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SAMPLING DEVICE FOR PRESSURIZED CONVEYORS

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2 Sheets-Sheet 1

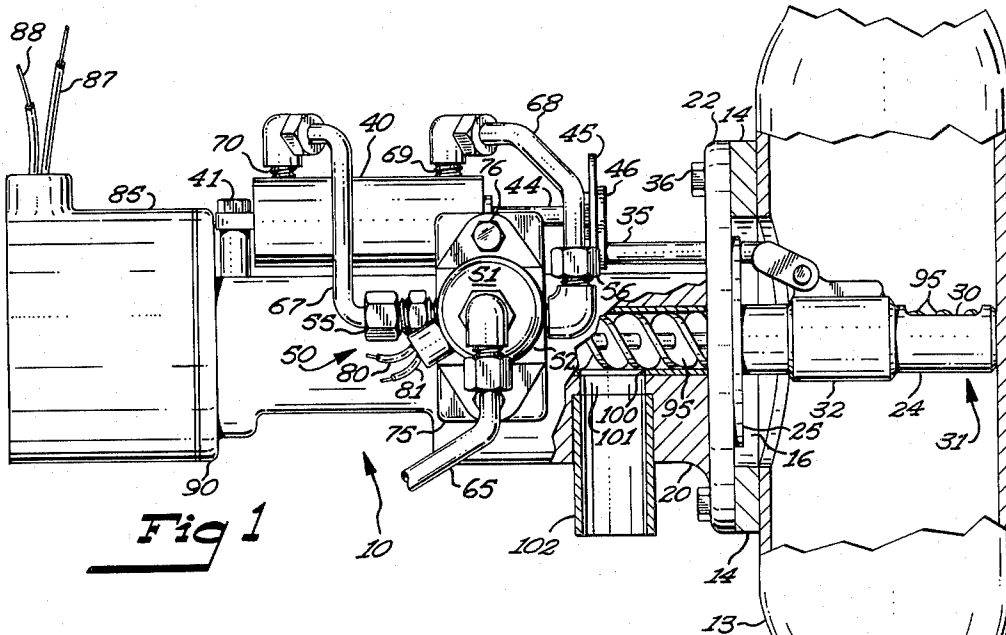


Fig 1

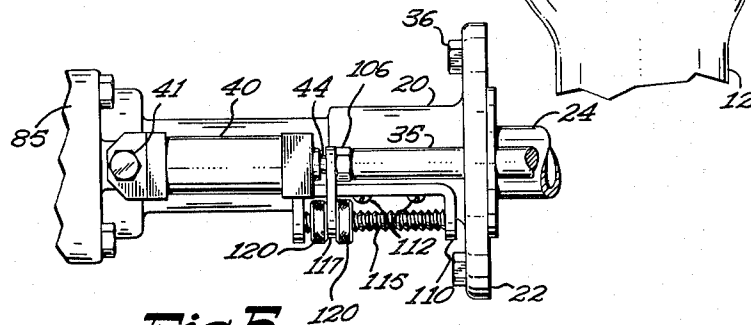


Fig 5

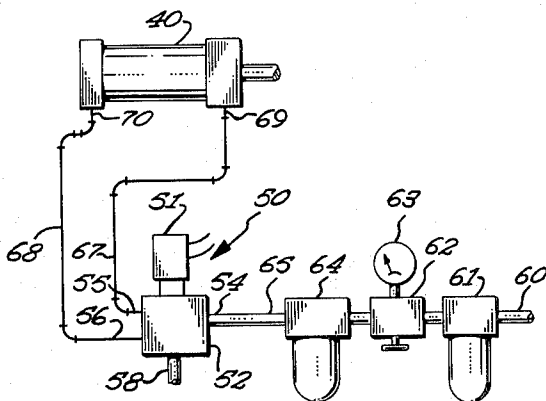


Fig 3

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SAMPLING DEVICE FOR PRESSURIZED CONVEYORS

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This invention relates to sampling devices for sampling granular or powdery material in bulk and more particularly to an improved sampling device for taking samples of granular material which are being conveyed through a tube or conduit under pressure, such as in pneumatic type conveying apparatus.

Devices of this general type have previously had a disadvantage in that they impede conveying flow and fail to get accurate samples. Some of these inaccuracies arise from the fact that such devices do not clean themselves thoroughly and thus retain part of the previous sample. Further, these prior devices do not take samples which are truly representative of the material being conveyed because the sample is not large enough for the material being conveyed or is not taken over a sufficient period of time to be an accurate sampling. In addition, when samples are taken from pressurized conveying lines, such as pneumatic conveyors, the sample is delivered to a sample discharge passage under pressure such as to be mixed with air and a problem exists in handling of the sample and separating it from the air for examination and test. This makes it difficult to utilize a sampling device in an automatic and continuous sampling process.

The present invention provides a device which overcomes these difficulties and disadvantages without impeding the conveying operation. With the improved sampling device of the subject invention, sampling may be done selectively over a wide range of sampling periods and with variably sized samples being taken from a pressurized line. The device further provides for completely discharging a sample before a new one is taken and for discharging the sample under conditions where it is not disturbed by the pressure in the conveying line. The improved device is also capable of being used in a continuous sampling process and can be used with a variety of materials and types of pressurized conveying apparatus.

