

Description

This invention relates generally to sampling apparatus for gathering a representative sample of flowing material and more particularly, but not by way of limitation, to an automatic sampling apparatus that obtains a representatively broad cross-sectional sample by scanning across a pipe within a positively or negatively pressurized (i.e. above or below atmospheric pressure) pipe or duct system.

In blending processes, there is a need for sampling mixed or blended materials, whether the blends are of solids or liquids or a mixture of solids and liquids or a mixture of solids and gases, to know the amounts of the constituent components for controlling the composition of the ultimate blend. For example, in making a cement slurry for use during a cementing job at an oil or gas well, the operator of the job needs to monitor the constituents of the blend to ensure that the resultant cement slurry has the necessary properties for the particular job. This need is particularly critical when the blend may have segregated layers of constituent elements so that the blend is not homogeneous. In such a case, a broad cross-sectional sample of the blend should be taken to obtain portions of all the layers.

Because some blends are conveyed under pressure, such as in a pneumatic flow, there is the further need for such broad cross-sectional sampling even in such a pressurized environment, thereby necessitating a suitable sealed construction to prevent loss of material and pressure from within the system. That is, there is the need for an apparatus including a sealing structure which allows the sample of material to pass out of the primary flow path without unwanted loss of material or pressure. The need for a sealing structure also exists when the sampling is under-taken in a negatively pressurized environment, such as in a vacuum conveyance system.

Several automatic sampling apparatus have been marketed or suggested. Some are for gravity-flow systems and others are for pressurized systems. Some utilize a sample-taking element fixed in the flow stream and others utilize retractable elements. Some elements are movable across the flow path to take a broad cross-sectional sample (cross-cut sampling), but these are generally not known to be for use in above-atmospheric or below-atmospheric pressure systems. However, US-A-4082004 describes a cross-cut sampler for use in a pressurized system. This sampler incorporates a scoop-like element which effectively impedes or otherwise adversely affects the primary flow. US-A-4120203 describes a cross-cut sampler for use in a pressurized system which has a relatively unobtrusive sample-taking element but in

which the closure of the element is by means of a valve; this type is relatively expensive because of the valve and actuator required, and it is also difficult to clean.

Despite these other types of automatic material samplers, we believe there is a need for an improved automatic cross-cut sampling apparatus of the type which can take a broad cross-sectional sample of a material flowing under a greater or less than atmospheric pressure without significantly adversely affecting the primary flow, but whereby more accurate and reliable samples can be collected from such a pressurized flow system and whereof the sample-taking element may be cleaned easily. Such accuracy and reliability are particularly important where the samples are being used to monitor flows within systems for producing complex blends, such as for producing complex cement slurries at a well site. Improved accuracy and reliability would, in general, provide an important competitive advantage. Such improved sampling makes the blending process more cost effective. To further enhance the cost effectiveness, it is desired that such an apparatus which meets the aforementioned needs also be less expensively constructed than previously known types of sampling apparatus.

According to the present invention, there is provided apparatus for sampling material flowing through a conduit, comprising: housing means which receive therethrough a flow of the material as the material flows through the conduit, said housing means including cross-section defining means which define a representatively broad cross-sectional sample area, receptacle means which receive a collection member outside said defined cross-sectional sample area, and connector means which connect said cross-section defining means to the conduit so that the cross-sectional sample area defined by said cross-section defining means is aligned with the cross-section of the conduit; and sampler means, connected with said housing means, which collect a representatively broad cross-sectional sample of the material from said defined cross-sectional sample area as the material flows through said cross-section defining means of said housing means under pressure, said sampler means including: said collection member disposed in said housing means and extending across said cross-section defining means for receiving a portion of the flowing material, said collection member comprising an inlet element elongated in the direction of flow with an inlet extending transversely to the direction of flow for receiving said portion of the flowing material, said collection member having a flow line connected thereto, said flow line having a first sample flow channel defined therein and said inlet element of said collection member having a

second sample flow channel defined therein in communication with said inlet and said first sample flow channel; and movement means which move said collection member from a location outside the defined cross-sectional sample area of the material to scan across the defined cross-sectional sample area of the material, so that it receives said portion of said flowing material as it passes thereacross, characterised in that said flow line has a first purge channel defined therein, and said inlet element of said collection member has a second purge channel defined therein in communication with said inlet and said first purge channel.

As used herein, "pressurized" or the like refers to a non-atmospheric pressure, i.e. a positive pressure greater than atmospheric pressure or a negative or evacuated pressure less than atmospheric pressure.

Apparatus of the present invention can be constructed relatively inexpensively. Furthermore, operation of the apparatus can be effected without significant adverse effect on the primary flow of material.

In order that the invention may be more fully understood, an embodiment thereof will hereafter be described, by way of example only, with reference to the accompanying drawings.

