June 3, 1952 N. F. PRESCOTT 2,599,197

CONTROL SYSTEM FOR CATALYTIC REACTORS

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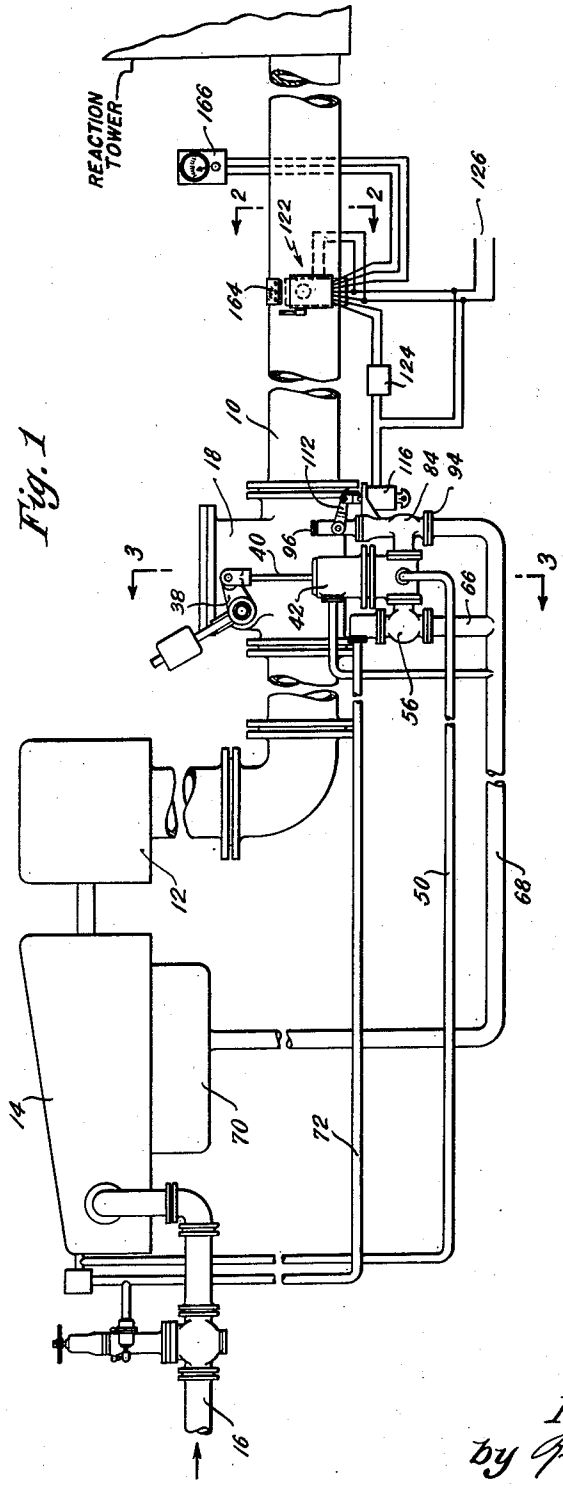


Fig. 1.

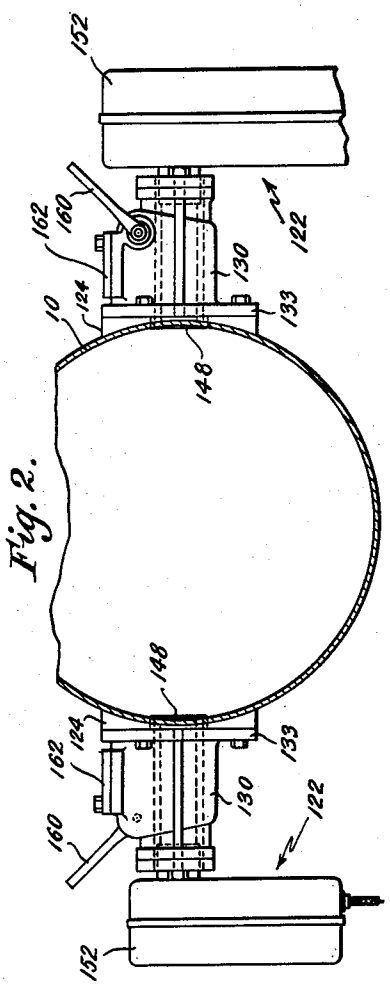


Fig. 2.

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CONTROL SYSTEM FOR CATALYTIC REACTORS

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Fig. 4.