The improved sampling device of the subject invention includes a sampling tube adapted to be positioned in a pressurized conveying line which tube has a valve therein that is adjustable in its degree of opening and operation to vary the size of sample and the length of time in which a sample is to be taken. The tube includes an auger which is motor driven for conveying the sample to a discharge point, and the motor driven auger is operated in conjunction with the operation of the valve and over a sufficient period to insure that the sample is completely discharged before a new one is taken. Further, the operation of the motor driven auger is adjustable over a period of time for any size sample and any period of sampling to obtain a truly representative sampling. The improved sampling device includes a control and timing apparatus for operating the sampling device. In addition, the operation of the motor driven auger and its physical relationship with respect to the sampling tube prevents the air or pressurized medium in the conveying line from escaping into the sample discharge area. This improved sampling device for a pneumatic conveyor is relatively compact, simple in design, and is inexpensive to manufacture.

It is therefore an object of this invention to provide an improved sampling device for granular or powdery material conveyed in a pressurized conveying apparatus.

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Another object of this invention is to provide a sampling device which does not impede the conveying operation.

A further object of this invention is to provide an improved sampling device wherein samples of the material may be taken from a pressurized conveying line in a continuous operation or at will without disturbing the timing of the sampling operation.

Another object of this invention is to provide a sampling device which is adjustable to take a sample over selectively variable periods and in variable amounts to provide a highly representative sample for the material being conveyed in the pressurized conveying line.

A still further object of this invention is to provide in an improved sampling device an arrangement for removing a previous sample prior to the taking of a new sample to insure reliability and accuracy in the sampling operation.

A further object of this invention is to provide in an improved sampling device for pressurized conveying lines means for eliminating the effect of the pressure on the material being conveyed at the sample discharge point.

A still further object of this invention is to provide an improved sampling device which is reliable in operation and simple to operate, install and maintain.

These and other objects of this invention will become apparent from the reading of the attached description together with the drawings wherein:

FIGURE 1 is a side elevation view of the improved sampling device with a mounting tube for the same shown in section,

FIGURE 2 is a top elevation view of the device shown in FIGURE 1,

FIGURE 3 is a schematic diagram of a pneumatic circuit for a portion of the improved sampling device,

FIGURE 4 is a schematic electrical diagram for a portion of the improved sampling device, and

FIGURE 5 is a diagrammatic view of an alternate construction of a portion of the improved sampling device.

Our improved sampling device for pressurized conveyors is shown in elevation view in FIGURES 1 and 2 with portions of the apparatus omitted for simplicity. This sampling device has been designated with a general numeral 10 and may be used in pressurized conveying lines directly or mounted in a special connecting tube section indicated at 12 having an enlarged portion as at 13, which tube section may be connected into a pressurized conveying line. The improved sampling device, however, may be directly inserted into a conveying line without the separate mounting section through a suitable adapter. As will be seen in FIGURE 1, the conveying section 12 at the enlarged portion 13 thereof includes a circular flange 14 integral therewith and having a passage therethrough, as at 16, communicating with the interior of the tube. The sampling device 10 is adapted to be mounted on the circular flange 14 of the enlarged section of the conveying tube and, as will be seen in FIGURE 1, the sampling device includes a support or mounting member 20 having a circular flange 22 integral therewith which is designed to fit against and mount on the circular flange 14 of the conveying tube. The flanged mounting member 20 of the sampling device has secured therein the sampling tube 24 which is designed to be sealed in the mounting member 20 and rigidly positioned therein through a support member 25 with portions of said conveying tube extending to either side of the flange 22 of the mounting member 20. One portion of the sampling tube 24 extending beyond the flange 22 is adapted to be positioned within the conveying tube 12 when the sampling device is mounted on the flange portion 14 of the enlarged section of the conveying tube. This portion of the sampling tube has an opening or aperture 30 therein

which is located within the conveying tube when the sampling device is mounted thereon. Further, this opening will be so positioned, when the sampling device is assembled on the conveying tube, to be facing upstream of the flow of material through the conveying tube so that a portion of the material within the conveying tube will be directed through the opening 30 and into the sampling tube 24. Associated with the opening 30 is a sleeve type valve member 32 which is slidably mounted on the tube and cooperates with the opening 30 to form a sliding valve 31 for the sampling tube.

As will be hereinafter noted, the sliding valve 31 will be periodically and selectively opened in varying degrees, depending upon the size of the sample to be obtained and the frequency of sampling, to receive a portion of the material being conveyed in the pressurized conveying tube. The size of the opening 30 of the valve and its location relative to the confines of the enlarged section 13 of the conveying tube will insure that a generally representative sample of the material being conveyed through the tube over its entire cross section is obtained. It will be understood that during material flow in the pressurized conveying tube or in a coupling section, such as in shown in FIGURE 1, that the material under pressure will be generally mixed with air and the taking of the sample will normally involve opening a passage from the conveying tube through the sampling device to allow a portion of the air within the tube to escape, taking the sample material therewith. Therefore, unless the valving can be selectively controlled and the path through the sampling device substantially impeded, the material being sampled will normally be blown into the sample receiver and be mixed with the air taking additional time for the particles of the material being conveyed to settle out before the sample can be tested and sometimes resulting in wastage of the sample material. As will be hereinafter noted, the improved valve of the sliding type offers substantially little impedance to the flow of material through the conveying tube and cooperates with means for delivering the sample from the sampling device to prevent the sampled material from being blown, scattered or agitated at the delivery point.