Figures 1 to 17 and 21 of the accompanying drawings show embodiments of apparatus for sampling material flowing through a conduit which embodiments do not have the purge channels of the present invention. However, they do illustrate features of apparatus which may be used with the present invention. The purge channels are illustrated in

Figures 18 to 20. In the accompanying drawings:

Figure 1 is a functional block and schematic diagram of a first arrangement of apparatus for sampling material flowing through a conduit;

Figure 2 is an elevational view of a portion of the apparatus shown in Figure 1 as taken along line 2-2;

Figure 3 is a plan view of a housing means of the apparatus of Figure 1;

Figure 4 is a side elevational view of the housing means of the apparatus of Figure 1;

Figure 5 is an elevational view of a seal plate of the apparatus of Figure 1;

Figure 6 is an elevational view of a retaining plate of the apparatus of Figure 1;

Figure 7 is a cross-sectional end elevational view, taken along line 7-7 in Figure 4, of a cross-section defining means of the housing means of the apparatus of Figure 1;

Figure 8 is a side elevational view, taken along line 8-8 in Figure 7, of a receptacle means of the apparatus of Figure 1;

Figure 9 is a plan view of a portion of an adapter member of the apparatus of Figure 1;

Figure 10 is an end elevational view of the portion of the adapter member shown in Figure 9;

Figure 11 is a side elevational view of the portion of the adapter member shown in Figure 9;

Figure 12 is a plan view of a collection member of the apparatus of Figure 1;

Figure 13 is a front elevational view of the collection member of the apparatus of Figure 1;

Figure 14 is an end elevational view of the collection member of the apparatus of Figure 1;

Figure 15 is a sectional elevational view showing the relationship between the collection member and the cross-section defining means of the apparatus of Figure 1;

Figure 16 is a plan view of a part of the housing means of the apparatus of Figure 1 having an alternative sealing structure associated therewith;

Figure 17 is a side elevational view of the alternative sealing structure shown in Figure 16;

Figure 18 is an elevational view of a second arrangement of sampling apparatus and illustrates an embodiment of the present invention;

Figure 19 is a plan view of a portion of the embodiment shown in Figure 18;

Figure 20 is a cross-sectional view, taken along line 20-20 in Figure 19, of a portion of the housing means and collection member of the embodiment of Figure 18; and

Figure 21 shows a further arrangement of a collection member.

Several configurations of an automatic sampling apparatus suitable for the present invention have been illustrated. Broadly, each of these arrangements includes housing means for receiving a pressurized (as previously defined, either positively or negatively pressurized) flow of the material to be sampled as it flows through a conduit, such as a pipe or duct, into which the apparatus is connected in an in-line or aligned configuration (i.e. the apparatus becomes part of the primary flow path of the flowing material). Each arrangement also includes sampler means for collecting a full cross-sectional sample of the material as the material flows through the housing means under pressure. The sampler means includes a collection member disposed in the housing means, and it further includes movement means for moving the collection member, from a location outside the full cross-sectional flow sample area of the material, across the full cross-sectional, pressurized flow sample area of the material. The housing means includes cross-section defining means for defining the cross-sectional sample area across which the collection member is movable, and it also includes

connector means for connecting the cross-section defining means to the conduit so that the cross-sectional sample area defined by the cross-section defining means is aligned with the cross-section of the conduit. These general elements of the apparatus of the present invention will be more particularly described with reference to the drawings which disclose two principle alternative arrangements, both of which are shown with specific alternative components, and the second of which specifically embodies the present invention.

The first arrangement is illustrated in Figures 1-17. Because the housing means of the present invention is inserted into the flow path of the material to be sampled, the housing means can be said to define a flow path insert means for inserting the apparatus into the line through which the material to be sampled flows. In this arrangement, the housing means, or flow path insert means, includes a sampling window member 2 and receptacle means 4 for receiving the collection member in a non-sampling position outside the sampling window defined by the sampling window member 2. The elements 2, 4 define the cross-section defining means of the first preferred embodiment. An adapter means is used in this arrangement as the connector means for connecting the sampling window member 2 and receptacle means 4 into the line through which the material to be sampled flows.

The sampling window member 2 of the arrangement is particularly shown in FIG. 7. The member 2 includes a rectangular outlet plate 6 defining a side wall of the member 2. The plate 6 has a slot 8 defined therein. The slot 8 is elongated and has a notch or key portion 9 at the top for receiving the collection member as subsequently described hereinbelow; however, the portion 9 may be deleted when the collection member is constructed so that it can be manipulated or otherwise moved through a straight slot. In this arrangement the slot 8 extends parallel to the height of a rectangular area defined within the sampling window member 2. Stated differently, the slot 8 extends transversely to the width of such rectangular area. The length of the slot 8 is not less than the height of the subsequently described sampling window area.

The outlet plate 6 is connected, such as by welding, to an L-shaped bracket 10 having legs defining a side wall 12 and a side wall 14 of the member 2. The side wall 12 extends parallel to the plate 6. The side wall 12 is spaced from the plate 6 by the side wall 14 extending perpendicularly therebetween. Also extending between the side wall 12 and the plate 6 is the receptacle means 4 which includes a bifurcated plate 16 having two portions connected by a semicircular member 18 defining a receptacle 20 having a beveled front

surface 22 as shown in Figure 8. This defines a fourth side wall of the cross-section defining means of this arrangement. Attached to the surface 22 is a seal member 23, such as a foam rubber strip.

