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PARTICULATE SOLID SAMPLING DEVICE

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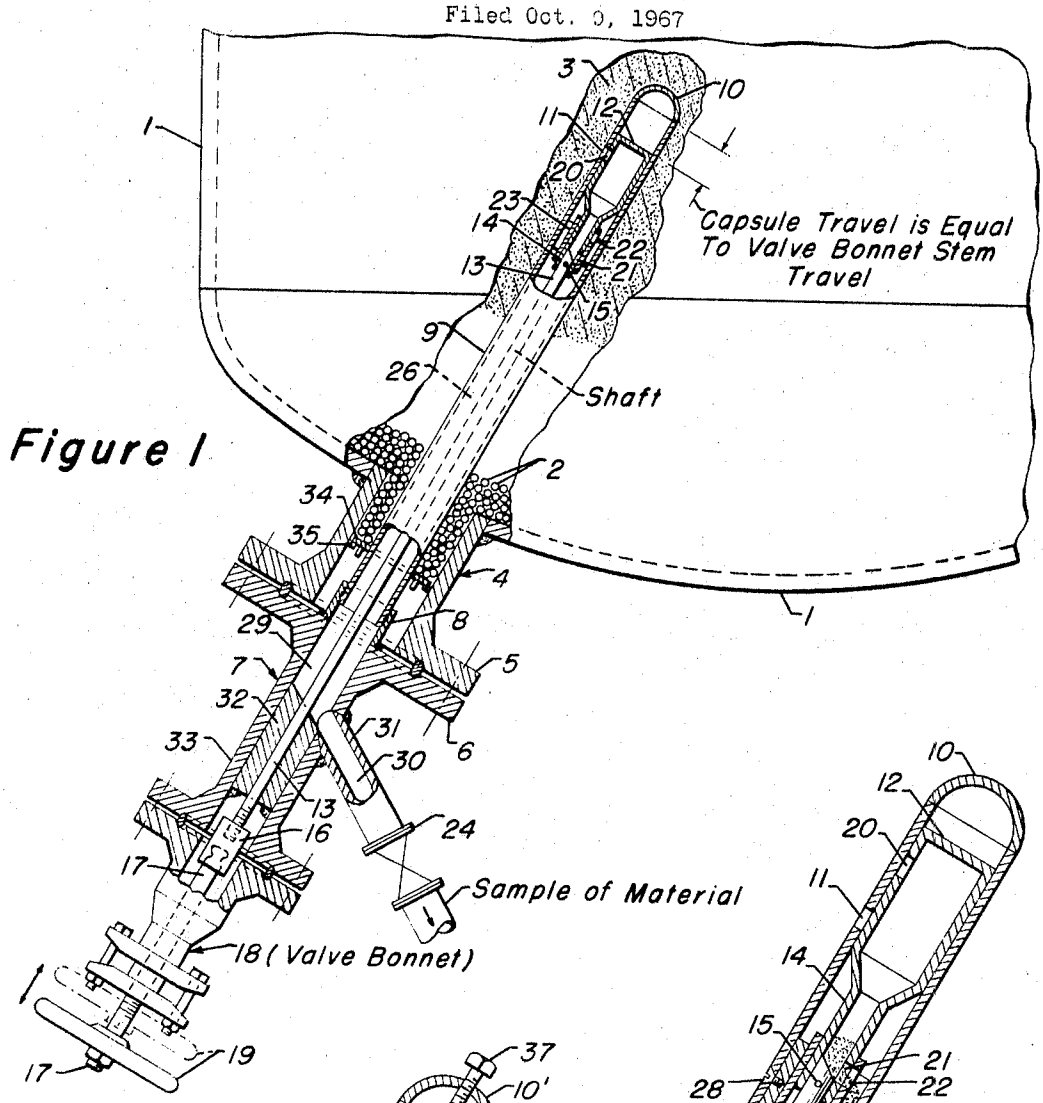

