

May 27, 1952

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2,598,535

SAMPLING DEVICE

Filed June 30, 1948

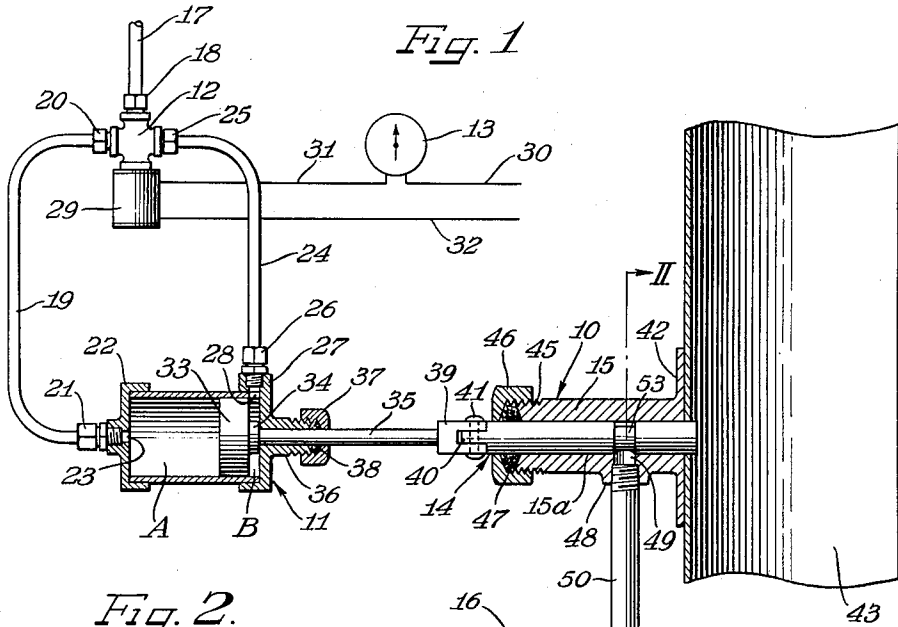


Fig. 2.

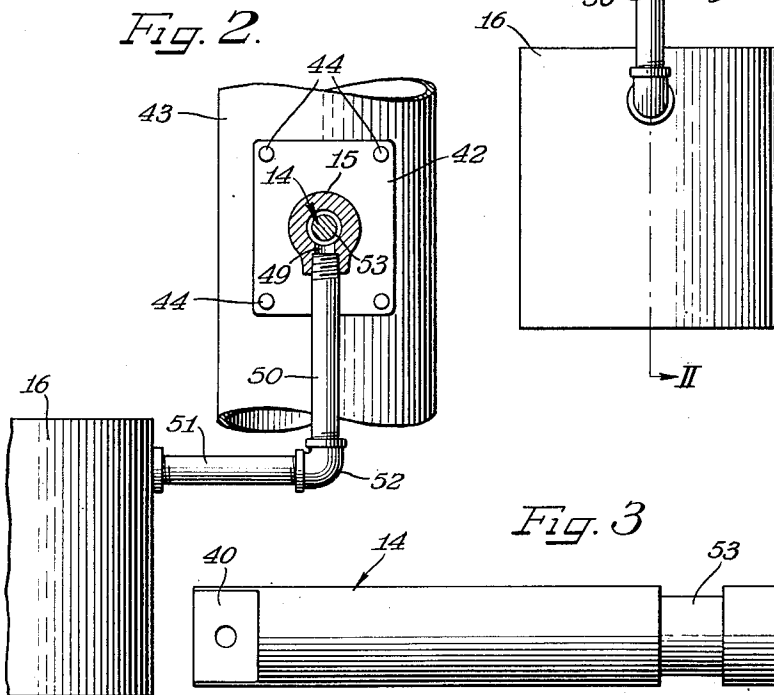
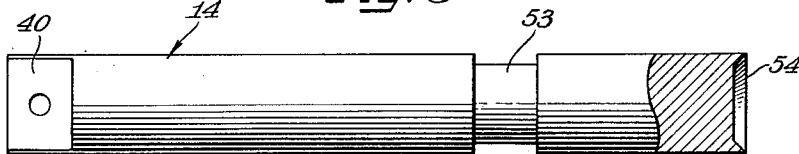


Fig. 3



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UNITED STATES PATENT OFFICE

2,598,535

SAMPLING DEVICE

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Application June 30, 1948, Serial No. 36,091

4 Claims. (Cl. 73-422)

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This invention relates to a sampling device, and more particularly to devices for the sampling of flowable materials, such as liquids, liquids containing semi-solids or particulated solids.