The interior surfaces of the elements 6, 12, 14, 16 define a rectangular flow area through which the material to be sampled can flow. Within this area is a rectangular cross-sectional sample area, or sampling window, 24 (see Figure 7). This area is co-extensive with the area swept by an inlet opening in the collection member subsequently described. As is apparent from viewing Figure 7, the area 24 is substantially the same as the maximum potential flow area of the material, but it need only be an area by which a sufficiently representative sample of the complete flow can be obtained. The area 24 lies within a plane extending perpendicular to the direction of the primary flow of the material to be sampled. Although the area 24 is illustrated to be rectangular, it is contemplated that other cross-sectional shapes can be accommodated by the present invention in varying aspects.

The adapter means by which the cross-section defining means is connected into the line or conduit containing the primary flow of material includes two adapter members 26 and 28. Each adapter member 26, 28 has a transition section 30 having a polygonal end to which is connected a suitable circular coupling element 32, such as a Victaulic clamp nipple. The other end of the transition section 30 has a rectangular opening communicating with the rectangular cross-sectional area 24. The rectangular end of the transition section 30 of the member 26 is welded to the inlet side of the sampling window member 2 and receptacle means 4 combination and the rectangular end of the member 28 is welded to the outlet side of the combination.

The transition section 30 is constructed of two similar half-sleeve members, one of which is shown in Figures 9-11 and identified by the reference numeral 34. Figures 9-11 show that each member 34 has one polygonal forming end 36 and one rectangular forming end 38. These shapes are used to adapt the apparatus for use in circular conveying lines of types normally used for conveying, pneumatically or otherwise, materials of the type to be sampled by the present invention. The circular cross-section of such a line is converted into the rectangular cross-section including the area 24 through which the collection member of the sampler means can be readily moved for obtaining a full cross-sectional sample of the flowing material.

The collection member of the first arrangement shown in FIGS. 1-17 is particularly illustrated in FIGS. 12-14. This member is generally identified in these drawings by the reference numeral 40. The

member 40 includes a body 42 having a beveled or angular inlet face or surface portion 44 in which inlet means is defined for receiving as a sample a portion of the flowing material. The inlet means includes an elongated slot 46; however, other types of openings, such as multiple slots or holes, may be used. The slot 46 extends laterally across the width of the cross-sectional area 24, and thus transversely to the flow of material, when the member 40 is disposed in the cross-section defining means such as is illustrated in FIG. 15.

The body 42 is elongated so that it presents only a small cross-sectional obstruction in the primary flow path whereby the primary flow is not substantially adversely affected when the body 42 is moved within the sampling cross-sectional area. This elongated body extends longitudinally from the face portion 44 into a neck portion 48 having a central bore defined therethrough in communication with the slot 46. The neck portion 48 terminates in an outlet opening 50 to which a flow line 52 (FIGS. 1 and 2) is connected.

The flow line 52 is a hose or other suitable tubing or the like having an interior channel or opening through which the collected sample can be conveyed from the collection member 40 to a sample collecting container or jar 54. Associated with the jar 54 in the first illustrated arrangement is a dust filter 56 through which air collected with the sample is filtered by a paper filter and vented to atmosphere. A suitable purging apparatus can be used for purging the dust filter 56.

In its assembled combination, the collection member 40 is disposed within the cross-section defining means as illustrated in FIG. 15. The neck portion 48 extends therefrom through the slot 8 to the flow line 52 which extends to the sample jar 54 as shown in FIGS. 1 and 2. Because the interior of the cross-section defining means, which includes the cross-sectional sample area 24, is pressurized in that it is in communication with the pressurized conduit through which the material to be sampled is primarily flowing, the apparatus must include a suitable pressure seal by means of which the slot 8 can be sealed around the neck portion 48 so that material and pressure do not escape from or enter into the hollow interior of the housing means. In this arrangement, such seal means includes a seal plate 58 and means for retaining the seal plate 58 in sealing engagement with the plate 6 of the sampling window member 2. The seal plate 58 is best viewed in FIGS. 3 and 5, wherein the seal plate 58 is shown to be a rectangular plate having a central circular aperture 60 defined therethrough. The aperture 60 has an inner diameter substantially the same as the outer diameter of the neck portion 48 of the collection member 40, or it is otherwise constructed to provide a suitable seal between the

plate 58 and the neck portion 48. The plate 58 is disposed adjacent the plate 6 between a plurality of outwardly extending bolts 62. The seal plate 58 is made of any suitable substance which will establish a movable pressure seal adjacent the slot 8. For example, ultra-high molecular weight (UHMW) polyethylene provides a suitable abrasion-resistant substance of which the seal plate 58 can be made.

The means for retaining the seal plate 58 adjacent the plate 6 includes one of two illustrated alternative constructions. One of these alternatives includes a rectangular retaining plate 64 having an elongated slot 66 defined therein as shown in FIG. 6. Along the periphery of the retaining plate 64 are six apertures 67 disposed for receiving the bolts 62. The retaining means also includes springs 68, each of which is mounted on a respective one of the bolts 62 and retained thereon by suitable fastening means, such as by a respective one of a plurality of nuts 70. The springs 68 and nuts 70 define biasing means for urging the retaining plate 64 against the seal plate 58.

The other illustrated alternative construction of the retaining means is shown in FIGS. 16 and 17. In this alternative construction, a retaining plate constructed as a roller bracket 72 has a plurality of rollers or cam followers 74 attached thereto. Similar springs 68 and nuts 70 are used to bias the roller bracket and cam rollers against the seal plate 58 as illustrated in FIGS. 16 and 17.