Figure 1

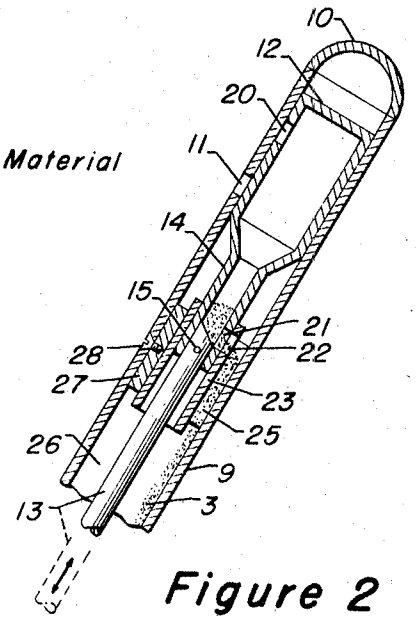

Figure 2

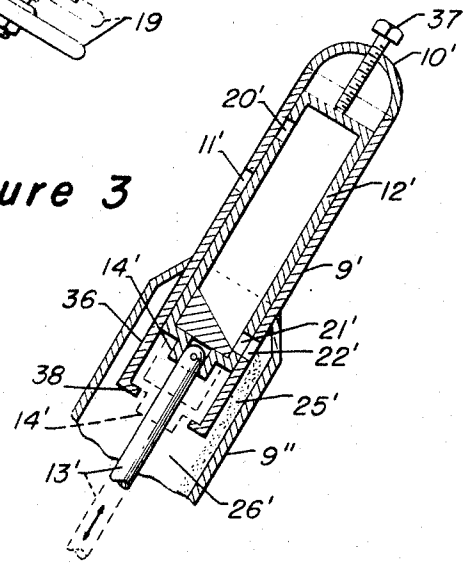

Figure 3

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PARTICULATE SOLID SAMPLING DEVICE

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ABSTRACT OF THE DISCLOSURE

A sampling device particularly adapted to obtain samples of free-flowing particulates from the interior of a contact chamber. The improved device makes use of a non-rotating sample receiving capsule member which can slide in a reciprocating manner within an enclosing lance-like tubular member. In one slide position, a set of inlet openings are in alignment with one another, while, in the other position, a set of sample outlet openings are in alignment.

This invention relates to an improved form of sampling valve or apparatus for attachment to a processing chamber. While the device may be used for fluid sampling, it is more particularly adapted to effect the removal of a desired sample portion of free-flowing particulates from the interior of a contact chamber with a minimum of moving parts and in an efficient manner.

In connection with catalyst chambers used in chemical and petroleum processing operations, it is frequently desired to test the activity of the catalytic material being used in a particular reactor or chamber by removing a sample portion without interrupting the continuous operation. As a result, various types of sampling means have been devised. However, most known types of sampling devices seem to have installation and cleaning problems as well as operational difficulties. For example, many types of sample valves provide for rotational movement between intake and discharge positions so that marking or gauge means are required to insure the proper alignment of openings. Also, certain of the known devices are adapted to obtain a sample only from a point adjacent the chamber wall and not from a more favorable interior point where a more representative sample of material can be obtained. Still other devices are designed to have an elongated small diameter flow path which can readily become blocked and stop the flow of a desired predetermined quantity of particulates.

It may be considered a principal object of the present invention to provide an improved sampling device which uses a movable but nonrotating sampling capsule in the end of a long tube or lance-like probe member.

It is also an object of the present invention to have a device with a relatively large internal flow path for the passage of sampled material such that blockage problems are substantially precluded.

Still another object of the present invention is to have a design which provides for installation or mounting of the entire sampling unit directly through a standard form of vessel nozzle, which may, if desired, also be used to remove the contents of the vessel.

