

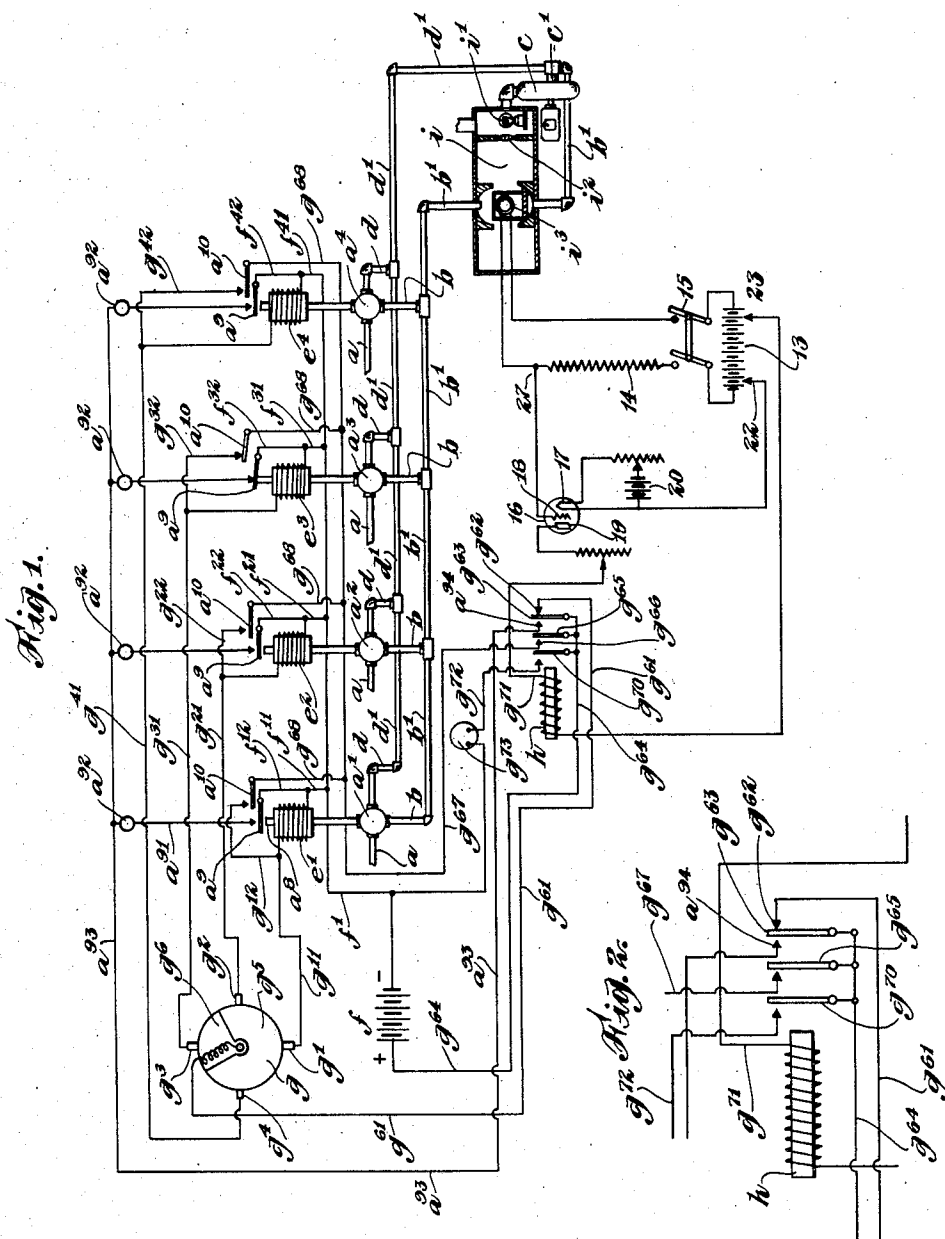
March 3, 1936.

H. C. GRANT, JR

2,032,746

DETECTION OF SUSPENDED MATTER IN FLUIDS

Original Filed Oct. 26, 1923 2 Sheets-Sheet 1



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Fig. 3.