The sleeve member 32 of the valve 31 is actuated or moved through a shaft 35 which is slidably mounted and sealed in the flange 22 of the mounting member 20. This seal, together with the sealing of the tube 24, and the mounting of the sampling device on the conveying tube prevents air leakage at these points. Thus, as will be seen in FIGURE 1, the flange 22 of the mounting member 20 is mounted on the flange 14 of the conveying tube and is suitably secured thereon by bolt means 36 to provide a pressure seal at this point. The valve 31 formed by the sleeve member 32 and opening 30 is operated by a fluid pressure pneumatic actuator, indicated at 40, mounted on the mounting member 20 of the sampling device through bolt means 41. The actuator 40 is shown in outline form only with the internal details omitted for simplicity since any conventional reversible fluid actuator may be utilized for this purpose. It includes an operating shaft 44 extending from the cylindrical form of the fluid actuator and being guided through an upstanding guide 45 mounted on the flanged mounting member 20 of the sampling device through a hole therein. A coupling member 46 couples the actuator shaft 44 with shaft 35 operating the valve 31 so that the sleeve type valve member 32 may be moved with movement of the actuator shaft 44. The guide 45 is adjustably positioned on the mounting member 20 of the sampling device through slots 48 therein by means of which the guide 45 is mounted on the flanged mounting member 20 through suitable bolt means 49. Coupling member 46 serves a dual function in that it also provides a stop member for controlling the movement of the sleeve 32 with respect to the guide 45 or an upstanding portion thereof. While separate shafts are shown herein for the connection from the motor

to the sleeve type valve member 32, it will be recognized that a single shaft of the motor may be employed for this purpose, if desired. By limiting movement of the actuator shaft 44, in the direction where it is withdrawn into the confines of the actuator 40, the opening movement of the slide valve 31 or the movement of the sleeve member 32 of the same is limited. This valve is shown in FIGURES 1 and 2 in its maximum opened position and through adjustment of the position of the guide 45 on the mounting member 20, any degree of opening of the valve 31 may be set to limit the size of the sample being taken from the conveying tube.

Actuator 40 is controlled from a pneumatic fluid source through the operation of a valve means, indicated generally at 50, having an electric solenoid or actuator part 51 for operating the same. The valve structure includes a four way valve indicated at 52, as will be seen in FIGURE 3, having an inlet pipe 54 with a pair of outlets 55, 56 therefrom and a vent to atmosphere indicated schematically at 58. The actuator 40 is energized through the pneumatic circuit shown schematically in FIGURE 3 which includes a conduit 60 adapted to be connected to a source of pneumatic power and including a general assembly of a filter 61, a pressure regulating valve 62 with an indicating meter 63 thereon, and an oil bath 64, which assembly is connected to and supplies air under regulated pressure to the valve 52 through the conduit indicated generally at 65. The outlet conduits 55, 56 of the valve are connected through piping or conduits indicated schematically at 67, 68 leading to the extremities of the actuator 40 as indicated by the coupling members 69, 70. For simplicity, a portion of this apparatus is removed from FIGURES 1 and 2 since it is a conventional assembly. Thus, in FIGURES 1 and 2, the assembly including the filter 61, pressure regulating valve 62, meter 63, and oil bath 64 are eliminated from the connection to the valve since their details form no part of the present invention and represent only a source of regulated pressure to be controlled by the valve 50 in the energization and operation of the actuator 40. Thus, as will be seen in FIGURES 1 and 2, only the control component or valve 50 is shown mounted on the mounting member 20 through suitable bracket means 75 secured to the mounting member 20 through screw means 76 with the conduits 67 and 68 extending from the valve to the coupling ends 69 and 70 of the actuator. The inlet conduit 65 for the valve is shown and it will be understood that the filtering and regulating assembly will be attached to the valve and suitably mounted on the flange type mounting member 20 or may be separated therefrom if desired. The control of the valve 50 will direct air to one or the other of the extremities of the fluid actuator or pneumatic actuator to cause the shaft 44 thereof to move in one or the other direction to open or close the sliding valve 31 or the sleeve member 32 forming the same with the opening 30 in tube 24. Whenever air is introduced into one end of the cylinder, the opposite end of the cylinder is connected through the four way valve 50 to atmosphere, as indicated by the schematic piping 58 in FIGURE 3. The internal details of the valve 50 are omitted as well as the internal details of the solenoid or electromagnetic actuator 51 since any conventional electromagnetically operated valve of the four way type may be utilized for this purpose. The electromagnet or actuator 51 of the valve 50 is adapted to be energized through inlet conductors 80, 81 which appear in the electrical control circuit of FIGURE 5 to be hereinafter described.

