of upper portions **15** of FIG. 7 are string-like portions that are attached to an edge **15e** of the upper half portion of the circular portion **11c** of the valve body **11** and are in contact with a pair of parallel end surfaces **22f** that define a groove portion **22** of the half-circumference groove **20** of FIG. 4. The lower portion **16** of FIG. 7 is a string-like portion that is attached to an edge **16e** of the lower half portion of the circular portion **11c**

of the valve body **11** and are in contact with the inner periphery surface of the branch pipe portion **42** of FIG. **4**. The middle portions **17** of FIG. **7** are attached respectively to the opposite sides of the valve body **11**.

[0046] The pair of upper portions **15** extend from above to be continuous with the middle portions **17** of FIG. **7(b)** and the lower portion **16** extends from below to be continuous with the middle portions **17**. The middle portions **17** of FIG. **6** each include a semicylindrical portion **18** that fits into the semicircular portion **21** of the half-circumference groove **20**.

[0047] The middle portions **17** of FIG. **7** each include an upper surface **F0** (FIG. **6**) that is bonded to the lower surface of the valve body-side portion **12**, a first side surface **F1** that is bonded to the side surface of the valve body **11**, and a second side surface **F2** that is bonded to the guider **13**.

[0048] Prior to the boring step, the T-shaped pipe **4**, the first gate **G1**, the second gate **G2**, the upper tank **7**, etc., shown in FIG. **2** to FIG. **5** are provided in advance.

Note that in the present example, the existing pipe **1** is a steel pipe.

[0049] The proximal end of the branch pipe portion **42** is integrally continuous with the main body portion **41**. When the existing pipe **1** is a steel pipe, the T-shaped pipe **4** including the main body portion **41** is preferably made of a steel that can be welded on site to the existing pipe **1**. In this case, the main body portion **41** may be a curved plate having a cylindrical surface, or

may be obtained by dividing in two a cylindrical tube whose radius is slightly larger than the existing pipe **1**.

[0050] The half-circumference groove **20** that is cut open over half the circumference in a circumferential direction **R** is formed in the branch pipe portion **42** of the T-shaped pipe **4** of FIG. **3**, as described above. A circular flange **42f** used for the attachment of a boring machine (not shown) well known in the art is provided at the distal end of the branch pipe portion **42**. Note that each flange, such as the circular flange **42f**, includes a number of through holes (not shown) through which bolts are inserted.

[0051] The upper tank **7** is attached to the upper surface of the first tube portion **44**, which is integral with the branch pipe portion **42** of FIG. **2**, with the rectangular flange **44f** between. The upper tank **7** of FIG. **2** is for accommodating the first gate **G1** in the valve-open state, and the inside of the upper tank **7** of FIG. **3** is continuous with the first access passage **43**.

[0052] A butterfly valve, a first cover plate **47**, etc., are provided in advance as the piping member **6** to be attached after boring as shown in FIG. **10**. A butterfly valve as the piping member **6**, in place of the first gate **G1** (FIG. **8**), stops a fluid from flowing out of the branch pipe portion **42**.

[0053] A commercially available product may be employed as the butterfly valve of FIG. **10**, which may be a flange-less butterfly valve, for example. Note that this butterfly valve is connected to the branch pipe portion **42** while being sandwiched between the circular flange **42f** of the branch pipe portion **42** and

a flange short pipe (not shown).

[0054] Next, the details of the boring step will be described.

[0055] First, as shown in FIG. 2, the main body portion **41** of the T-shaped pipe **4** is attached by welding to the existing pipe **1**. Note that when the existing pipe **1** is a cast iron pipe, the main body portion **41** may include a plurality of separate cases that are coupled together so as to enclose the existing pipe **1**.

[0056] Then, the upper tank **7** accommodating the first gate **G1** of FIG. 2 is assembled to the rectangular flange **44f** of the tube portion **44**. The sheath **2** accommodating the second gate **G2** is assembled to the first attachment flange **45** of the first tube portion **44**.

[0057] Thereafter, as is well known in the art, a boring machine having the hole saw **H** of FIG. 3 is attached to the circular flange **42f** of the branch pipe portion **42**. The hole saw **H** advances toward the existing pipe **1** while the first gate **G1** is open, and the hole saw **H** further advances while rotating, thereby boring a branch hole **H0**, indicated by a broken line, in the existing pipe **1**.