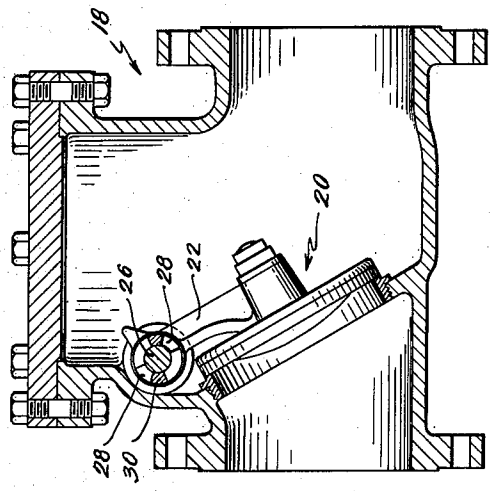
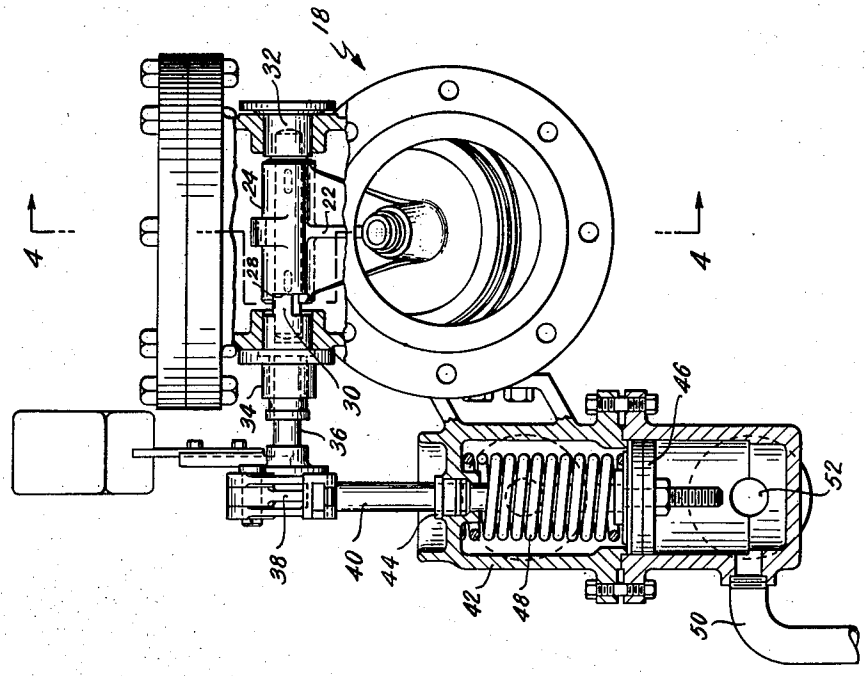


Fig. 3.



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CONTROL SYSTEM FOR CATALYTIC REACTORS

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Fig. 7.

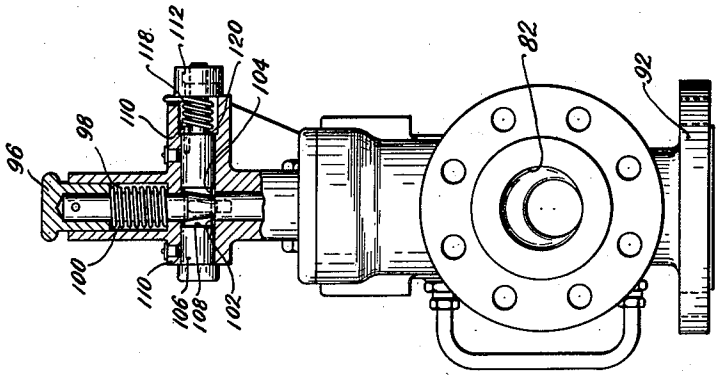


Fig. 6.