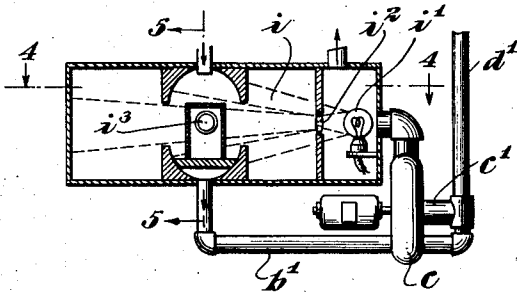


Fig. 4.

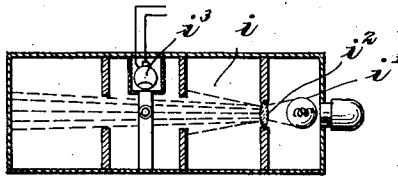


Fig. 7.

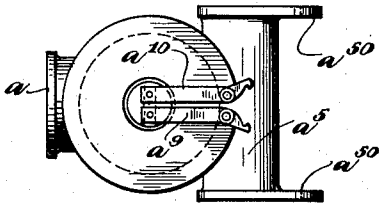


Fig. 5.

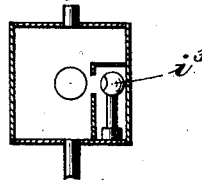


Fig. 6.

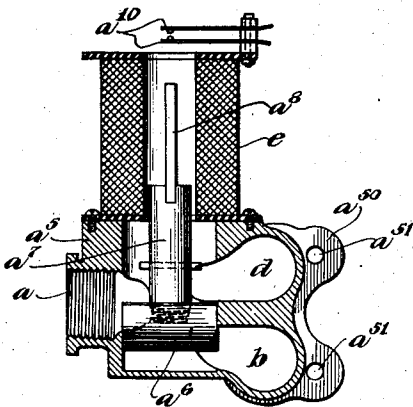
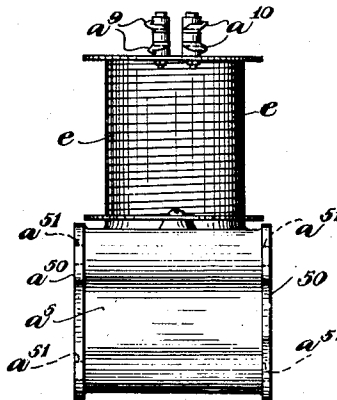


Fig. 8.



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2,032,746

DETECTION OF SUSPENDED MATTER IN FLUIDS

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Application October 26, 1928, Serial No. 315,264
Renewed June 16, 1932

22 Claims. (Cl. 177-311)

In another application for Letters Patent of the United States, Serial No. 298,760, filed August 10, 1928, there are disclosed and covered broadly means for the detection of suspended matter in fluids, which means comprise a plurality of conductors for the fluid streams to be inspected and a constantly moving selector which takes fluid from each stream in succession and directs it to a point where the existence of suspended matter in the stream can be detected. In the means illustrated in that application as an embodiment of the broad invention the selector is a rotating selector which receives from a series of conductors in turn a portion of the fluid to be observed, such as air which may be smoke laden, and delivers such portion of fluid to the detecting devices.

In the embodiment of the invention which is illustrated in the present application, the fluid to be observed is delivered from its source to the corresponding one of a series of valves which are operated in succession, preferably by electro-magnetic devices, to direct such fluid to the detecting devices, the other valves of the series at the same time permitting the discharge of the fluid otherwise than to the detecting devices. The detecting devices may be substantially the same as the detecting devices described in said former application, but will be described herein so far as may be necessary to enable the relation of the detecting devices to the selecting devices to be understood.

The invention will be more fully explained hereinafter with reference to the accompanying drawings in which it is illustrated and in which:

Figure 1 is a diagrammatic and conventional view of a complete system, showing the selecting valves and their actuating means together with the detecting devices.

Figure 2 is a view on a larger scale, illustrating particularly the relations of a series of contacts to a controlling relay.