[0058] After the boring, after the hole saw **H** retracts, the first gate **G1** lowers downward through the first access passage **43**, and the first gate **G1** enters the branch pipe portion **42** through the half-circumference groove **20**, thereby bringing the first gate **G1** to the valve-closed state, as shown in FIG. 5 and FIG. 8. In this valve-closed state, the first gate **G1** prevents a fluid from flowing out of the branch pipe portion **42**.

[0059] In the valve-closed state of FIG. 6, the upper portions **15**

of the rubber packing **14** of the valve body **11** are in contact with the end surfaces **22f** (FIG. 4) of the groove portion **22** of the half-circumference groove **20**. The middle portions **17** of the valve body **11** are in contact with end surfaces **21f** (FIG. 4) of the semicircular portions **21** of the half-circumference groove **20**. The lower portion **16** of the valve body **11** is in contact with the inner periphery surface of the branch pipe portion **42**.

[0060] After the boring step, a connection step of connecting a butterfly valve as the piping member **6** to the branch pipe portion **42** of the T-shaped pipe **4** of FIG. 9 is performed. The butterfly valve is connected in the valve-closed state.

[0061] After the connection step, as shown in FIG. 9, while the butterfly valve is closed, the first gate **G1**, which has been inserted into the half-circumference groove **20**, is pulled up from the branch pipe portion **42** to the upper tank **7** so that the first gate **G1** is accommodated in the upper tank **7**. In this process, the first access passage **43** is opened/closed by the second gate **G2**, and the first gate **G1** is pulled out of the first tube portion **44** of the branch pipe portion **42**.

[0062] After the pull-up, the operation portion **31** of FIG. 2 is operated to rotate the small valve body **V** of FIG. 2 as shown in FIG. 9(b) to open an access opening **33**, and the second gate **G2** is advanced through the access opening **33** horizontally and parallel to the radial direction of the branch pipe portion **42** to close the access passage **43** for the first gate **G1**.

[0063] After thus closing the access passage **43** of FIG. 9, the

first gate **G1** is removed from the first tube portion **44** together with the upper tank **7**. After the removal, the first cover plate **47** is attached to the rectangular flange **44f** of the first tube portion **44** of FIG. **10** to shut the first access passage **43** of the first tube portion **44**. Thereafter, as shown in FIG. **10**, the second gate **G2** is retracted in the sheath **2** so that it is accommodated therein.

[0064] After the accommodation, the operation portion **31** (FIG. **2**) of FIG. **2** is rotated to close the access opening **33** as shown in FIG. **11(b)**. While the access opening **33** is closed, the second gate **G2** is removed from the first attachment flange **45** together with the sheath **2**.

[0065] After the removal, as shown in FIG. **13** and FIG. **12**, a second cover plate **48** is fastened to the first attachment flange **45**. Thus, the access opening **33** is completely shut. Note that the flow of a fluid through the existing pipe **1** to be described below is stopped after a necessary bypass pipe is connected to the butterfly valve, as is well known in the art.

[0066] Next, prior to the description of the plug insertion step, devices to be used in this step will be described. The devices include the first and second gates **G1** and **G2**, etc., of FIG. **20**, which have been removed after the boring step, as well as a milling device **M** of FIG. **14**.

[0067] The milling device **M** of FIG. **14** includes a sealing case **5** and a cutter **8**. The sealing case **5** and the cutter **8** form the cut groove **10**, which is indicated by a broken line on the existing pipe **1**. First, the sealing case **5** will be described.

[0068] The sealing case **5** is divided in two into an upper piece and a lower piece, i.e., first and second separate cases **51** and **52**, which are welded together on site. This sealing case **5** encloses a portion of the existing pipe **1**. Note that the first and second separate cases **51** and **52** may be made of cast iron or may be fastened together by assembly bolts.

As is well known in the art, the gap between the sealing case **5** and the existing pipe **1** is sealed by a rubber packing.

[0069] The first separate case **51**, of the separate cases, includes a second tube portion **54** whose shape and structure are similar to the tube portion **44** of the T-shaped pipe **4** (FIG. 1).

[0070] That is, the second tube portion **54** of FIG. 20 extends toward directly above the cut groove **10**, and defines the second access passage **53** of the first gate **G1** as shown in FIG. 20.

[0071] The second tube portion **54** of FIG. 20 is provided with a second attachment flange **55**, to which the sheath **2** including the second gate **G2** is attached. A second accommodating portion **56** for the second small valve body **V2** is provided on an inner portion of the second attachment flange **55** in the second tube portion **54** of FIG. 16.