The present invention is particularly adapted for the sampling of fluid suspensions of finely particulated solid material which may contain relatively large chunks of solid matter. The suspensions may be contained in any type of receptacle, the term "receptacle" being understood to include both vessels containing the flowable material and conduits through which the material may flow. For example, in the manufacture of paper, wood pulp in the form of a finely particulated aqueous suspension must be tested by both chemical and physical methods at various stages of pulp manufacturing, treating and refining process in order to insure the preparation of a uniform product. A sample taken from the digester prior to the final "blowing" step may, for instance, contain relatively large uncooked knots or chips which would jam or block conventional sampling devices.

The present invention now provides a sampling device which may be employed to obtain test samples of pulp masses or the like material while the masses are flowing through a conduit or are contained within a tank. The sampling device of the present invention is self-cleaning and will not be jammed by the presence of relatively large chunks of solid material. The sampler may be automatically regulated so that the frequency of sampling and the size of sample obtained may be regulated and varied in accordance with the desires of the user. The operation of the sampling device is independent of the pressure or temperature to which the body of material to be sampled is subjected, and the simplicity of the sampler construction makes possible the operation of the device under adverse conditions.

In general, the sampling device of the present invention comprises an air cylinder having a piston mounted therein for reciprocating movement, the movement of the piston being determined by the introduction of air under pressure from a suitable air source controlled by a solenoid operated valve which in turn may be controlled by a timer to determine the frequency and size of the samples. The reciprocating piston within the air cylinder is secured to a piston rod or stem extending beyond the air cylinder and connected to a piston or plunger movable in an accurately bored cylindrical aperture formed in a mounting block secured to the container or conduit within which the material to be tested is confined. The plunger extends into the conduit or vessel through an aperture in one of the walls thereof and reciprocates within the cylindrical bore of the mounting block to open and close a port formed in the block in communication with a

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sample receptacle. In the operation of the sampling device of the present invention, the timer and the solenoid operated valve, by controlling the movement of the piston mounted in the air cylinder, also control the movement of the plunger reciprocating within its cylinder to open or close the port leading to the sample receptacle. Thus, test samples of the material confined in the vessel or conduit may be extracted therefrom in amount and at timed intervals determined by the movement of the piston within the air cylinder. The forward edge of the plunger (that edge extending into the vessel or conduit) is provided with a sharp cutting edge to shear off and eject knots or other solid matter which may be present in the suspension and which would tend to jam the sampling device by wedging in the openings or ports thereof. This self-cleaning feature provided by the sharpened edge of the plunger makes possible the sampling of paper pulp even though the pulp suspension may contain uncooked knots or chips.

It is, therefore, an important object of the present invention to provide a sampling device for the sampling of flowable materials contained in a receptacle.

It is a further important object of the present invention to provide a sampling device which may be automatically regulated to determine the size of the sample and frequency of sampling of a fluid suspension of finely particulated solid material containing relatively large chunks of solid matter, the suspension being contained in a suitable receptacle.

A still further important object of the present invention is to provide a sampling device for the removal of samples of predetermined size and at predetermined intervals from a body of flowable material flowing through a conduit, the device being self-cleaning to prevent the jamming of the device by relatively large particles of solid matter in the flowable material.

Other and further important objects of this invention will be apparent from the disclosures in the specification and the accompanying drawings.

On the drawings:

Figure 1 is a cross-sectional view with parts shown in elevation of a sampling device of the present invention;

Figure 2 is a partial cross-sectional view taken along the line II-II of Figure 1; and

Figure 3 is an enlarged elevational view with parts shown in section of the plunger of the sampling device of the present invention.

As shown on the drawings:

In Figure 1, reference numeral 10 refers generally to the sampling device of the present invention comprising in general an air cylinder 11, a solenoid-operated, three-way valve 12 for control-

ling air introduced into the air cylinder, a timer 13 for controlling the movement of the valve 12, a plunger 14 capable of reciprocating movement determined by air introduced into the air cylinder 11 through the valve 12, a mounting block 15 within which the plunger 14 operates, and a sample catcher 16 in communication with the cylinder 15.

More particularly, the air cylinder 11 is connected to a suitable source of air under pressure (not shown) by means of air conduit 17 connected to the three-way valve 12 by means of fitting 18. Conduit 19, connected to the valve 12 by fitting 20, is secured by means of fitting 21 to one face plate 22 of the air cylinder 11. The face plate 22 is centrally apertured as at 23 to provide an inlet for air under pressure into the air chamber A of the air cylinder 11. A second conduit 24 is connected to the three-way valve 12 by fitting 25 and to the air cylinder 11 by fitting 26 connected to the other face plate 27 of the air cylinder 11. Communication with the air chamber A of the cylinder 11 is provided by means of aperture 28 in the face plate 27.