Summary of the invention

In a broad aspect, the present invention provides a sampling apparatus for a meterial being held within a contact chamber and comprises in combination an elongated and closed end tubular member having external mounting means adapted to rigidly hold such member inserted into the contact chamber, with said tubular member further having a side wall sample inlet opening adjacent the inner end thereof and a sample outlet passageway provided

from the exterior end portion thereof, a non-rotating sample receiving capsule member sized and adapted to slidably fit into said tubular member for reciprocatory longitudinal movement therein, an inner sleeve member with a wall opening therethrough fixedly held in said tubular member and positioned to have sliding a contact with the lower portion of said capsule member, said capsule member being provided with upper and lower openings in the side wall portion thereof, with the upper opening positioned to be in alignment with said opening in said tubular member for one position therein, and said lower opening positioned to be in alignment with said opening of said sleeve member for a different position, passageway means from around said sleeve and through the interior of said tubular member to said sample outlet passageway therefrom, and longitudinally movable shaft means extending through said tubular member from the exterior end portion thereof to connect with said capsule member for effecting its longitudinal sampling movements.

In a preferred design of the sampling device, the entire unit may be connected to or mounted from a conventional flange member which in turn is adapted to connect with the flange of a standard nozzle on the contacting chamber. Thus, there is provision for introducing the elongated tubular member, or lance-like probe portion of the device, through a conveniently located nozzle member into the interior of a processing chamber, or if desired, into a large conduit.

It may be considered a particular improved feature of the present invention to utilize a sliding or longitudinally movable type of sample receiving capsule within a fixed position hollow tubular member and means for effecting the reciprocating movement of the capsule for the intake and discharging sampling operation, rather than using rotational members and rotational movement for the sampling operations. It may also be considered an advantageous feature of the present improved construction to have means for discharging the sampled portion of material from the lower part of the capsule member into a relatively large cross-sectional area passageway, as provided by the encompassing tubular member which extends into the particular processing chamber. The use of a large diameter flow passageway is, of course, advantageous in precluding blockage of the movement of the normally small quantity of material which is being sampled, and must reach the discharge port of the sampling device on the outside of the processing chamber.

Various means may be provided for effecting the alignment of material inlet and outlet holes for the sampling operation whereby the outlet means from the capsule is blocked until such time as a predetermined quantity of material is allowed to flow into the sampling capsule. At the same time, the valving arrangement shall be such that the inlet hole is blocked-off during the period of time the sample is being discharged from the outlet opening of the capsule unit. Preferably, an inner sleeve arrangement is provided around the lower portion of the capsule unit and is spaced internally from the inside wall of the elongated enclosing tubular member whereby the sampled portion of material may fall through aligned openings of the capsule and of the sleeve member into the interior portion of such tubular member. In one design, the lower portion of the capsule and the encompassing sleeve may be of smaller diameter cross-section than the interior of the tubular member so as to leave a passageway. In a modified design, there may be a varying sized external tubular member, or at least an enlarged section around the lower portion of the capsule and around an inner sleeve, whereby a uniform cross-section may be provided for the entire capsule unit and the inner sleeve section, which encompasses the lower portion of the capsule unit, will still be spaced internally away from the inside wall

of the external tubular member to provide a passageway.

Reference to the accompanying drawing and the following description thereof will serve to better illustrate the novel mechanical and structural features of the improved sampling device of this invention as well as serve to point out additional advantageous features in connection with the use thereof for a closed processing chamber.

Description of the drawing

FIGURE 1 of the drawing is an assembly view, partially in section, illustrating the positioning of the samplng device in combination wth a contact chamber having an internal bed of particulate material, such as catalyst, which it is desired to periodically sample.

FIGURE 2 of the drawing shows, in an enlarged sectional view, the construction and operation of the internal sample receiving capsule of the device.

FIGURE 3 indicates, in a sectional view, a modified design and arrangement for the sample receiving capsule portion of the device.

Referring now particularly to FIGURE 1 of the drawing, there is shown a portion of a large chamber **1** with internal packing **2**, which may be ceramic balls, gravel, or the like, and an internal bed **3** of subdivided material, such as catalyst, which is held within a fixed internal bed for contact with a reactant stream. As hereinbefore set forth, it is frequently desirable to use some form of sampling device, such as presently provided, to effect the periodic withdrawal of a portion of the finely divided material **3** and test for activity or other desired characteristic.