Also mounted on the mounting member 20 of the sampling device is an electric motor, indicated generally at 85, which motor has inlet conductors 87, 88 connected therewith for energizing the same. The energizing circuit for the motor is also shown in FIGURE 5. Motor 85 is mounted on the mounting member 20 through a

flange portion 90 thereof which is secured thereto through suitable screw means (not shown). Extending from the motor 85 is an operating shaft (not shown) which connects with an auger 95 positioned within the sampling tube 24. The auger 95 has a high pitch flighting and is physically sized to fit snugly within the sampling tube to provide a minimum of clearance between the walls of the tube and the surface of the auger. Although not shown, it will be understood that the sampling tube 24 is closed at its extremities and the operating shaft of the motor extending through the flange type mounting member 20 will pass through and be journaled in the end of the sampling tube which is supplied with a suitable seal to prevent the escape of the air at this point from the sampling tube. A discharge opening 100 in the sampling tube is provided which connects with an opening 101 in the mounting member 20 and terminates in a fitting member 102 by means of which flexible conveying pipe for the sampled material may be connected to pass the sample to the location at which testing of the same will be completed or at which the sample will be collected for testing. Thus, except for the valve opening 30 of the slidable valve and the opening 100 in the sampling tube, the sampling tube is sealed with the auger 95 positioned therein which is designed to move the sample material from the opening 30 where it is received from the conveying pipe through the sampling tube to be discharged through the discharge conduit or fitting member 102 of the sampling device.

It will therefore be seen that the improved sampling device includes a motor driven auger 95 within the sampling tube for moving the sampled material from the sampling tube to a discharge point. Further, the sampling device includes a slidably mounted valve on the end of the sampling tube which controls the amount of sample to be taken into the sampling tube from the pressurized conveying line. The size of the valve opening may be adjusted for given materials and different pressures on the conveying line through adjustment of the guide 45 defining the stop for the actuator 40 and hence the limit position for the valve 31 in the open direction.

An alternate construction of this stop means is shown in FIGURE 5. In this reduced size view, the actuator 40 through its shaft 44 is connected to a coupling member 106, equivalent of the coupling member 46 in FIGURE 2, which serves to connect the actuator shaft to the guide shaft 35 for the valve 31. Only a portion of the sampling device is shown sufficient to outline the details of the alternate or modified stop structure. In this alternate embodiment, a U shaped bracket 110 is mounted on the mounting member 20 through suitable screw means 112 with the extremities of this bracket mounting a threaded shaft 115 therebetween. Loosely positioned on the shaft is a flange type stop member 117 which is adjustably positioned along the threaded shaft through a pair of nuts 120 positioned on either side thereof. By adjustment of the nuts 120 on the shaft 115, the flange member 117 may be adjusted relative to the mounting member 20 to define a limit position for the coupling member 106. The free extremity of the flange 117 has an aperture therein, not shown, through which the shaft 44 extends such that the flange 117 will be engaged by the coupling member 106 on the shaft in the return or opening stroke of the valve 31. The bracket 110 is rigidly secured to the flanged mounting member 20 of the sampling device and adjustment of the nuts 120 on the threaded shaft 115 will limit the position of the valve shaft 35 to limit the opening position of the valve connected thereto.

The electrical circuit for operating the solenoid operated or electrically operated valve 50 and the motor 85 of the improved sampling device is shown schematically in FIGURE 6. This portion of the improved sampling device is normally positioned in a control console which

may be located remote from or in proximity with the improved sampling device, as desired, with the electrical connections therebetween. The electrical connections extending between the electric control circuit in the console (not shown) includes the lead wire conductors 80 and 81 of the valve 50 and motor leads 87, 88 of the motor 85 as shown in FIGURES 1 and 2.

As will be seen in FIGURE 6, the electrical portion of the improved sampling device is adapted to be connected to a source of alternating current, such as a 110 volt, 60 cycle source, which source is evidenced by the conductors 110, 111 in FIGURE 6. The electrical circuit includes an ON-OFF control switch 112 of the single pole double throw type which is schematically indicated as separate switches. These switches isolate the source conductors 110, 111 from the control circuit which includes a fuse element 114 and conductors 116, 117 across which is connected an indicating light 115 to provide a visual indication of when power is applied to the control circuit. In addition to the ON-OFF switch 112, the electrical circuit includes a pair of single throw double pole control switches, indicated at 120 and 122, which switches, as will be later described, provide a shunt circuit control around a timing device generally designated at 130 which controls normally the energization and operation of the electromagnetically operated valve 50 and the motor 85. The timing device 130, as will be seen in FIGURE 6, controls the energization of a pair of timing relays evidenced by the coils 132, 134 and a time delay control switch or relay 136 operative to control the motor 85.