The three-way solenoid operated valve 12 is controlled by means of the solenoid 29 so that air under pressure entering the valve through conduit 17 may be directed into either of the conduits 19 or 24 for introduction into the air chamber A of the air cylinder 11. The energization of the solenoid 29 may be controlled by an electrically or mechanically operated timer 13. The timer 13 may be, for instance, an electric motor connected to conductor 30 and having a speed reducer operating electrical contacts connected to conductor 31 whereby the energization of the solenoid 29 through conductors 31 and 32 may be controlled.

A piston 33 carrying a concentric integrally formed boss 34 is mounted for reciprocating movement within the air chamber A of the air cylinder 11. The movement of the piston 33 within the chamber A is accomplished by the introduction of air under pressure through either of the conduits 19 and 24, depending upon the position of the solenoid 29 as determined by the timer 13. It is to be noted that the boss 34, being smaller in diameter than the piston 33 and extending laterally therefrom, contacts the end plate 27 of the air cylinder 11 to prevent any abutment of the piston 33 against the end plate 27. The boss, when in abutment with the end plate 27, thus provides a small annular air space B between the piston 33 and the end plate 27 so that air admitted into the chamber B through the conduit 24 may serve to force the piston 33 through the air chamber A into contact with the end plate 22.

A piston stem 35 is secured to the boss 34 and extends outwardly beyond the cylinder 11 through an externally threaded and internally apertured boss 36 formed integrally with the end plate 27 and receiving an internally threaded centrally apertured nut 37 threaded thereon. The valve stem 35 extends through the central apertures of the boss 36 and the nut 37, and packing 38 is provided in the nut 37 to prevent leakage of air about the piston stem from the air chamber B.

The stem 35 is secured to a bifurcated mounting block 39, the bifurcated portions of the block being centrally apertured as illustrated. The piston 14 is provided with a mounting stud 40 adapted to extend between the bifurcated portions of the mount 39. The stud 40 is centrally apertured, the aperture being in registration with

the apertures of the bifurcated portions of block 39 to receive rivet 41 therethrough to secure the piston 14 to the rod 35 for reciprocating movement therewith.

The piston 14 is thus operatively connected to the piston 33 for reciprocating movement therewith, the piston 14 reciprocating within the central cylindrical bore 15a of the mounting block 15 for the purposes hereinbefore defined. The block 15 carries integral mounting flange 42 curved to the contour of the conduit 43, the flange 42 being secured to the conduit 43 by means of rivets 44 or by other suitable means. That end of the block 15 opposite the flange 42 is externally threaded as at 45 to threadedly receive a centrally apertured nut 46, the nut 46 and the matching end of the cylinder 45 being cut away to provide an annular space for receiving packing 47. The block 15 is also provided with an integrally formed depending boss 48 which is centrally apertured as at 49 at right angles to the central bore 15a of the block 15. The boss 48 is internally threaded to receive a conduit 50 depending therefrom and connected to a horizontally extending conduit 51 by means of elbow 52. The horizontally extending conduit 51 is threaded into an aperture formed in the sample receptacle 16 so that fluid flowing from the conduit 43 through the aperture 15a, the aperture 49 and the conduits 50 and 51 may enter the sample receptacle.

As illustrated in Figure 3, the piston 14 is generally cylindrical in form and has a reduced shank portion 53 which directly overlies the vertically extending aperture 49 of the block 15 when the piston is in its forwardmost position as illustrated in Figure 1. The forward edge of the piston 14 (that edge opposite the stud 40) is sharpened as illustrated in Figure 3 with the head of the piston being axially countersunk to define an annular cutting edge 54.

In the operation of the sampling device of the present invention, the device is assembled as shown in Figure 1, and the conductors 30 and 32 are connected to a suitable source of electricity. The conduit 17 is connected to a suitable source of air under pressure and the flange 42 is secured to the wall of a conduit such as 43 or a suitable vessel which is apertured to receive a sharpened end 54 of the piston 14. The solenoid 29, operated by the timer 13, operates the three-way valve 12 to alternately direct air under pressure into the conduits 19 and 24 in predetermined order and in timed sequence. The introduction of air under pressure into the air chamber A of the cylinder 11 causes movement of the piston 33 within the chamber, the direction of movement of the piston depending upon that particular conduit into which air is directed from the three-way valve 12. Movement of the piston 33 causes a corresponding movement of the piston 14 within the block 15. Upon the movement of the piston 33 toward the end closure 22 of the air cylinder 11, the piston 14 is moved away from the conduit 43 so that the suspension of pulp or other solid material passing through the conduit 43 may flow into the bore 15a, through the aperture 49, and through the conduits 50 and 51 into the sample receptacle 16. The introduction of air through the conduit 19 into the air cavity A will cause the piston to move toward the closure plate 27, causing a corresponding movement of the piston 14 and closing the communication between the bore 15a and the aperture 49.