The chamber is indicated as being provided with a suitable nozzle **4** in turn having a standard bolting flange **5** so as to accommodate a suitable connecting flange **6** that may be provided to hold and mount the entire sampling device **7**. Various structural arrangements may be provided, however, in this instance there is shown a threaded coupling member **8** welded or otherwise attached to the inside face of flange **6** and adapted to connect and support an elongated tubular member **9**. Such member serves as an external casing or sheath which can extend in a lance-like manner through nozzle **4** into the interior of chamber **1**, and well within the bed **3** of such chamber so as to obtain a desired representative internal sample of such bed. However, the internal end of the tubular member **9** is closed with a suitable cap member **10** so that the subdivided material **3** will be precluded from entering the end of the member **9** and in any way reaching the interior thereof except through a suitable inlet opening **11**.

Within the interior end portion of the tubular member **9** there is provided a hollow capsule member **12** which is sized to be able to have a close tolerance and sliding fit within the interior of tube **9**. The capsule member **12**, which will be utilized to receive a predetermined quantity of subdivided material, will thus be fabricated to have a particular length in relation to its diameter in order that it will accommodate the desired predetermined quantity of the material being sampled. Member **12** will be moved longitudinally in tubular member **9** by means of an elongated shaft **13** which connects by pin means **15** to a lower smaller diameter end portion **14** of capsule **12**. An opposing external portion of the shaft **13** is, in this embodiment, shown connected through a swivel means **16** to a rotatable shaft or stem member **17** of a standard form of valve bonnet **18** having a turnable hand wheel **19**.

In effecting the sampling operation of the device, the capsule member **12** is first moved longitudinally within the fixed position external tubular member **9** such that an inlet opening **20** for the capsule will be in direct alignment with the opening **11** within the upper side wall portion of tube member **9**. In a preferred assembly, the steam **17** is turned all the way out, to be at the end of its "travel" for this position of the capsule. Thus, the catalyst, or other material, being sampled will readily flow into the interior of capsule **12** until it is filled and provides the desired

sample quantity. The lower portion **14** of capsule **12** is provided with a sample outlet opening **21**, however, during the filling period such opening is maintained out of alignment with an opening **22** which is provided through sleeve **23** being, in turn, fixedly mounted around section **14**. The inner sleeve **23** shall, of course, be designed and constructed so as to provide a suitable close tolerance and sliding fit with the lower end portion **14** of capsule **12** whereby there is an adequate seal of all material being held within the capsule during a sampling operation. After a filling period for capsule **12**, the latter is moved longitudinally upwardly or outwardly by the operation of the external hand wheel **19** and stem **17**, which in turn operates the internal shaft **13**, such that there is a closing of the catalyst inlet path through the blocking of holes **11** and **20**. At the same time there is obtained a desired alignment of holes **21** and **22**, respectively provided in the lower portion of capsule **12** and in sleeve **23**. A preferred assembly has the stem travel all the way in for this discharging position of the capsule so as to provide a simplified means for obtaining proper capsule positioning. As best shown in FIGURE 2 of the drawing, where the capsule **12** is in the sample discharge position, it will be noted that it has been caused to be longitudinally moved upwardly for the full length of the stem travel of the valve bonnet **18**, whereby "stop means," gauge marks, and the like become unnecessary, in effecting the alignment of the holes **21** and **22**, to permit particulated material **3** to move downwardly through an annular space **25** into the still larger space **26**, as provided by the entire internal cross-sectional area of tubular member **9**.

With reference to FIGURE 2, it is believed that it shows in a better manner the internal positioning of sleeve member **23** for sliding engagement with the external wall of lower portion **14** of capsule member **12**. In this particular design, a rib member **27** on sleeve **23** provides for engagement with a threaded cap screw **28** so as to hold the entire sleeve section in the desired longitudinal position with respect to the lower end of the capsule **12**. However, various suitable mounting means, other than that shown, may be used for effecting the desired fixed attachment of sleeve section **23** into the interior of the hollow tubular member **9**.