Figure 3 is an enlarged view, partly in section, of the detecting devices.

Figure 4 is a detail view in sectional plan on the plane indicated by the broken line 4-4 of Figure 3.

Figure 5 is a detail view in section on the plane indicated by the broken line 5-5 of Figure 3.

Figure 6 is a view in sectional elevation and on a larger scale of one of the selecting valves and its actuating device.

Figure 7 is a view of the same from above.

Figure 8 is a view of the same in elevation as seen from the right hand in Figure 6.

In the embodiment of the invention illustrated

in the drawings the fluid to be observed, such as air which may be smoke laden, is led from its source, such as a room of a building or the hold of a ship, through a conductor *a* to a corresponding valve *a*¹, *a*², *a*³, *a*⁴, which is shown conventionally in Figure 1 and in detail in Figures 6, 7 and 8. In the present instance four of such valves are shown, but it will be understood that the number of valves will be varied to suit the requirements of use. Each of such valves is connected through a channel *b* and a common manifold *b*¹ to an exhaust fan *c* through a common connection *c*¹, the conductor *b*¹ being interrupted where it passes through the detecting device as will be explained hereinafter. Each valve is also connected through a channel *d* and a common manifold *d*¹ and the common connection *c*¹ to the exhaust fan *c*, which serves to induce the flow of the fluid to be observed from the source. Each of the valves *a*¹, *a*², etc. is separately controlled by a corresponding actuating device, *e*¹, *e*², etc. which, as in the embodiment of the invention shown, is preferably electro-magnetic.

The preferred construction of each valve and its actuating device is shown in detail in Figures 6, 7 and 8. The valve body *a*⁵ has at *a* a connection to the source of fluid to be observed, at *b* a channel for communication with the manifold *b*¹ by which the fluid is conducted to the detecting devices, and at *d* a channel for communication with the manifold *d*¹. The valve plug *a*⁶ is arranged to move vertically. In its lower position it closes communication between the inlet *a* and the channel *b*, establishing communication between the inlet and the channel *d*, and in its upper position closes communication between the inlet *a* and the channel *d* and opens communication between the inlet *a* and the channel *b*. The valve plug *a*⁶ is carried by a plunger *a*⁷ which, in the construction shown, is the movable core of a magnet *e* of solenoid form. When the magnet is energized the valve *a*⁶ is drawn to its upper position and when the magnet is de-energized the valve plug drops to its lower position. The plunger *a*⁷ is armed with an extension *a*⁸ which, when the magnet is energized and the plunger is raised, acts upon two pairs of contacts *a*⁹ and *a*¹⁰ to close branch circuits through them, as hereinafter explained.

It will be understood that when the preferred construction of the valves, as illustrated in Figures 6, 7, and 8, is employed, the several valves may be mounted end to end without the use of connecting pipes indicated conventionally in Figure 1, forming the common manifolds *b*¹ and

d^1 . For this purpose the valve bodies a^5 are provided at each end with flanges a^{50} which are bolted together through holes a^{51} . The several valve bodies, when thus secured together, form as between themselves both the branches b and d and the manifolds b^1 and d^1 , the channels b and d being closed at the leading end of the series and connected at the other end of the series with the detecting devices by the conductors b^1 and d^1 .

The several magnets e^1, e^2 , etc. are sufficiently energized from a source of current f , through the operation of a commutator g which may be of any suitable construction and may be driven continuously by any suitable means. In the embodiment of the invention illustrated in which provision is made for the operation of four valves, the commutator has three-fourths of its body or of its periphery, as indicated at g^5 , of non-conducting material, and one-fourth, as at g^6 , of conducting material. With the rotating body of the commutator there are arranged to cooperate four brushes g^1, g^2, g^3 , and g^4 , which are severally connected, through a line g^{11}, g^{21}, g^{31} , and g^{41} , with the coils of the corresponding magnet e^1, e^2 , etc., and through a branch g^{12}, g^{22}, g^{32} , and g^{42} , respectively, with the upper contact a^{10} of the corresponding magnet.