In the electrical circuit, switch 120 is a continuous run switch which is shown in the OFF position with the movable portions thereof connected by a conductor 140 to the conductor 116 or one side of the source of power and through conductor 141 and the OFF position of the switch 120 to the second switch 122 which is a manual instantaneous control switch. Switch 122 may be of the momentary contact type which in its OFF position is connected through the conductor 144 to a normally closed contact 145 of the timing reset relay 132. Relay 132 has a short time delay in closing upon energization and a given time delay in opening thereafter upon de-energization of the relay. This circuit from the contact 145 includes a coil 150 of a control relay within the interval timer 130. Relay coil 150 has a two position switch located within the timer 130 and identified generally at 152. The circuit from the relay coil 150 is completed through a conductor 153 leading to the conductor 117 at the opposite side of the source of power. Also included in the timer 130 is a timing motor 155 which is connected to the conductor 153 and a conductor 157 leading to a first single pole double throw switch 158 which is operated by the timing motor 155. The conductor 157 is connected to the switch 158 at its normally closed contact with this energization circuit being completed through the conductor 160 connected to a conductor 162 leading to the conductor 144 and the switches 120, 122. Thus, when the switches 120, 122 are in their normally closed position, a circuit is provided between conductors 116, 117 for the energization of the coil 150 and motor 155. Timing motor 155 includes a second single pole double throw switch, indicated generally at 165, which is moved between a normally open position represented by contact 167 and a normally closed position represented by contact 170. The normally open position 167 of switch 165 of the timer motor 155 connects the timer reset relay 132 or its coil between conductor 117 and conductor 162 leading to the switches 120 and 122 and the opposite side of the source of power or conductor 116. The time delay relay 134 or its relay coil is connected in parallel with this circuit by a conductor 172 which connects to the normally open contact of switch 165.

An alternate energization circuit bypassing the timer 130 for the time delay relay 134 is provided through the conductor 175 which connects to the normally open sides of the switches 120, 122, as indicated by the conductors 176 and 177. It will be seen in the schematic diagram, that a circuit may be provided independent of the timer 130 by moving either of the switches 120 or 122 from their OFF position to an ON position to provide a circuit from the conductor 116 through the conductor 140 and the open side of these switches to the conductor 175 leading to the relay coil 134 and the conductor 117 on the opposite side of the source of power. As will be later evident, the conductor 172 also permits energization of the timing reset relay coil 132 in this circuit, but since its only function is to control the contact 145 in series with the timer 130, its energization will have no effect on the bypass or independent operation of the control circuit for the valve 50 and motor 85. The timing relay coil 134 which is shown only schematically in the drawings includes the time delay provision on opening. Thus, its contact 180 which is shown normally open and coupled by a dotted line 181 to the coil 134 will be instantly closed upon energization but will be delayed in opening when the coil 134 is de-energized. This time delay closing relay provides time delay in the dropout of the solenoid 51 which is energized through closure of the contact 180 in a circuit which extends from supply conductor 116 through a conductor 184 to contact 180, a conductor 185, conductor 81, to electromagnetic coil 51, and conductor 82 leading to the supply conductor 117. Also included in parallel with this circuit is the motor time delay relay 136 which is connected at one extremity to the conductor 185, and the other extremity to the other conductor 117. The motor energization relay includes also a time delay provision on opening being instantaneously closed. Relay 136 includes a normally open contact 190 connected to the supply conductor 116 and having in series therewith the motor armature 85 which in turn is connected to the supply conductor 117. An indication light 195 is connected in parallel with the motor armature to provide visual indication on the control console when the motor of the sampling device is running. It will be noted in this energization circuit of the motor 85 and the electromagnetic actuator or solenoid portion 51 of the valve 50, that a first time delay relay 134 with time delay on dropout controls the energization of the coil 51 and that the motor relay energized from the coil relay 134 also includes time delay provisions on dropout in the control of the energization of the motor 85. The purpose of this sequence is to provide instantaneous closure of the energizing circuits for the solenoid 51 operating the pneumatic system and the actuator 40 to energize or operate the valve 31 of the sampling tube and the motor 85 operating the auger 95 in the sampling tube. The energization of the solenoid 51 provides for instantaneous opening of the slide valve 31 to allow a sample to enter the sampling device and the motor is energized simultaneously therewith to move this sample to the sample discharge chute or fitting member 102. The time delay aspect of the relay 134 will determine the amount of time that the valve 31 is to remain open and after closure of the same by de-energization of the coil 134 and opening of the contact 180, the motor relay controlling the energization of motor 85 will remain closed through its time delay provision for a limited period. This will provide for rotation of the auger after the valve 31 of the sampling tube is closed to insure that the sample in the sampling tube will be completely removed therefrom.

The operation of the pneumatic circuit for the actuator under the control of the solenoid valve 50 is conventional, and the pressure delivered from the source through the filtering and regulating assembly or components 61, 62 and 64 provides a regulated air source to the actuator

which is controlled by the four-way valve. In one position of operation, that of actuator de-energization, the air supply will be directed to the actuator such that the shaft will be moved out of the confines of the actuator closing the sliding valve 31 operated thereby. Upon energization of the solenoid valve 50, the passage through valve 50 will be reversed and pressure will be directed to the opposite extremity of the actuator 40 causing the shaft 44 to be moved within the confines of the actuator 40 opening the sliding valve 31. The four-way valve provides for a venting circuit to atmosphere through the pipe 58 of the extremity of the actuator not directly connected to the source of pressurized air.