After the particulated material **3** leaves the capsule **12** and flows through the interior of tubular member **9**, it will reach the external portion of the device and, as best shown in FIGURE 1, passing through flange **6** into a passageway **29** of spool section **33** to in turn reach outlet passageway **30** leading to discharge nozzle **31** and valve means **24**. Also with reference to FIGURE 1, there is shown a cylindrical filler section **32** within the spool section **33** so that the downward flow of the sampled material will be precluded from following shaft **13** beyond the juncture with the outlet nozzle **31**. Actually, a preferred design provides a suitable tapered interior face portion for cylindrical section **32** such that it will preclude the entrapment of any of the sampled material and insure its entire free flow into outlet passageway **30**.

It is to be realized that there may be various modifications made in the design and shape of various portions of the sampling device. For example, the fixed lance-like tubular member **9** may be round, square, or of other configuration, as long as the internal sliding capsule section **12** is designed to provide a sliding fit within the interior of such tubular section **9**. Also, the length of the latter may vary to accommodate a particular sized chamber or to accommodate the positioning of a particular bed of material which is to be sampled periodically by the device. It is, of course, a particular feature of the improved simplified construction of this invention to have a unitary type of design and construction which may be mounted on a single mounting means, such as flange **6**, which will in turn accommodate a standard vessel nozzle flange.

In referring to FIGURE 1 of the drawing, it will be noted that the removal of flange **6** and the unitary sam-

pling device **7**, including tubular member **9**, will permit the entire free flow of the particulate material from the nozzle **4** of the vessel **1**. Where desired, a suitable removable annular member **34** may be used in nozzle **4** to hold back the enlarged packing material **2** and the main portion of the smaller particulate material **3**. The annular plate member **34** may be supported on spaced lugs **35** so that the partial turning will provide alignment with openings or notches in such plate and permit its removal outwardly through flange **5**. This, will in turn provide for the ready discharge of all of the enlarged packing **2** and the subdivided particulates **3**. It is, of course, not intended to limit the present improved and simplified design for the sampling device to any one total discharge or "dumping" arrangement. However, it might be noted that with the standard nozzle mounting means to the vessel, there can be a split section (with two longitudinal joints) for a substitute in the position of spool **7**. Such split section would be mountable around the shaft section **13**, when spool **7** was removed for total particulate removal, and have provision to pull capsule **12** back out of the way to in turn allow free material flow down therethrough to a larger outlet opening connective with collection hoppers, or whatever.

In FIGURE 3 of the drawing, there is indicated a slightly modified design for a slidable capsule unit **12'** within an upper portion of an outer tubular member **9'**. In this instance, **12'** is of uniform cross-section and is a sliding fit within the interior of the upper portion of **9'**, while the lower portion is a sliding fit within an extended internal sleeve section **36**. Where the sleeve section **36** is of the same size as **9'** or a continuation thereof, there is required a still larger diameter for a portion of the fixed tubular section, such as **9''**, to in turn provide space for a withdrawn sample passageway **25'**. The operation of the embodiment of FIGURE 3 is, of course, similar to that shown in FIGURES 1 and 2, with the sample inlet flow being accomplished through the alignment of holes **11'** and **20'** during such period of time as the capsule **12'** is in the lower position indicated by dotted lines for shaft **13'** and connector section **14'**. During the discharge operation, such as illustrated, there is an alignment of holes **21'** and **22'** so that the particulated material can flow into the passageway **25'** and on down into the still larger internal passageway **26'** where the sample will eventually reach an outlet port, such as provided by nozzle **31** in FIGURE 1. In the embodiment of FIGURE 3, there is indicated a modified form of stop means for adjustment of the longitudinal movement of capsule **12'** by the use of a threaded screw member **37** passing through the end portion of cap section **10'**. For the positioning of inward movement, there may be a suitable stop means such as **38** on the lower end of sleeve **36** so that the lower end portion of capsule **12'** can move downwardly to engage such stop means **38** and provide for an alignment of holes **11'** and **20'**.