A second operation portion (not shown) is provided, with which it is possible to open/close the second small valve body **V2** in the second accommodating portion **56** from outside the second tube portion **54** to prevent a fluid from flowing out, thereby enabling attachment/detachment of the sheath **2** without disrupting the water supply. The structure and shape of the

second operation portion are similar to those of the first operation portion, and will not be further described below.

[0072] Next, a milling process of forming the cut groove **10** in the existing pipe **1** by using the endmill **E** of the cutter **8** of FIG. **16** will be described.

[0073] Assembly step:

First, as shown in FIG. **14**, a portion of the existing pipe **1** is airtightly enclosed by the case **5**. That is, the first separate case **51** and the second separate case **52** are welded together to sandwich and enclose the existing pipe **1** from the upper side and from the lower side. The cutter **8** is attached to the first separate case **51** with the rectangular flange **54f** therebetween.

Note that a fourth cover plate **58** is fastened to the second attachment flange **55**.

[0074] Cutting step:

Thereafter, as indicated by a solid line and a two-dot-chain line of FIG. **15**, the endmill **E** of the cutter **8** is moved toward the center **O** of the existing pipe **1** to cut a portion of the pipe wall of the existing pipe **1** with the endmill **E** of the cutter **8**, and the milling device **M** of FIG. **15** as a whole is rotated in the circumferential direction **R** of the existing pipe **1** while rotating the endmill **E** of the cutter **8**, thereby boring a portion of the existing pipe **1** and forming the cut groove **10** that extends over half the circumference, as shown in FIG. **15**.

[0075] The cut groove **10**, which is cut as described above, has the same shape and the same size as the half-circumference

groove **20** of FIG. **2**.

[0076] That is, as shown in FIG. **15** and FIG. **18**, the cut groove **10** that is cut open over half the circumference in a circumferential direction **R** is formed in the existing pipe **1**. The cut groove **10** of FIG. **18** includes a pair of semicircular portions **21** that protrude downward at the opposite ends, and the constant-width groove portion **22** that extends in the circumferential direction **R** to connect together the semicircular portions **21**.

[0077] Thus, the first gate **G1** enters the cut groove **10** of FIG. **18**, and the first gate **G1** can stop the flow of a fluid in the existing pipe **1**.

[0078] Note that although the cutting range **B** of the cut groove **10** of FIG. **15** is about 180°, the rotation angle **α** of the case **5** is slightly smaller than 180°.

[0079] Replacement step:

Thereafter, the endmill **E** of FIG. **15** is retracted, and as shown in FIG. **17**, the sheath **2** having the second gate **G2** therein is attached to the second attachment flange **55** of the second tube portion **54**, and the second access passage **53** is shut with the second gate **G2** of FIG. **18**, after which the cutter **8** and the endmill **E** of FIG. **14** are removed from the rectangular flange **54f**. After the removal, the upper tank **7** having the first gate **G1** of FIG. **17** therein is attached to the rectangular flange **54f**.

[0080] After the replacement step, the second gate **G2** of FIG. **18** is retracted from the second access passage **53** to open the second

access passage **53**. Thereafter, as shown in FIG. **19**, the first gate **G1** lowers downward through the second access passage **53**, and the first gate **G1** enters the existing pipe **1** through the cut groove **10**, thereby bringing the first gate **G1** to the valve-closed state.

[0081] In the valve-closed state, the upper portions **15** of the valve body **11** of FIG. **18** are in contact with the end surfaces **22f** of the groove portion **22** of the half-circumference groove **20**. The middle portions **17** of the valve body **11** are in contact with the end surfaces **21f** of the semicircular portion **21** of the cut groove **10**. The lower portion **16** of the valve body **11** is in contact with the inner periphery surface of the existing pipe **1**.

[0082] Thus, it is possible to disrupt the water in the existing pipe **1** of FIG. **19** and disrupt the water in the T-shaped pipe **4** of FIG. **8** using the same, single first gate **G1**. That is, both of the boring step for the flow-undisrupted branching of FIG. **8** and the plug insertion step of FIG. **19** can be performed by using a single first gate **G1**.

[0083] Note that where the first gate **G1** is left inside the existing pipe **1**, e.g., where the first gate **G1** is provided as a product, another first gate, different from the first gate **G1**, may be manufactured in advance and used as a plug.

[0084] Where the first gate **G1** is not needed after the plug insertion step, after necessary piping operations, such as cutting off the existing pipe **1**, are performed, the second access passage **53** is opened/closed by the second gate **G2**, and the first gate **G1** is

pulled up into the upper tank **7** through the cut groove **10** of the existing pipe **1**, thereby removing the first gate **G1**, as shown in FIG. **19** and FIG. **20**. The method of removal after the pull-up is similar to that after the boring step, and will not be further described below.