When another suitable material, such as steel, is used instead of UHMW material, the springs 68 may be eliminated because they are used in the illustrated arrangement to compensate for significant thickness changes which can occur in UHMW material with varying temperatures. When an elastomer seal is used, the biasing means may be simply the nuts 70 compressing the seal plate against the outlet plate.

The movement means of the first arrangement, by which means the movable pressure seal and the collection member 40 are moved, includes a piston housing 76 having a piston member 78 slidably disposed therein for linearly moving the seal plate 58, to which plate the piston member 78 is connected by a suitable coupling yoke 80 as shown in FIGS. 1 and 2. The piston housing, or cylinder, 76 is attached to the flow path insert means by a mounting bracket 81 welded thereto as is apparent in FIGS. 1 and 2. The elements 76, 78 define a pneumatic drive means operable in response to an air supply controlled through an air control valve 82 which in turn is controlled by an electric timer 84 operating a solenoid 86. These elements are of suitable types as known to the art. Generally, any suitable means of linearly moving the seal plate may be used, including electric actuators, hydraulic cylinders, or mechanically driven devices.

The electric timer 84 is suitably controlled to actuate the valve 82 whereby the piston member 78 linearly moves the seal plate 58, and thus the flow line 52 and the collection member 40 connected therewith, in a vertical direction for the orientation shown in the drawings, from a retracted or non-sampling position, wherein the collection member 40 is sealingly received in receptacle 20 with the face portion 44 sealed by the seal 23, to a fully lowered position at the bottom of the rectangular area 24 adjacent the side wall 14 and then back to the fully retracted position, whereby the inlet slot 46 of the collection member 40 is twice swept across the cross-sectional sampling area 24. The timer 84 can be adjusted so that such movement is continuous or so that the movement can be stopped at any suitable location, such as at the bottom of the travel, across the cross section 24. Generally, the timer 84 is to be controlled so that a representative sample from across the cross section of the flowing material is obtained. Although the timer 84 has been described as electric, it is contemplated that a pneumatic or a mechanical timer, or other suitable control mechanism can be used. Such other type might even be selected as an explosion-proof type for use in environments where such a precaution is required.

All of the elements but the electric timer will be enclosed in a weatherproof housing for protection. It is contemplated that the electric timer will be positioned in a control room or at a suitable control location to allow convenient operation of the apparatus at a site spaced from the actual flow.

Reiterating, this operation is achieved by the timer 84 actuating the control valve 82 to move the piston member 78 downward, which moves the seal plate 58 and the flow line 52 and the collection member 40 longitudinally downward relative to the slot 8, and by the timer 84 then controlling the valve 82 to retract the piston member 78 after a sufficient downward movement, which moves the seal plate 58 and the flow line 52 and the collection member 40 upward. FIG. 15 shows the collection member 40 in its fully retracted, or non-sampling, position outside of the rectangular cross-sectional area 24 and the flow path of the material. The downwardmost sampling position of a plurality of possible vertically related sampling positions of the collection member 40 is shown in phantom lines in FIG. 15. Thus, it can be seen from FIG. 15 that the collection member 40 moves vertically across the entire cross-sectional area 24 for receiving through the elongated slot 46 individual, horizontally extending sectors of material ("sector" here referring to the area of the slot 46) which collectively constitute a full cross-sectional sample of the flowing material.

Although the foregoing describes apparatus

wherein the collection member is moved vertically various alternatives are possible. The retracted position of the collection member may be located other than at the top of the housing, for example.

A second arrangement of sampling apparatus which, unlike the first arrangement, embodies the present invention is shown in Figures 18-20. The housing means of the illustrated embodiment of the invention is substantially the same as that for the first illustrated arrangement except for the receptacle means. In the embodiment the receptacle means includes a larger protuberant portion 88 for receiving the collection member of the embodiment in its retracted position. In particular, the receptacle means includes a head receiving portion 90 which is similar to the member 18 of the first-described arrangement, and it also includes a neck receiving portion 92 extending transversely from the head receiving portion 90 longitudinally along a portion of one of the adapter members otherwise constructed similarly to the corresponding adapter members 26, 28 in the first-described arrangement, as indicated by the use of the same reference numerals.

Aside from the receptacle means, the principal difference in the illustrated embodiment is the construction of the sampler means which includes a collection member 94 and movement means 96.

The collection member 94 has a rigid body including an inlet or head portion 98 having a beveled or angular frontal or inlet face 100 in which an elongated slot 102 is defined (as mentioned hereinabove with reference to the first arrangement, other suitable inlet means may be used). The head portion 98 is similar to the corresponding portion 44 of the collection member 40. In the illustrated embodiment of the collection member 94, however, a neck portion 104 extends perpendicularly from a central location of the head portion 98, as opposed to extending longitudinally from the end of the head portion as in the first-described arrangement. The neck portion 104 is constructed so that a sample flow channel 106 and a separate purge channel 108 are defined therethrough as shown in FIG. 20. Both of these channels communicate with the inlet slot 102 so that the sample is received through the sample flow channel 106 and so that purge air can be applied to the slot 102 through the channel 108 for purposes of cleaning the slot 102. When the collection member 94 is in its retracted position, as shown in FIG. 20, the inlet face is sealingly engaged with a suitable seal member 110, such as a foam rubber strip attached to the beveled wall of the receptacle means.