It is possible that uncooked knots or chips pres-

ent in the pulp suspension may block the aperture 49 by becoming wedged therein and extending into the bore 15a, or it is possible that the bore 15a itself may become blocked at its entrance by the presence of such relatively large chunks. The sharp edge 54 of the piston 14 will shear off any such knots or chips so that the piston may be returned to the position shown in Figure 1 to shut off the flow of suspension from the conduit 43 to the sample catcher 16. The advantages of this self-cleaning feature of the sampling device of the subject invention as particularly applied to the sampling of a suspension of pulp will be readily appreciated.

It will, of course, be understood that various types of timing devices may be employed to determine the duration of time during which the sample is taken and also to determine the number of samples to be taken in a given period of time. The sampling device of the present invention is entirely automatic and the sample catcher may be emptied when desired so that the samples contained therein may be analyzed by any desired method.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention, and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. A sampling device for the sampling of material contained in a receptacle comprising a mounting block secured to said receptacle and having a centrally extending bore formed therein having an opening in communication with the interior of said receptacle, a plunger mounted in said block for reciprocating movement within said bore and having a sharpened edge extending through the side wall of said receptacle, a sample receptacle conduit in communication with said bore in spaced relation to said bore opening, and means for reciprocating said piston within said bore to establish and interrupt the flow of material contained within said receptacle to said sample receptacle conduit, said plunger being retractable beyond said conduit to accommodate flow thereinto from said receptacle and extensible for interposition between said conduit and said receptacle, the sharpened edge of said plunger serving to sever any particles which may become lodged in said bore to impede the flow of material into said receptacle conduit whereby movement of said piston within said bore controls the flow of material from said receptacle into said sample receptacle conduit.

2. A sampling device for the removal of samples of flowable material from a receptacle comprising a mounting block adapted to be secured to the side wall of said receptacle and having a bore extending axially therethrough in communication with the interior of said receptacle, a piston carried by said block for reciprocating movement from a first end position to a second end position within said bore, a sample receptacle in communication with said bore, and pneumatic means for reciprocating said piston within said bore, said piston constituting a cut-off barrier in the communication between said receptacle and said sample receptacle in said first end position and permitting a direct communication between said receptacle and said sample receptacle in said second end position so that a portion of the material contained in said recep-

tacle may be diverted into said sample receptacle.

3. A sampling device for the removal of portions of a suspension of particulated material in a fluid medium from a receptacle comprising a mounting block secured to said receptacle and having a central bore formed therein in communication with the interior of the receptacle at one end thereof, a sample receptacle communicating with said bore in spaced relation to said one end thereof, a plunger freely movable in said bore within the confines thereof and having a sharpened edge extending into said bore and means for effecting reciprocating movement of said plunger in said bore to establish and interrupt the flow of said suspension from said receptacle into said sample receptacle by movement of said plunger into and out of that portion of said central bore joining said receptacle to said sample receptacle, the sharpened edge of said plunger serving to shear any particles which may become lodged in said bore so that the flow of said suspension into said sample receptacle may not be impeded.

4. A sampling device for the removal of portions of a suspension of particulated material in a fluid medium from a receptacle comprising a mounting block secured to said receptacle and having a central bore formed therein having one end in communication with the interior of the receptacle, a plunger freely movable in said bore and having a sharpened edge extending into said receptacle, a sample receptacle, a sample conduit in communication with said bore in spaced relation to said one end of said bore and pneumatic means for effecting reciprocating movement of said plunger in said bore, said plunger being retractable in said bore beyond said sample conduit to establish the flow of said suspension from said receptacle into said sample receptacle and movable to a position interposed between said sample conduit and said one end of said bore to interrupt flow of said suspension therebetween, said pneumatic means including a pneumatic cylinder connected to a source of fluid under pressure, a piston mounted in said pneumatic cylinder for reciprocating movement therein, means for introducing fluid under pressure into said cylinder in predetermined timed sequence to effect movement of said piston therein and means operatively connecting said plunger to said piston for movement therewith, the sharpened edge of said plunger serving to shear any particles which may become lodged in said bore between said one end thereof and said sample conduit, so that the flow of said suspension into said sample receptacle may not be impeded.

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