[0085] Thus, the boring operation and the plug insertion operation are completed as shown in FIG. **21**.

Note that a third cover plate **57** may be attached to the rectangular flange **54f**, and the fourth cover plate **58** may be attached to the second attachment flange **55**.

[0086] While preferred embodiments have been described above with reference to the drawings, various obvious changes and modifications will readily occur to those skilled in the art upon reading the present specification.

For example, the first gate may be an externally threaded gate. The fluid may be oil or gas. The first gate, which is inserted as a plug insertion, may be left as a valve. A bypass piping may be completed before plug insertion without providing a butterfly valve.

Thus, such changes and modifications are deemed to fall within the scope of the present invention, which is defined by the appended claims.

INDUSTRIAL APPLICABILITY

[0087] The flow-undisrupted process and apparatus of the present invention can be used for inserting a gate valve body into

a line of an existing pipe of water, gas, etc., to disrupt the flow of the fluid with the inserted gate valve body.

The flow-undisrupted process of the present invention can be employed when installing a branch pipe after flow-undisrupted boring.

REFERENCE SIGNS LIST

[0088] 1: Existing pipe, 10: Cut groove

11: Valve body, 11c: Circular portion, 12: Valve body-side portion, 13: Guider, 14: Rubber packing

15: Upper portion, 15e: Edge, 16: Lower portion, 16e: Edge, 17: Middle portion, 18: Semicylindrical portion

2: Sheath

20: Half-circumference groove, 21: Semicircular portion, 21f: End surface, 22: Groove portion, 22f: End surface

31: Operation portion, 32: Second operation portion, 33: Access opening

4: T-shaped pipe, 41: Main body portion, 42: Branch pipe portion, 42f: Circular flange

43: First access passage, 44: First tube portion, 44f: Rectangular flange

45: First attachment flange, 46: First accommodating portion, 47: First cover plate, 48: Second cover plate

5: Case, 51: First separate case, 52: Second separate case, 53: Second access passage

54: Second tube portion, 54f: Rectangular flange, 55:

Second attachment flange, 56: Second accommodating portion

57: Third cover plate, 58: Fourth cover plate

6: Piping member, 7: Upper tank, 8: Cutter, E: Endmill

F0: Upper surface, F1: First side surface, F3: Second side surface

G1: First gate, G2: Second gate, V: Small valve body, V2: Second small valve body

H: Hole saw, H0: Branch hole

M: Milling device, O: Center, R: Circumferential direction

CLAIMS

1. A flow-undisrupted process comprising:

a boring step of attaching a main body portion **41** of a T-shaped pipe **4**, which includes the main body portion **41** and a branch pipe portion **42**, to an existing pipe **1**, and boring the existing pipe **1** with a hole saw **H** when a first gate **G1** for opening/closing the branch pipe portion **42** opens, in order to install a bypass pipe;

a plug insertion step of attaching a case **5** to the existing pipe **1**, rotating an endmill **E** arranged in the case **5** together with the case **5** to form a cut groove **10** that is cut open over generally half a circumference, and inserting a plug into the existing pipe **1** through the cut groove **10**;

prior to the boring step, a step of providing the T-shaped pipe **4** that has, in the branch pipe portion **42**, a half-circumference groove **20** that is cut open over half the circumference in a circumferential direction **R**;

after the boring step, a first gate insertion step of inserting the first gate **G1** into the half-circumference groove **20**;

after the first gate insertion step, a connection step of connecting a piping member **6** to the branch pipe portion **42** of the T-shaped pipe **4**; and

after the connection step, a step of pulling the first gate **G1**, which has been inserted into the half-circumference groove **20**, out of the branch pipe portion **42**,

wherein in the plug insertion step, the first gate **G1** or another first gate, which has the same shape and the same structure as the first gate **G1**, is inserted as the plug into the existing pipe **1** through the cut groove **10**.

2. The flow-undisrupted process according to claim 1, wherein in the plug insertion step, the first gate **G1** is inserted as the plug into the existing pipe **1** through the cut groove **10**.

3. The flow-undisrupted process according to claim 1 or 2, wherein:

after the boring step, the connection step is performed by connecting a butterfly valve, as the piping member **6**, to the branch pipe portion **42**; and

the step of pulling the first gate **G1** out of the branch pipe portion **42** is performed with the butterfly valve closed.