Extending transversely from the end of the neck portion 104 opposite the head portion 98 is a rigid portion of a flow line 112 having two channels 114, 116 defined therethrough respectively com-

municating with one of the channels 106, 108 in the collection member 94. The flow line 112, which forms another part of the sampler means of the embodiment, exits portion 92 of the receptacle means through a collar 118 having an adapter 120 threadedly connected thereto. Connected to the adapter member 120 by a suitable clamping mechanism 122 is one end of a flexible boot or hose 124. The boot 124 has its opposite end sealingly connected to the outer periphery of the flow line 112 by a suitable clamping mechanism 126. These elements define, as another part of the sampler means of the embodiment, a sealing means for sealing the exit of the flow line 112 from the receptacle means so that material and pressure within the housing means of the present invention, and the conduit into which it is connected, are not lost.

For supporting the flow line 112 and boot 124, the movement means 96 includes a pivotal brace means including at least one elongated member 128 (two are shown in FIG. 19) having one end attached to the coupled hose 124 and flow line 112 and having another end pivotally connected about a pivot axis 130 to the collar 118 as best viewed in FIG. 18. Forming another part of the movement means 96 is an air cylinder, or piston housing, 132 having a piston member 134 linearly movable therethrough. The cylinder 132 is connected to the housing means by a suitable bracket 136. Actuation of the air cylinder 132 and piston 134, such as by similar mechanisms to those described hereinabove with reference to the first arrangement, pivot the brace member 128 to which the piston 134 is connected at a pivot connection 138.

Connected to the flow line 112 are a suitable container 140 and dust filter 142 of types similar to those described hereinabove with reference to the first arrangement.

Due to the rigid construction of the collection member 94 and at least a portion of the flow line 112 connected thereto and further due to the use of the flexible boot 124, actuation of the air cylinder 132 causes the collection member 94 to pivot so that it moves between its retracted position shown in FIG. 20 and a fully extended position adjacent the bottom of the sampling window member of the cross-section defining means within the housing means of this embodiment. Thus, the sample receiving slot 102 is arcuately swept through an arc which covers an area sufficient to obtain a full cross-sectional sample of the flow of material passing through the rectangular cross-sectional area 24 which is similarly included in the embodiment.

A different collection member is shown in Figure 21. This construction is generally identified by the reference numeral 144. This member has an outer flexible hose 146 which encloses an adjust-

able linkage framework 148 forming part of the movement means of this alternative construction. A flow line 149 extends through the hose 146. The adjustable linkage framework 148, which is shown as a pivotable parallelogram structure, is controlled by suitable control wires (not shown) so that the flexible hose 146 can be manipulated to sweep across any of various desired sampling areas. This exemplifies the contemplation that the collection member may be constructed with a single, relatively small opening and that the movement means may be used therewith to move the collection member in a pattern both horizontally and vertically (or otherwise) to cover the full cross-section of the flow. This can be adapted to embody the present invention by provision of a purge channel therein and may be adapted for use with circular or other shaped cross-sections of conveying conduits so that no transition sections, such as in adapter members 26, 28, are needed.

Regardless of which embodiment is considered, the present invention broadly provides a novel and improved sampling apparatus for obtaining representative, full cross-sectional samples of a flowing material, particularly one flowing under a pressure greater or less than atmospheric pressure. Thus, the present invention is well adapted to carry out the objects and attain the ends and advantages mentioned above as well as those inherent therein. While preferred embodiments of the invention have been described for the purpose of the disclosure, numerous changes in the construction and arrangement of parts can be made by those skilled in the art.

Claims

1. An apparatus for sampling material flowing through a conduit, comprising: housing means (2,4) which receive therethrough a flow of the material as the material flows through the conduit, said housing means including cross-section defining means which define a representatively broad cross-sectional sample area, receptacle means (4) which receive a collection member (40;94;144) outside said defined cross-sectional sample area, and connector means (26,28) which connect said cross-section defining means to the conduit so that the cross-sectional sample area defined by said cross-section defining means is aligned with the cross-section of the conduit; and sampler means, connected with said housing means, which collect a representatively broad cross-sectional sample of the material from said defined cross-sectional sample area as the material flows through said cross-section defining means of said housing means under pressure,

municating with one of the channels 106, 108 in the collection member 94. The flow line 112, which forms another part of the sampler means of the embodiment, exits portion 92 of the receptacle means through a collar 118 having an adapter 120 threadedly connected thereto. Connected to the adapter member 120 by a suitable clamping mechanism 122 is one end of a flexible boot or hose 124. The boot 124 has its opposite end sealingly connected to the outer periphery of the flow line 112 by a suitable clamping mechanism 126. These elements define, as another part of the sampler means of the embodiment, a sealing means for sealing the exit of the flow line 112 from the receptacle means so that material and pressure within the housing means of the present invention, and the conduit into which it is connected, are not lost.

For supporting the flow line 112 and boot 124, the movement means 96 includes a pivotal brace means including at least one elongated member 128 (two are shown in FIG. 19) having one end attached to the coupled hose 124 and flow line 112 and having another end pivotally connected about a pivot axis 130 to the collar 118 as best viewed in FIG. 18. Forming another part of the movement means 96 is an air cylinder, or piston housing, 132 having a piston member 134 linearly movable therethrough. The cylinder 132 is connected to the housing means by a suitable bracket 136. Actuation of the air cylinder 132 and piston 134, such as by similar mechanisms to those described hereinabove with reference to the first arrangement, pivot the brace member 128 to which the piston 134 is connected at a pivot connection 138.