The physical degree of opening of the valve 31 is determined by the adjustment of the stop mechanism which in the preferred embodiment is a slidable guide 45 mounted on the flange mounting member 20 of the sampling device to limit the movement of the actuator 40 in the condition where the solenoid 50 is energized. This is adjustable to vary the size or amount of the opening 30 uncovered by the sleeve member 32 of the valve 31 to vary the amount of sample to be taken in. This adjustment is made with varying types of materials, such that for coarse materials the valve is normally set to a larger opening than with powdered materials or finely granulated materials. The alternate embodiment of the stop structure merely provides a different construction for adjusting the stop with the same operation or effect being provided on the open position of the valve 31.

In the electrical circuit, operation of the switch 112 to the ON position will supply power to the conductors 116, 117 of the control circuit and energize the indicating light 115 to provide a visual indication that power is supplied to the circuit. The electrical control circuit also includes an energizing circuit for the components for the timer 130 through the normally closed position of the switches 120 and 122, which provide for continuous and manual operation of the apparatus, respectively. In the closed or OFF position of these switches, with the timer 130 being mechanically adjusted for a given timing cycle, through means not shown, the frequency of operation of the timer will be set so that initially the coil 150 and motor 155 will be energized. The coil 150 upon energization will close the normally open contact 152 of the relay and at the same time the motor of the timer will be energized through the circuit which includes the conductor 140, switches 120 and 122 in their OFF position, conductor 144, conductor 162, conductor 160, the normally closed position of switch 157, motor 155 and conductors 153 connected to the conductor 117 for the opposite side of the power source. The initial energization of the relay 150 will close the contact 152, but the timer must run the given adjusted sequence before the switch contacts are shifted. Thus, the switches 158 and 165 will remain in the normal position until the timing sequence is completed at which time they will shift over from their normally closed to normally open positions. In the normally open position of switch 158, the energizing circuit to the motor 155 is broken and the normally open position of switch 165 will provide an energizing circuit for the timing reset relay 132 and the time delay relay 134 for the solenoid 51. The closure of the switch 152 at the start of the cycle merely sets up a holding circuit for the coil 150 through the switch 152 and switch 165. The timing reset relay 132 has an adjustable time delay on closing and opening, the delay being approximately two seconds on closing and approximately three seconds on opening. Its contact 145 will open after a time delay upon energization of the coil 132 which will operate to reset the timing motor 155 and its contacts and allow the solenoid or relay coil 150 to move to its normally closed position. Upon reclosure, the timing cycle will be repeated if the switches 120 and 122 are in their OFF position. The energization of the coil 134

will close instantly its contact 180 setting up the energizing circuit for the coil 51 of the solenoid valve in the pneumatic circuit for the actuator 40 and at the same time will energize the relay coil 136, which through its contact 190, will energize the motor 85 and provide the indication at the light 195 of the motor operation. These relays have a time delay in opening and the time delays will be selected or adjusted to determine the amount of time that the slide valve 31 on the sampling tube is to be opened for the purpose of taking a sample from the pressurized conveying line and an additional period of time which the motor 85 is to operate the auger in the clean-out of the sample from the sampling tube.

The circuit represents a first or normal mode of operation for the timing device 130 in which the frequency of timing of the sampling is determined by the mechanical adjustment of the timer 130 and the period or length of time which the valve 31 is open and the motor 85 is energized will be determined by the time delay aspects of the relays 134 and 136. The frequency of sampling will continue uninterrupted, thus making the apparatus available for continuous sampling in a pressurized line where flow within the conveying line is continuous. As was indicated above, the sample entering the sampling tube 24 will be prevented from being blown through the sampling tube and into the discharge opening by the tight fit of the auger therein and the presence of the material being sampled in the high pitched flighting of the auger 95.

In addition to the normal mode of operation, there are two other modes of operation for the improved sampling device. These additional modes are controlled by operation of one or the other of the switches 120, 122 to provide for continuous sampling independent of the timer and instantaneous manual sampling of a momentary type. In the mode of operation of continuous sampling, the switch 120 will be moved from its OFF to its ON position in which the circuit from the supply conductor 116 through conductor 140 will extend to conductors 175 and 177 directly to the relay 134 to control the energization of the solenoid 51 and motor 85 independent of the operation of the switches 158 and 165 of the timing motor 155. The circuit energizing the timer under these conditions will be broken through the switch 120 and hence the time sequence of the same will remain unchanged and will be initiated again upon movement of the continuous switch 120 to its OFF position. With the movement of the switch 120 to the ON position, the relay 134 is energized through the circuit described above and its operation or energization will control the closure of contact 180, which in turn energizes relay 136 and solenoid 51 of the valve 50. The energization of the relay 136 will, through its contact 190, energize the motor 85 and provide the indication at the light 195 that the motor is operating. The time delay sequence for these relay components will not take effect since as long as the switch 120 is closed, the motor will run and the valve 50 will be open and a continuous sampling will be taken until the switch 120 is returned to its normal or OFF position.

The third mode of operation is that of a momentary or instantaneous sampling which is obtained by deflection of the switch 122 or the manual switch from its OFF position to its ON position. This switch movement will provide the circuit to conductor 176 from conductor 141. This will provide the same energizing circuit through the conductor 175 for the relay 134 described above which will energize the relay 136, solenoid 51, and the motor 85. However, the switch 122 is of the momentary type and upon release of the same, the time delay provisions of the relays 136 and 134 will take effect to provide a single sample from the sampling tube.