4. The flow-undisrupted process according to claim 3, comprising:

a step of connecting a bypass pipe to the butterfly valve; and

after connecting the bypass pipe, a step of stopping a flow of a fluid in the existing pipe **1** with the first gate **G1**.

5. The flow-undisrupted process according to claim 2, wherein:

the branch pipe portion **42** includes a first tube portion **44** that extends toward directly above the half-circumference groove **20** and defines a first access passage **43** for the first gate **G1**;

the process further comprises a step of installing a second gate **G2** in the branch pipe portion **42**, wherein the second gate **G2** advances/retracts horizontally and parallel to a radial direction of the branch pipe portion **42** to open/close the first access passage **43**; and

the process comprises a step of opening the first access passage **43** by the second gate **G2**, and pulling the first gate **G1** out of the branch pipe portion **42**.

6. The flow-undisrupted process according to claim 5, wherein:

the case **5** includes a second tube portion **54** that extends toward directly above the cut groove **10** and defines a second access passage **53** for the first gate **G1**;

the process further comprises:

a step of removing the second gate **G2** from the first tube portion **44**;

a step of installing the second gate **G2** in the second tube portion **54**, wherein the second gate **G2** advances/retracts horizontally and parallel to a radial direction of the case **5** and opens/closes the second access passage **53**; and

a step of opening the second access passage **53** by the second gate **G2**, and pulling the first gate **G1**, which has been

inserted into the existing pipe 1, out of the existing pipe 1.

7. A flow-undisrupted boring apparatus comprising a first gate **G1** in a branch pipe portion **42** of a T-shaped pipe **4**, wherein:

a half-circumference groove **20** that is cut open over half a circumference in a circumferential direction **R** is formed in the branch pipe portion **42** of the T-shaped pipe **4**;

the half-circumference groove **20** includes a pair of semicircular portions **21** that protrude downward at opposite ends, and a constant-width groove portion **22** that extends in the circumferential direction **R** and connects together the semicircular portions **21**;

the first gate **G1** includes a valve body **11** having a circular portion that is inserted into the branch pipe portion **42** through the half-circumference groove **20**, a pair of valve body-side portions **12** that protrude toward sides of the valve body **11**, a pair of guiders **13** that protrude downward from the valve body-side portion **12**, and a sealing rubber packing **14**;

the rubber packing **14** includes:

a pair of string-like upper portions **15** that are attached to an upper half portion of the circular portion and are in contact with a pair of parallel first end surfaces that define the groove portion **22**;

a string-like lower portion **16** that is attached to a lower half portion of the circular portion and is in contact with an inner periphery surface of the branch pipe portion **42**; and

a pair of middle portions **17** that are attached respectively to opposite sides of the valve body **11**;

the pair of upper portions **15** extend from above to be continuous with the middle portions **17** and the lower portion **16** extend from below to be continuous with the middle portions **17**;

the middle portions **17** each include a semicylindrical portion **18** that fits into the semicircular portion; and

the middle portions **17** each include an upper surface **F0** that is bonded to a lower surface of the valve body-side portion **12**, a first side surface **F1** that is bonded to a side surface of the valve body **11**, and a second side surface **F2** that is bonded to the guider **13**.

8. A flow-undisrupted boring apparatus comprising:

a T-shaped pipe **4** and a first gate **G1**, wherein the T-shaped pipe **4** includes a main body portion **41** and a branch pipe portion **42**, wherein:

a half-circumference groove **20** that is cut open over half a circumference in a circumferential direction **R** is formed in the branch pipe portion **42**;

the first gate **G1** enters the branch pipe portion **42** through the half-circumference groove **20** to stop a flow of a fluid in the branch pipe portion **42**;

a first tube portion **44**, which extends toward directly above the half-circumference groove **20** and defines a first access passage **43** of the first gate **G1**, is coupled to the branch pipe

portion **42**;

a second gate **G2** is provided that advances/retracts parallel to a radial direction of the branch pipe portion **42** to open/close the first access passage **43**;

a sheath **2** is provided that accommodates the second gate **G2** therein while the second gate **G2** leaves the access passage **43** open;

the first tube portion **44** is provided with a first attachment flange **45**, to which the sheath **2** including the second gate **G2** is attached;

a first accommodating portion **46** for a small valve body **V** is provided in a portion of the first tube portion **44** that is on an inner side of the first attachment flange **45**; and

an operation portion **31** is provided, with which it is possible to open/close the small valve body **V** in the first accommodating portion **46** from outside the first tube portion **44**, thereby enabling attachment/detachment of the sheath **2**.