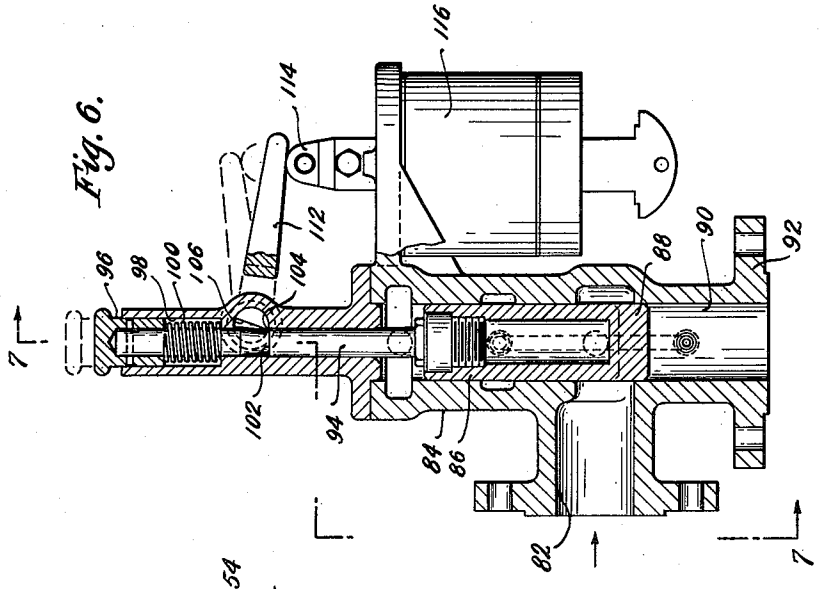
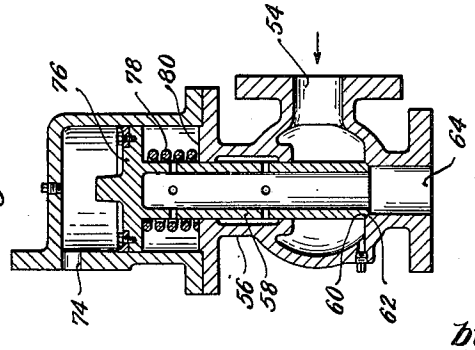


Fig. 5.



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CONTROL SYSTEM FOR CATALYTIC REACTORS

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Fig. 8.

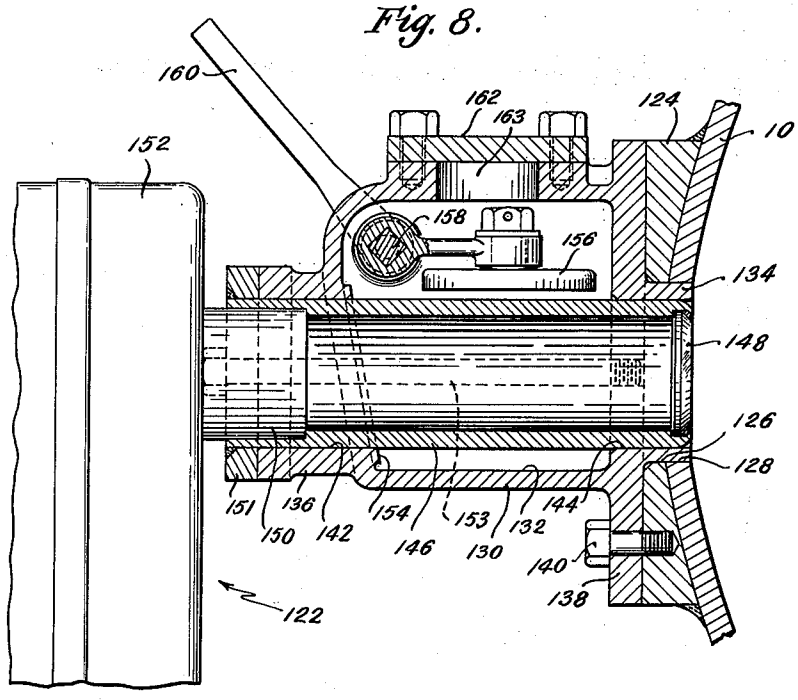
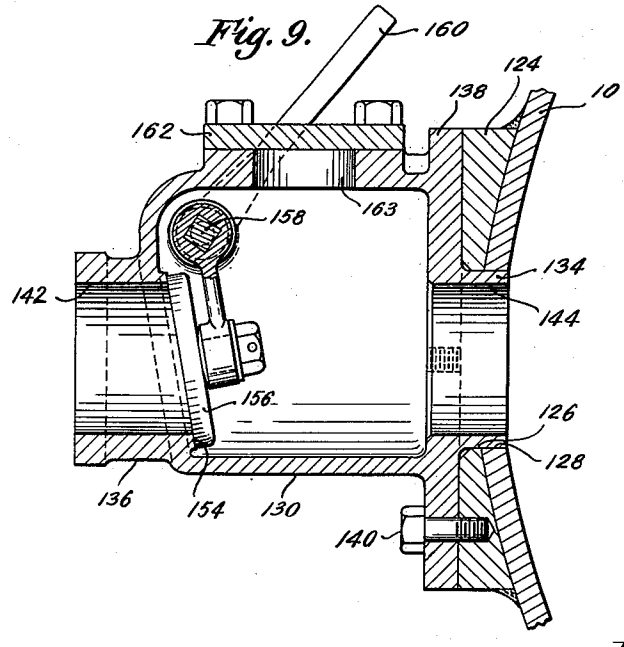


Fig. 9.