The conducting portion g^6 of the commutator receives current through a line g^{61} , a back contact g^{62} , a contact g^{63} , movable under the influence of a relay h and a line g^{64} , from the source of current f on the positive side.

The negative side of the battery or source of current f is connected through a line f^1 and a branch f^{11}, f^{21} , etc. with the coils of the corresponding magnet e^1, e^2 , etc. through which circuit is thus completed to the corresponding brush, (the brush g^3 , in Figure 1) which at the time is in contact with the conducting portion g^6 of the commutator. At the time when the circuit is thus completed through one of the magnets (e^3 in Figure 1) and the magnet energized, the circuits through the other magnets e^1, e^2, e^4 are broken through contact of the corresponding brushes g^1, g^2 and g^4 with the non-conducting portion of the commutator.

Each branch f^{11}, f^{21} , etc. is also connected through an extension f^{12}, f^{22} , etc. with the movable contact of the corresponding pair a^9 closed by the extension a^8 of the plunger a^7 , above mentioned, when the magnet is energized. From the other contact of this pair connection is made by a line a^{91} through a visual indicator at a^{92} and a common line a^{93} to the back contact at a^{94} where the circuit is closed through the movable contact g^{63} , above mentioned, when the relay h is energized as hereinafter explained. Under these conditions the visual indicator a^{92} is caused to indicate the presence of suspended matter in the fluid which at the time is passing through the corresponding valve a^1, a^2 , etc.

The movable contact g^{65} , influenced by the relay h when that relay is energized, closes the circuit from the source of current f through the line g^{64} , the contact g^{66} , and the line g^{67} with its branch g^{68} of the magnet e^3 in Figure 1, the movable member of the pair of contacts at a^{10} , where the circuit is also closed by the extension a^8 , of the plunger when the corresponding magnet e^3 is energized, the wire g^{32} , the magnet e^3 , the wire f^{31} and the wire f^1 , back to the source of current.

The relay h , when energized, also closes the circuit from the battery and the line g^{64} through the movable contact g^{70} , and the line g^{72} , which

includes an audible signal g^{73} , back to the negative side of the source of current f .

Each volume of fluid which passes through the chamber i of the detecting devices is illuminated in its passage from a source of light at i^1 , the beam of light therefrom being directed through a lens i^2 . Within the chamber i and preferably out of the direct path of the beam of light from the source i^1 is placed a photo-electric cell or light sensitive element i^3 which, in the operation of the invention, serves to initiate the operation of an alarm or alarms such as the visual signal at a^{92} and the audible signal at g^{73} by which the attention of the attendant or observer is called to the fact that suspended matter is passing, in the fluid stream, through the detecting apparatus from one or another of the sources of supply, the particular source of supply being indicated in this instance by one or another of the visual signals a^{92} .

The manner in which or the means by which the light sensitive element of the photo-electric cell i^3 initiates the operation of the alarm, forming no part of the present invention, is sufficiently illustrated in Figure 1, where the cell is shown in circuit with a source of current 13 through a resistance 14 and a switch 15. A three-electrode thermionic amplifier 16, of ordinary construction, having a filament 17, a grid 18, and a plate 19, with a source of current 20 for the filament, is shown as having its plate electrode 19 connected with the coils of the relay h , while the grid is connected at a point 27 to the lead-in of the photo-electric cell i^3 , and the filament is connected, as at 22, to the current source 13 which is shown as connected, as at 23, to the other side of the relay h . In this manner the action of the photo-electric cell when illuminated by reason of the passage of suspended matter in the fluid, is made to effect, through the connections described above, the operation of the audible signal g^{73} and the visual signals a^{92} .