Again, it is pointed out that other structural or mechanical forms of stop arrangements may be provided for limiting movement for the alignment of holes. Such means being obvious to those skilled in the mechanical arts, and it is not intended to limit the present invention, which uses the longitudinally moving capsule section and improved internal flow path arrangements, to any one detailed design. However, as set forth hereinbefore, a preferred design and assembly utilizes the valve bonnet stem **17** travel to effect alignment of both the inlet and outlet openings.

I claim as my invention:

1. A sampling apparatus for material being held within a contact chamber, which comprises in combination,

(1) an elongated and closed end tubular member having external mounting means adapted to rigidly hold such member inserted into the contact chamber, with

(2) said tubular member further having a side sample inlet opening adjacent the closed inner end thereof and a sample outlet passageway provided from the exterior end portion thereof,

(3) a non-rotating sample receiving capsule member sized and adapted to slidably fit into said tubular member for reciprocatory longitudinal movement therein,

(4) an inner sleeve member with a sample outlet wall opening therethrough fixedly held in said tubular member and positioned to have a sliding contact with the lower portion of said capsule member, said inner sleeve member being located intermediate to said sample inlet opening and the sample outlet passageway,

(5) said capsule member being provided with upper and lower openings in the side wall portion thereof, with the upper opening positioned to be in alignment with said inlet opening in said tubular member for one position therein, and said lower opening positioned to be in alignment with said outlet opening of said sleeve member for another position,

(6) passageway means from around said sleeve and through the interior of said tubular member to said sample outlet passageway therefrom, and

(7) longitudinally movable shaft means extending through said tubular member from the exterior end portion thereof to connect with said capsule member for effecting its longitudinal sampling movements.

2. The sampling apparatus of claim **1** further characterized in that said sample receiving capsule member has an upper portion sized to be a sliding fit within the upper portion of said tubular member and the lower portion of said capsule member is of smaller cross-section which is sized to provide a sliding fit within said inner sleeve member, with the latter being smaller than the interior of said tubular member whereby to provide a sample outlet passageway between said sleeve and the interior of said tubular member.

3. The sampling apparatus of claim **1** further characterized in that said sample receiving capsule member is of a uniform cross-section throughout the major portion of its length and said inner sleeve member is provided around the lower portion of said capsule member of a cross-section equivalent to the upper portion of said tubular member, whereby there is a uniform path for a sliding longitudinal movement of said capsule member, and at least a portion of said tubular member is of enlarged cross-sectional area at the zone of said inner sleeve member and spaced therefrom to provide passageway means for the withdrawn sample to the interior of said tubular member.

4. The sampling apparatus of claim **1** further characterized in that said longitudinally movable shaft means from said capsule member extends through said tubular member and through said external mounting means to a swivel connection in turn connecting with a hand wheel means and rotatable stem means which will provide for longitudinal adjustment of the capsule member within said tubular member.

5. The sampling apparatus of claim **4** still further characterized in that the rotatable hand wheel means and the stem means are provided in a valve bonnet type assembly and the length of travel of the stem therefrom is correlated with the spacing of said inlet and outlet openings whereby proper sample inlet positioning is obtained for one end of travel of the stem and a proper sample outlet positioning obtained for the opposing end of travel for the stem.

6. The sampling apparatus of claim **1** further characterized in that the external mounting means for said tubular member includes a bolted flange member to which said tubular member is fixedly attached in a manner extending axially therefrom, whereby said flange member

may have a bolted connection with a standard nozzle flange from said contact chamber, and whereby said elongated tubular member can in turn extend axially through said nozzle into the interior of said chamber.

7. The sampling apparatus of claim 6 still further characterized in that said external mounting means provides a spool section extending exteriorly from said flange member and a sample outlet nozzle extends from such section to provide the sample outlet passageway, and a filler section is provided around the movable shaft means in the furthermost part of the internal portion of said spool member to provide a blockage for the passageway for sample withdrawal and to divert sampled particulates to said outlet passageway.

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