Connected to the flow line 112 are a suitable container 140 and dust filter 142 of types similar to those described hereinabove with reference to the first arrangement.

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A different collection member is shown in Figure 21. This construction is generally identified by the reference numeral 144. This member has an outer flexible hose 146 which encloses an adjust-

able linkage framework 148 forming part of the movement means of this alternative construction. A flow line 149 extends through the hose 146. The adjustable linkage framework 148, which is shown as a pivotable parallelogram structure, is controlled by suitable control wires (not shown) so that the flexible hose 146 can be manipulated to sweep across any of various desired sampling areas. This exemplifies the contemplation that the collection member may be constructed with a single, relatively small opening and that the movement means may be used therewith to move the collection member in a pattern both horizontally and vertically (or otherwise) to cover the full cross-section of the flow. This can be adapted to embody the present invention by provision of a purge channel therein and may be adapted for use with circular or other shaped cross-sections of conveying conduits so that no transition sections, such as in adapter members 26, 28, are needed.

Regardless of which embodiment is considered, the present invention broadly provides a novel and improved sampling apparatus for obtaining representative, full cross-sectional samples of a flowing material, particularly one flowing under a pressure greater or less than atmospheric pressure. Thus, the present invention is well adapted to carry out the objects and attain the ends and advantages mentioned above as well as those inherent therein. While preferred embodiments of the invention have been described for the purpose of the disclosure, numerous changes in the construction and arrangement of parts can be made by those skilled in the art.

Claims

1. An apparatus for sampling material flowing through a conduit, comprising: housing means (2,4) which receive therethrough a flow of the material as the material flows through the conduit, said housing means including cross-section defining means which define a representatively broad cross-sectional sample area, receptacle means (4) which receive a collection member (40;94;144) outside said defined cross-sectional sample area, and connector means (26,28) which connect said cross-section defining means to the conduit so that the cross-sectional sample area defined by said cross-section defining means is aligned with the cross-section of the conduit; and sampler means, connected with said housing means, which collect a representatively broad cross-sectional sample of the material from said defined cross-sectional sample area as the material flows through said cross-section defining means of said housing means under pressure,



said sampler means including: said collection member (40;94;144) disposed in said housing means and extending across said cross-section defining means for receiving a portion of the flowing material, said collection member comprising an inlet element (44;98) elongated in the direction of flow with an inlet (46;102) extending transversely to the direction of flow for receiving said portion of the flowing material, said collection member having a flow line (112) connected thereto, said flow line having a first sample flow channel (114) defined therein and said inlet element of said collection member having a second sample flow channel (106) defined therein in communication with said inlet and said first sample flow channel; and movement means (76;78;96) which move said collection member from a location outside the defined cross-sectional sample area of the material to scan across the defined cross-sectional sample area of the material, so that it receives said portion of said flowing material as it passes thereacross, characterised in that said flow line has a first purge channel (116) defined therein, and said inlet element of said collection member has a second purge channel (108) defined therein in communication with said inlet and said first purge channel.

2. Apparatus according to claim 1, wherein said cross-section defining means includes an outlet plate (6) having a slot (8) defined therethrough in communication between the interior and exterior of said cross-section defining means, said slot having said collection member disposed therethrough; and said sampler means further includes movable pressure seal means for sealing said slot as said collection member moves longitudinally in said slot in response to said movement means, said seal means including: a seal plate (58) having an aperture (60) defined therein through which said collection member is received in sealing engagement; a retaining member (64) having a slot (66) defined therein through which said collection member is received; and biasing means (68) for biasing said retaining member against said seal plate so that said seal plate sealingly engages said outlet plate.
3. Apparatus according to claim 2 wherein said retaining member includes roller means (74) for engaging said seal plate.
4. Apparatus according to any of claims 1 to 3, wherein said movement means (96) includes pivotally retaining means (128,130) for said

collection member in said receptacle means so that said collection member is pivotally movable between a first position, wherein said collection member is received in said receptacle means, and a second position, wherein said collection member receives a sector of the material flowing through the conduit.

5. Apparatus according to claim 4, wherein said collection member (94;144) has a rigid body and said flow line (112) has a rigid portion connected to said rigid body in communication with said channels, said flow line extending externally of said housing means; and said pivotally retaining means includes pivotal brace means (128) which pivotally support said rigid body and said flow line relative to said cross-section defining means.
6. Apparatus according to claim 4, wherein said pivotally retaining means includes an adjustable linkage framework (148) and said collection member includes a flexible casing (146) having said framework disposed therein.
7. Apparatus according to claims 1, 4, 5 or 6, wherein seal means provide a pressure seal between said flow line and said housing means and include a flexible sealing boot (124) coaxially disposed around at least a portion of said flow line.