It will now be understood that by the action of the commutator g each magnet e^1, e^2 , etc. is energized in turn. So long as no suspended matter, by the presence of which the light sensitive cell is illuminated, is present in any one of the fluid streams, there is no change in any of the signaling devices. When, however, there is present in any of the fluid streams such suspended matter, whereby light is reflected upon the light sensitive element i^3 , a current is established which energizes the relay h and, in the case illustrated in Figure 1, opens at g^{62} the circuit from the positive side of the battery f through the wire g^{64} , the movable contact g^{63} , the wire g^{61} , the conducting portion g^6 of the commutator g , the brush g^3 , the wire g^{31} , the magnet e^3 , the wire f^{31} , and the wire f^1 back to the negative side of the battery f . Simultaneously, and before the de-energization of the magnet e^3 permits the contacts a^9 and a^{10} to be opened, the circuit is closed from the positive side of the battery f through the wire g^{64} , the movable contact g^{65} , the contact g^{66} , the wire g^{67} , the wire g^{68} , the contact a^{10} , the wire g^{32} , the magnet e^3 , the wire f^{31} , and the wire f^1 back to the negative side of the battery f , thus maintaining the magnet in an energized condition. The effect of the opening of the contact at g^{62} is to disconnect the battery f from the commutator g and hence to disconnect the battery from all of the magnets; while the effect of the closing of the contact g^{66} is to maintain the energization of the magnet e^3 and hence the effective position of the valve a^3 . At the same

time the circuit is closed from the positive side of the battery *f* through the wire *g*⁶⁴, the movable contact *g*⁷⁰, the back contact *g*⁷¹, the wire *g*⁷², the audible alarm *g*⁷³ back to the negative side of the battery *f*, while the circuit is closed from the positive side of the battery *f* through the wire *g*⁶⁴, the movable contact *g*⁶³, the back contact *g*⁶⁴, the wire *a*⁶³, the visual alarm *a*⁶², corresponding to the valve *a*³, the contact *a*⁹, the wire *f*³¹, and wire *f*¹ back to the negative side of the battery *f*.

It will be noted that upon energization of the relay *h* and opening of the contact *g*⁶² upon the detection of suspended matter in the fluid stream of any one fluid stream conductor connected to the detecting device at a given time, the commutator *g* is deenergized, the reason being to prevent successive operation of the remaining valves with consequent dilution of the fluid stream passing through an actuated valve to the detecting device.

While the selector valves have been shown and described as operated by electromagnetic devices, it will be understood that many of the advantages of the present invention may be accomplished by the operation of the selector valves by other means which will permit the application of actuating energy to the several selectors in succession through the medium of a distributor which, in the case of the electromagnetic devices shown takes the form of a commutator.

I claim as my invention:

1. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, valves in the conductors, common means connecting the valves to the detecting device, selecting means for actuating the valves to direct fluid from the conductors to the detecting device, and means operated by the detecting device to actuate the valves independently of the selecting means.

2. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, valves in the conductors, common means connecting the valves to the detecting device, selecting means for actuating the valves to direct fluid from the conductors to the detecting device, and means operated by the detecting device to maintain the valve in one certain fluid conductor in actuated condition upon actuation of the detecting device due to the presence of suspended matter in the said one certain conductor.

3. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, electromagnetic valves in the conductors, common means connecting the valves to the detecting device, a selecting switch and connections to actuate the valves in a predetermined order to direct fluid from the conductors to the detecting device in such order, and a relay actuated by the detecting device to energize the electromagnetic valve in one certain conductor continuously to maintain the detecting device actuated to give a signal upon actuation of the detecting device due to the presence of suspended matter in the said one certain conductor.

4. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means responsive to the presence of opaque suspended matter in fluids, means to maintain a flow of fluid in a normal path from the sources substantially continuously, and means relatively adjacent the responsive means to connect the responsive means successively to the sources to

shunt the fluid flow therethrough from a normal path.

5. An installation for the detection of suspended matter in fluids comprising a plurality of tubes leading from fluid sources, means to create a fluid flow through the tubes, means responsive to the presence of opaque suspended matter in fluids, means to connect the respective tubes successively with the last named means and preserve the fluid flow through the remaining tubes, and means to actuate the connecting means.

6. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, means relatively adjacent the responsive means to connect the responsive means successively to the sources to shunt the fluid flow therethrough from a normal path, an indicator, and means whereby the detecting device actuates the indicator upon the presence of suspended matter in the responsive means.

7. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, means relatively adjacent the responsive means to connect the responsive means successively to the sources to shunt the fluid flow therethrough from a normal path, an indicator, means whereby the detecting device actuates the indicator upon the presence of suspended matter in the responsive means, and means to maintain the indicator in an indicating condition.

8. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, means relatively adjacent the responsive means to connect the responsive means successively to the sources to shunt the fluid flow therethrough from a normal path, said fluid flow from a selected source being directed to the said responsive means, and means to indicate from which source suspended matter is directed to the responsive means.

9. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means responsive to the presence of opaque suspended matter in fluids, means to connect the last named means successively to the sources, means to maintain a fluid flow from the sources substantially continuously, said fluid flow from a selected source being directed to the said responsive means, and means to indicate which source is in communication with the responsive means.

10. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means to maintain a flow of fluid streams from the sources substantially continuously, means responsive to the presence of opaque suspended matter in fluids, means to periodically connect the responsive means successively to the sources and to direct one of the fluid streams thereto from a respective source, and indicating means operable upon passage of suspended matter through the responsive means to indicate from which source suspended matter is directed to the responsive means.

11. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, 75

means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, means relatively adjacent the responsive means to connect the responsive means successively to the sources to shunt the fluid flow therethrough from a normal path, said fluid flow from a selected source being directed to the said responsive means, indicating means, and means to maintain the last named means in a continuous indicating condition upon the existence of suspended matter in the responsive means.

12. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, means relatively adjacent the responsive means to connect the responsive means successively to the sources to shunt the fluid flow therethrough from a normal path, said fluid flow from a selected source being directed to the responsive means, indicating means to indicate from which source suspended matter is directed to the responsive means, an alarm, and means whereby the alarm is actuated by the responsive means.

13. A device for detecting suspended matter in fluids comprising a plurality of fluid sources, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, means relatively adjacent the responsive means to connect the responsive means successively to the sources to shunt the fluid flow therethrough from a normal path, means to actuate the connecting means, and means to render the actuating means inoperative upon passage of suspended matter through the responsive means.

14. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, electro-magnetic valves in the conductors, common means connecting the valves to the detecting device, commutator means to rotate the commutator continuously, connections with the commutator to actuate the valves in a predetermined order to direct fluid from the conductors to the detecting device in such order, said commutator having a normally energized distributing element for effecting energization of said connections, and means to effect deenergization of the distributing element upon actuation of the detecting device due to the presence of suspended matter in the fluid in one of the fluid stream conductors.

15. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, electro-magnetic valves in the conductors, common means connecting the valves to the detecting device, commutator means to rotate the commutator continuously, connections with the commutator to actuate the valves in a predetermined order to direct fluid from the conductors to the detecting device in such order, said commutator having a normally energized distributing element for effecting energization of said connections, and means to effect deenergization of the distributing element comprising a relay actuated by the detecting device upon actuation of the detecting device due to the presence of suspended matter in the fluid in one of the fluid stream

conductors, said relay having a normally closed contact controlling the energization of said distributing element.

16. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, electro-magnetic valves in the conductors, common means connecting the valves to the detecting device, commutator means to rotate the commutator continuously, connections with the commutator to actuate the valves in a predetermined order to direct fluid from the conductors to the detecting device in such order, said commutator having a normally energized distributing element for effecting energization of said connections, a relay actuated by the detecting device to energize the electro-magnetic valve in one certain conductor continuously to maintain the detecting device actuated to give a signal upon actuation of the detecting device due to the presence of suspended matter in the said one certain conductor, and means to effect deenergization of the distributing element comprising a normally closed contact controlling the energization of said distributing element.

17. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, electro-magnetic valves in the conductors, common means connecting the valves to the detecting device, a selecting switch, means to actuate the switch, connections with the switch to actuate the valves in a predetermined order to direct fluid from the conductors to the detecting device in such order, an indicator, and means to actuate the indicator upon actuation of the detecting device due to the presence of suspended matter in the fluid in one of the fluid stream conductors, said last named means comprising a relay actuated by the detecting device, a normally open contact controlled by said relay and connections therewith for establishing a holding circuit for the particular electro-magnetic valve passing suspended matter to the detecting device, normally open series contacts in the connections, and means actuated by the particular electro-magnetic valve to actuate the last named series contacts for effecting actuation of the indicator.