Thus, it will be seen that we have provided an improved sampling device particularly adaptable for pneumatic type conveyors in which movement of the material

being conveyed may be sampled in a continuous, periodic or spot type sampling operation. The physical relationship of the sampling auger within the sampling tube and the valve position within the conveying tube for taking the sample prevents escape of air pressure from the conveying tube and blowing of the sample at the discharge point. This will insure that the sample may be instantaneously handled for testing purposes and no loss of sample will be present. In this improved sampling device, the degree of opening of the valve 31 is controlled or adjusted for given material sizes and the length of time the valve is open, as well as the frequency of sampling is determined by appropriate electrical components in the control circuit operating the improved sampling device. Therefore, the improved sampling device may be used over a wide range of frequencies of sampling. It may also provide a continuous sampling through operation of the control circuit bypassing the timing mechanism and maintaining the sampling valve open and the sampling auger operating for a continuous period. In spot checking with the improved sampling device, momentary operation of the manual switch will provide a single sample by operating the electrical control circuit for a single period of energization of the solenoid valve and motor controlling respectively the operation of the actuator and auger.

Therefore, in considering this invention, it should be remembered that the present disclosure is intended to be illustrative only and the scope of the invention should be determined by the appended claims.

We claim:

1. In an automatic sampling device for a pneumatic conveying tube for granular and powdery type material comprising, a conveying tube having an enlarged section with a flanged opening therein, a sampling tube including a flanged mounting means supporting said tube and mounted on the flanged opening of said conveying tube, said sampling tube being sealed in said conveying tube and extending substantially across said conveying tube at said enlarged section, an opening in said sampling tube positioned within said enlarged section of said conveying tube when said sampling tube is mounted on said conveying tube, a sleeve type valve member slidably mounted on said sampling tube relative to the opening in said sampling tube to vary the opening of a valve formed by the sleeve type valve member mounted on the sampling tube and said opening therein, means for sliding said sleeve type valve member on said sampling tube including a shaft extending parallel to the sampling tube and being slidably mounted through said flanged mounting of said sampling tube, an auger positioned within sampling tube and journaled in the housing supporting said sampling tube fitting closely with the interior of the sampling tube, a sample discharge opening in said sampling tube remote from the valve within said sampling tube and adapted to discharge said sample moved by said auger in said sampling tube, a motor, means mounting the motor on the mounting means of said sampling tube, said motor being coupled to the auger for rotation of the same, a fluid power actuator mounted on said mounting means for the sampling tube and connected to the shaft of said valve on said sampling tube for moving the sleeve type valve member and operating the valve, a fluid pressure control circuit means including a control valve adapted to be connected to a fluid pressure source for controlling the operation of said fluid actuator to operate said valve, and electrical control circuit means including timer means interconnected with said first named control circuit means for controlling the energization and operation of said valve to control the length of time the valve is operated, said electric control circuit means also controlling the energization of said motor driving said auger.

2. The automatic sampling device of claim 1, and including means mounted in part on the mounting means

for the sampling tube and in part on the shaft connected to the sleeve type valve member on said sampling tube for adjusting the degree of opening said valve to adjust the size of the sample taken therefrom.

3. The automatic sampling device of claim 1, and including additional switch means in said electrical control circuit means for operating said valve and motor independent of said timer means.

4. The automatic sampling device of claim 1, and including means in said electrical control circuit means for controlling auger rotation after the valve means on said sampling tube has been closed to clean out the auger and the sampling tube.

5. The automatic sampling device of claim 1 in which the close tolerance between the auger and the sampling tube and the flighting of the auger prevent escape of air and the material conveyed under pressure through said sampling tube when the valve is opened to the pneumatic conveying line.

6. The automatic sampling device of claim 1 in which the timer means in the electrical control circuit means is adjustable to control the sequence of operation of the sampling device, said circuit means also including means for varying the length of the time the valve is open and additional time delay means to control the length of time the motor is energized.

7. In an automatic sampling device for a pneumatic conveying tube for granular and powdery type material comprising, a sampling tube including a mounting means adapted to be mounted on a pressurized conveying tube and to be sealed therein with said sampling tube extending substantially across said conveying tube, an opening in said sampling tube positioned within said conveying tube when said sampling tube is mounted on said conveying tube, a sleeve type valve member slidably mounted on said sampling tube relative to the opening in said sampling tube to form a valve in said sampling tube, means for sliding said sleeve type valve member on said sampling tube including a shaft slidably positioned through said flanged mounting of said sampling tube, an auger positioned within said sampling tube and fitting in closely with the interior of the sampling tube, a sampling discharge opening in said sampling tube remote from the valve adapted to discharge said sample moved by said auger in said sampling tube, a motor connected to the mounting means for said sampling tube being coupled to the auger for rotation of the same, a fluid power actuator mounted on said mounting means and connected to the shaft of said valve on said sampling tube for operating the valve, first control circuit means including a control valve adapted to connect a source of fluid power to said actuator for controlling the operation of said fluid actuator to control the length of time the valve is opened, and additional control circuit means including timer means interconnected with said first named control circuit means and controlling the energization of said motor driving said auger.