Revendications

1. Appareil pour prendre un échantillon d'une matière qui circule dans une canalisation comprenant : des moyens formant carter (2, 4) à travers lesquels un courant de la matière s'écoule lorsque cette matière circule dans la canalisation, lesdits moyens formant carter comprenant des moyens de définition de la section transversale qui définissent une surface d'échantillon formée d'une section transversale possédant une étendue représentative, des moyens formant réceptacle (4) qui reçoivent un élément collecteur (40 ; 94 ; 144) en dehors de ladite zone d'échantillon de section transversale définie, et des moyens de raccordement (26, 28) qui raccordent lesdits moyens de définition de la section transversale à la canalisation de telle manière que la zone d'échantillon formée d'une section transversale qui est définie par lesdits moyens de définition de la section transversale soit alignée sur la section transversale de la conduite ; et des moyens de prise d'échantillon, raccordés auxdits moyens formant carter, qui prélèvent un échantillon de matière d'une section transver-



sale possédant une étendue représentative dans ladite zone d'échantillon de section transversale définie, lorsque la matière s'écoule sous pression à travers lesdits moyens de définition de la section transversale desdits moyens formant carter, lesdits moyens de prise d'échantillon comprenant : ledit élément collecteur (40 ; 94 ; 144) disposé dans lesdits moyens formant carter et s'étendant en travers desdits moyens de définition de la section transversale pour recevoir une partie de la matière en écoulement, ledit élément collecteur comprenant un élément d'entrée (44 ; 98) allongé dans la direction de l'écoulement et muni d'une entrée (46 ; 102) qui s'étend transversalement à la direction de l'écoulement, pour recevoir ladite partie de la matière en écoulement, ledit élément collecteur portant un conduit (112) qui lui est raccordé, un premier canal (114) d'écoulement de l'échantillon étant défini dans ce conduit, un deuxième canal (106) d'écoulement de l'échantillon étant défini dans ledit élément d'entrée dudit élément collecteur, en communication avec ladite entrée et avec ledit premier canal d'écoulement de l'échantillon ; et des moyens moteurs (76, 78 ; 96) qui déplacent ledit élément collecteur, en partant d'un point de la matière situé en dehors de ladite zone d'échantillon de section transversale définie de la matière pour balayer la zone d'échantillon de section transversale définie, de manière qu'il reçoive ladite partie de ladite matière en écoulement en parcourant cette zone, caractérisé en ce qu'un premier canal de purge (116) est défini dans ledit conduit, et en ce qu'un deuxième canal de purge (108) est défini dans ledit élément d'entrée dudit organe collecteur, en communication avec ladite entrée et avec ledit premier canal de purge.

2. Appareil selon la revendication 1, dans lequel lesdits moyens de définition de la section transversale comprennent une plaque de sortie (6) à travers laquelle est définie une fente (8), qui établit la communication entre l'intérieur et l'extérieur desdits moyens de définition de la section transversale, ladite fente étant traversée par ledit élément collecteur, et lesdits moyens de prise d'échantillon comprennent en outre des moyens mobiles d'étanchéité à la pression, qui servent à fermer ladite fente à joint étanche lorsque ledit élément collecteur se déplace longitudinalement dans ladite fente en réponse auxdits moyens moteurs, lesdits moyens d'étanchéité comprenant : une plaque d'étanchéité (58) dans laquelle est définie une ouverture (60) à travers laquelle ledit élément

collecteur est disposé à joint étanche ; un élément de retenue (64) dans lequel est définie une fente (66) à travers laquelle passe ledit élément collecteur ; et des moyens de sollicitation (68) qui tendent à appliquer ledit élément de retenue contre ladite plaque d'étanchéité de manière que ladite plaque d'étanchéité s'appuie contre ladite plaque de sortie en formant un joint étanche.

3. Appareil selon la revendication 2, dans lequel ledit élément de retenue comprend des rouleaux (74) destinés à rouler sur ladite plaque d'étanchéité.
4. Appareil selon une quelconque des revendications 1 à 3, dans lequel lesdits moyens moteurs (96) comprennent des moyens de retenue pivotants (128, 130) servant à retenir ledit élément collecteur dans lesdits moyens formant réceptacle, de sorte que ledit élément collecteur peut se déplacer en un mouvement de pivotement entre une première position, dans laquelle ledit élément collecteur est logé dans lesdits moyens formant réceptacle et une seconde position dans laquelle ledit élément collecteur reçoit un secteur de la matière qui s'écoule dans la canalisation.
5. Appareil selon la revendication 4, dans lequel ledit élément collecteur (94 ; 144) possède un corps rigide et ledit conduit (112) comprend une portion rigide reliée audit corps rigide, en communication avec lesdits canaux, ledit conduit s'étendant à l'extérieur desdits moyens formant carter et lesdits moyens de retenue pivotants comprennent des moyens formant une entretoise articulée (128) qui supporte ledit corps rigide et ledit conduit par une articulation qui permet un mouvement de pivotement par rapport auxdits moyens de définition de la section transversale.
6. Appareil selon la revendication 4, dans lequel lesdits moyens de retenue pivotants comprennent une tringlerie réglable (148) et ledit élément collecteur comprend un boîtier souple (146) dans lequel est disposée ladite tringlerie.
7. Appareil selon une des revendications 1, 4, 5 ou 6, dans lequel des moyens d'étanchéité établissent un joint étanche à la pression entre ledit conduit et lesdits moyens formant carter, et comprennent une manchette d'étanchéité souple (124) disposée coaxialement autour d'une partie dudit conduit.