18. The combination with a plurality of fluid stream conductors, a device for detecting the presence of suspended matter in fluids, electro-magnetic valves in the conductors, common means connecting the valves to the detecting device, commutator means to rotate the commutator continuously, connections with the commutator to actuate the valves in a predetermined order to direct fluid from the conductors to the detecting device in such order, said commutator having a normally energized distributing element for effecting energization of said connections, an indicator, means to actuate the indicator upon actuation of the detecting device due to the presence of suspended matter in the fluid in one of the fluid stream conductors, said last named means comprising a relay actuated by the detecting device, a normally open contact controlled by said relay and connections therewith for establishing a holding circuit for the particular electro-magnetic valve passing suspended matter to the detecting device, normally open series contacts in the connections, and means actuated by the particular electro-magnetic valve to actuate the last named series contacts for effecting actuation of the indicator, and means to effect deenergization of the distributing

element comprising a normally closed contact of the relay, and connections therewith controlling the energization of said distributing element.

19. The combination with a plurality of fluid stream conductors, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, valves in the conductors, common means connecting the valves to the responsive means, selecting means for actuating the valves in succession to direct fluid from the conductors to the responsive means, means operated by the responsive means to indicate the presence of suspended matter in a fluid stream conductor, and means to control the action of a valve independently of the selecting means, whereby a conductor passing suspended matter to the responsive means may be maintained in connection therewith.

20. The combination with a plurality of fluid stream conductors, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, electrically controlled valves in the conductors, common means connecting the valves to the responsive means, selecting means for actuating the valves in succession to direct fluid from the conductors to the responsive means, means operated by the responsive means to indicate the presence of suspended matter in a fluid stream conductor, and means to control the action of a valve independently of the selecting means, whereby a conductor passing suspended matter to the responsive means may be maintained in connection therewith, said last named means comprising means to establish an electrical holding circuit for said valve.

21. The combination with a plurality of fluid stream conductors, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, electrical-

ly controlled valves in the conductors, common means connecting the valves to the responsive means, selecting means for actuating the valves in succession to direct fluid from the conductors to the responsive means, means operated by the responsive means to indicate the presence of suspended matter in a fluid stream conductor, means to control the action of a valve independently of the selecting means, whereby a conductor passing suspended matter to the responsive means may be maintained in connection therewith, said last named means comprising means to establish an electrical holding circuit for said valve, means to indicate which conductor is passing suspended matter to the responsive means, and a circuit in parallel to the holding circuit for the independently actuated valve connected to the last named indicating means to actuate the same.

22. The combination with a plurality of fluid stream conductors, means responsive to the presence of opaque suspended matter in fluids, means to maintain a fluid flow in a normal path from the sources substantially continuously, electrically controlled valves in the conductors, common means connecting the valves to the responsive means, a source of current, an electrical commutator, means to rotate the commutator continuously, and connections from the source of current to the commutator and from the commutator to the several electrically controlled valves and back to the source of current, whereby the valves are operated in succession to direct fluid from the conductors to the responsive means, means operated by the responsive means to indicate the presence of suspended matter in a fluid stream conductor, means to control the action of a valve independently of the selecting means, and means to disconnect the commutator from the source of current, whereby a conductor passing suspended matter to the responsive means may be maintained in connection therewith to the exclusion of any other conductor.

HARRY CAMPBELL GRANT, Jr.

CERTIFICATE OF CORRECTION.

Patent No. 2,032,746.

March 3, 1936.

HARRY CAMPBELL GRANT, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, lines 47 and 64, claims 14 and 15 respectively, and second column, lines 9 and 54, claims 16 and 18 respectively, after "commutator" insert a comma; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of April, A. D. 1936.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.