8. In an automatic sampling device for a pneumatic conveying tube for granular and powdery type material comprising, a conveying tube having a flanged opening therein, a sampling tube including a flanged mounting means and mounted on the flanged opening of said conveying tube and being sealed therein with said sampling tube extending substantially across said conveying tube, valve means mounted on said sampling tube and adapted to be positioned within said conveying tube when said sampling tube is mounted on the conveying tube, operating shaft means for operating said valve means included in the flange mounting of said sampling tube, an auger positioned within sampling tube and fitting closely within the interior of the sampling tube, a sample discharge opening in said sampling tube adapted to discharge a sample moved by said auger in said sampling tube, a motor mounted on said mounting means and connected to the auger for rotation of the same, actu-

ator means mounted on said mounting means and connected to the operating shaft of said valve means for operating said valve means, first control circuit means including a control valve connecting said actuator to a source of power for controlling the operation of said actuator to control the length of time the valve is opened, and additional control circuit means including timer means interconnected with said first named control circuit means for controlling the energization of said motor driving said auger and said control valve.

9. In an automatic sampling device for a pneumatic conveying tube for granular and powdery type material comprising, a conveying tube with a flanged opening therein, a sampling tube including a flanged mounting means and mounted on the flanged opening of said conveying tube being sealed therein with said sampling tube extending substantially across said conveying tube, valve means mounted on said sampling tube and adapted to be positioned within said conveying tube when said sampling tube is mounted on the conveying tube, operating shaft means for operating said valve means included in the flange mounting of said sampling tube, an auger positioned within said sampling tube fitting closely within the interior of the sampling tube, a sample discharge opening in said sampling tube remote from the valve within said sampling tube adapted to discharge said sample moved by said auger in said sampling tube, an electric motor, means mounting the electric motor on said flanged mounting of said sampling tube and coupling said motor to the auger for rotation of the same, pneumatic actuator means mounted on said mounting means and connected to the operating shaft of said valve means for operating said valve means, a pneumatic circuit including a control valve adapted to connect the actuator means to a pneumatic source, first electric control circuit means including means for controlling the operation of said control valve to control said fluid pneumatic actuator in the operation of the valve on the sampling tube, additional electrical control circuit means including timer means interconnected with said first named electrical control circuit means for controlling the frequency of energization of said electric motor driving auger and the means controlling said control valve and switching circuit means connected to said additional electrical control circuit means for controlling the operation of said control valve and said motor driven auger independent of said timer means.

10. In an automatic sampling device for a pneumatic conveying tube for granular and powdery type material comprising, a conveying tube having a flange opening therein, a sampling tube including a flanged mounting means mounted on the flanged opening of said conveying tube and being sealed therein with said sampling tube extending substantially across said conveying tube, valve means mounted on said sampling tube and adapted to be positioned within said conveying tube when said sampling tube is mounted on the conveying tube, operating shaft means for operating said valve means extending through the flange mounting of said sampling tube, an auger positioned within sampling tube fitting in closely with the interior of the sampling tube, a sample discharge opening in said sampling tube adapted to discharge said sample moved by said auger in said sampling tube, an electric motor, means mounting the electric motor on the flange mounting of said sampling tube, means coupling said motor to the auger for rotation of the same, a pneumatic actuator means mounted on said flanged mounting means and connected to the operating shaft of said valve means for operating said valve means, a control valve connected to said actuator and adapted to be connected to a pneumatic source, first electric control circuit means including said control valve for controlling the operation of said fluid pneumatic actuator, additional electrical control circuit means including timer means interconnected with said first named

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electrical control circuit means for controlling adjustably the frequency of the period of energization of said electric motor driving auger and said control valve, switching circuit means connected to said additional electric control circuit means for controlling the energization of said control valve and said motor driven auger independent of said timer means, and electrical time delay control means included in the first electric control circuit means and said additional electric control circuit means to control with said timer means the operation of said control valve and said electric motor.

11. In an automatic sampling device for a pneumatic conveying tube for granular and powdery type material comprising, a sampling tube including a mounting means adapted to be mounted on a pressurized conveying tube and being sealed therein with said sampling tube extending substantially across said conveying tube, an opening in said sampling tube positioned within said conveying tube when said sampling tube is mounted on said conveying tube, means for adjusting the opening in said sampling tube relative to the flow of material in the conveying tube to pick up a sample therefrom, an auger positioned within said sampling tube fitting closely within the interior of the sampling tube, a sampling discharge opening in said sampling tube to discharge said

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sample moved by said auger in said sampling tube, a motor, a means mounting the motor on the flanged mounting means said motor being coupled to the auger for rotation of the same, an actuator mounted on said mounting means and adapted to control the operation of the means adjusting the positioning of the opening in the sampling tube relative to the flow in the conveying tube, first control circuit means for controlling the operation of said actuator to control the length of time the actuator is energized, additional control circuit means interconnected with said first named control circuit means for controlling the energization of said motor driving auger, and timer means included in said first and said additional control circuit means for repeatable initiation of the operation of said control circuit means to control the frequency of operation of said sampling device.

References Cited by the Examiner

UNITED STATES PATENTS

1,860,107	5/1932	Lien	73—421
2,727,390	12/1955	Houston et al.	73—423
3,060,746	10/1962	Gompper	73—422

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