Patentansprüche



1. Vorrichtung zur Probenahme aus einem durch eine Rohrleitung fließenden Material, enthaltend Gehäusemittel (2, 4) zur Aufnahme eines Materialflusses von dem durch die Rohrleitung fließenden Material, welche Gehäusemittel querschnittbestimmende Mittel, die eine Probenahme-Querschnittsfläche von repräsentativer Breite bestimmen, Aufnahmemittel (4) zur Aufnahme eines Sammelgliedes (40; 94; 144) außerhalb der bestimmten Probenahme-Querschnittsfläche, und Verbindungsmittel (26, 28) enthalten, welche die querschnittbestimmenden Mittel mit der Rohrleitung so verbinden, daß die durch die querschnittbestimmenden Mittel bestimmte Probenahme-Querschnittsfläche zum Querschnitt der Rohrleitung ausgerichtet ist, mit dem Gehäuse verbundene Probenehmermittel zur Aufnahme einer Materialprobe repräsentativer Querschnittsbreite aus der bestimmten Probenahme-Querschnittsfläche während das Material unter Druck durch die querschnittbestimmenden Mittel der Gehäusemittel fließt, welche Probenehmermittel das Sammelglied (40; 94; 144) enthalten, das in den Gehäusemitteln angeordnet ist und sich zur Aufnahme eines Teiles des fließenden Materials über die querschnittbestimmenden Mittel hinweg erstreckt und ein in Fließrichtung längliches Einlaßelement (44; 98) mit einem Einlaß (46, 102) aufweist, der zur Aufnahme des Teiles des fließenden Materials quer zur Fließrichtung verläuft, sowie eine mit dem Sammelglied verbundene Durchflußleitung (112) mit einem darin bestimmten ersten Probendurchflußkanal (114) und einen in dem Einlaßelement des Sammelgliedes bestimmten zweiten Probendurchflußkanal (106), der mit dem Einlaß und dem ersten Probendurchflußkanal in Verbindung steht, und Stellmittel (76; 78; 96) zur Verstellung des Sammelgliedes aus einer Stellung außerhalb der bestimmten Probenahme-Querschnittsfläche des Materials zum Durchlauf durch die bestimmte Probenahme-Querschnittsfläche des Materials für die Aufnahme des Teiles des fließenden Materials während des Durchlaufes,

dadurch gekennzeichnet, daß die Durchflußleitung einen ersten darin bestimmten Reinigungskanal (116) und das Einlaßelement des Sammelgliedes einen zweiten darin bestimmten Reinigungskanal (108) enthält, der mit dem Einlaß und dem ersten Reinigungskanal in Verbindung steht.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die querschnittbestimmenden

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Mittel eine Auslaßplatte (6) mit einem durch diese hindurch verlaufenden Schlitz (8) enthalten, der mit dem Inneren und dem Äußeren der querschnittbestimmenden Mittel in Verbindung steht und durch den hindurch verlaufend das Sammelglied angeordnet ist, daß die Probenehmermittel weiterhin verstellbare Druckdichtungsmittel zur Abdichtung des Schlitzes während der Längsverstellung des Sammelgliedes in dem Schlitz beim Ansprechen auf die Verstellmittel enthalten, und daß die Druckdichtungsmittel eine Dichtplatte (58) mit einer durch diese hindurch verlaufenden Öffnung enthalten, in der das Sammelglied in dichtendem Eingriff aufgenommen ist, ein Halteglied (64) mit einem darin bestimmten Schlitz (66), durch den hindurch verlaufend das Sammelglied aufgenommen ist, und Vorspannmittel (68) zur Vorspannung des Haltegliedes gegen die Dichtplatte, so daß die Dichtplatte der Auslaßplatte abdichtend anliegt.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß das Halteglied Rollenmittel (74) enthält, die an der Dichtplatte angreifen.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Verstellmittel (96) schwenkbare Haltemittel (128, 130) für das Sammelglied in den Aufnahmemitteln enthalten, so daß das Sammelglied zwischen einer ersten Stellung, in der das Sammelglied in den Aufnahmemitteln aufgenommen ist, und einer zweiten Stellung schwenkbeweglich ist, in der das Sammelglied einen Ausschnitt aus dem durch die Leitung fließenden Material aufnimmt.

5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß das Sammelglied (94; 144) einen starren Körper enthält und die Durchflußleitung (112) einen starren Teil aufweist, der mit dem starren Körper unter Verbindung mit den Kanälen verbunden ist, daß die Durchflußleitung außerhalb der Gehäusemittel verläuft, und daß die schwenkbaren Haltemittel schwenkbare Stützmittel (128) enthalten, die den starren Körper und die Durchflußleitung gegenüber den querschnittbestimmenden Mitteln abstützen.

6. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die schwenkbaren Haltemittel einen einstellbaren Gelenkrahmen (148) und das Sammelglied ein flexibles Gehäuse (146) enthalten, in dem der Gelenkrahmen angeordnet ist.



7. Vorrichtung nach Anspruch 1, 4, 5 oder 6, dadurch gekennzeichnet, daß Dichtmittel eine Druckdichtung zwischen der Durchflußleitung und den Gehäusemitteln bilden und eine flexible Umkleidung (124) aufweisen, die koaxial um wenigstens einen Teil der Durchflußleitung angeordnet ist.

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