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UNITED STATES PATENT OFFICE

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CONTROL SYSTEM FOR CATALYTIC REACTORS

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Application June 20, 1947, Serial No. 756,068

11 Claims. (Cl. 23—288)

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This invention relates to a system in which a current of air is maintained at a predetermined pressure so as to flow in a given direction and in particular to a control system embodying a check valve and means for closing the same to prevent counterflow.

The aforesaid system forms part of a cracking process wherein a catalyst in a finely divided form is air borne, that is, held in suspension and in a constant state of agitation in a catalyst tower by a current of air under pressure, created and maintained by a blower, and led to the tower through a suitable conduit. The blower is normally constantly driven by any suitable means such as a motor, a steam turbine, or the like, but through faulty operation, accident or other reason the blower may stop or slow down materially. Hence, there may be a complete failure of air pressure or such a drop therein in the conduit as to be insufficient to support the catalyst in the tower, and as a result there will be a back flow of the catalyst toward the blower. When this happens the blower becomes clogged with the catalyst which results in loss of production and damage to the equipment. To prevent this, it has been customary to place a check valve in the conduit between the blower and the catalyst tower operable upon reduction or failure of the air pressure to close the conduit. Because of the fact that such valves normally occupy a wide open position for long periods of time, due to infrequent operation, their bearings becoming dirty or rusty so that they stick and do not close readily and quick enough to prevent flow back. For this reason there have been provided valve actuating means for positively closing the check valve, this means being connected in to the oil pressure system of the turbine so that if the turbine is shut down by the overspeed trip or slows down due to a drop in steam pressure the valve will automatically be closed by the accompanying drop in pressure in the oil pressure system.

Such a control system is sluggish and unreliable in operation, since it is possible for the air pressure in the conduit to fall sufficiently to permit the catalyst to gradually creep back in the conduit by slowing down of the turbine without an accompanying drop in the oil pressure which is sufficient to actuate the aforesaid valve actuating means; hence an object of this invention is to provide other and more reliable means independent of the turbine oil pressure for initiating closing movement of the valve as soon as the catalyst begins to creep back into the conduit.

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Accordingly, as illustrated herein, the invention resides in one aspect in a system, in which air pressure created by a blower unit is employed to maintain a finely divided solid matter in suspension at a place of suspension, that is a catalyst tower, in which a check valve is disposed in a conduit between the blower unit and the tower, which is free to move between a closed and open position and which is normally held open by the air pressure in the conduit and in which a detector such as a photoelectric device or the like means responsive to the presence of suspended particles in the air stream, is disposed in the conduit at the upstream side of the check valve, that is, between the check valve and the catalyst tower, the detector being connected with a relay or the like capable of effecting the actuation of the check valve to a closed position upon detection of the presence of solid particles in the conduit. There is interposed between the check valve and the detector an actuator movable from an inoperative to an operative position and to effect, by movement to its operative position, operation of the check valve to a closed position. The actuator is held during normal operation of the system in an inoperative position by fluid pressure from the blower-driving mechanism and is only permitted to become operative at such times as the aforesaid photoelectric device, or the like means, detects particles in the conduit, whereupon a valve associated with the fluid pressure system is operated to vent or relieve the pressure, the valve being normally held in a closed position against spring means by a latch operated by a solenoid or the like associated with the detector so as to permit the valve to open the vent in response to operation of the detector.

The detector preferably comprises a photoelectric means, such as the conventional light sensitive cell, and light source mounted in diametrically disposed openings in the wall of the conduit. Each element includes a tube let into the wall of the conduit and preferably provided with a hardened glass lens at its exposed inner end substantially flush with the inner surface of the conduit to resist abrasion and pressure and to exclude dirt therefrom. These lenses may become dirty or fogged by dust and moisture, and hence effect improper operation of the control system when there is no solid matter present in the conduit, so that at intervals they should be cleaned. It is another object of this invention therefore to provide means for removably mounting the elements of the photoelectric means in the walls of the conduit so that they may be re-

moved without reduction in the air pressure in the system and/or without having to shut down the system.

Accordingly invention also resides in the means for removably mounting the elements of the photoelectric means in apertures in the walls of the conduit and means associated therewith for closing the apertures left by the elements when they are removed for cleaning purposes without reduction of the air pressure in the system. The aforesaid means comprise housings secured to the wall of the conduit over the apertures therein, the housings having bearing apertures aligned with the openings formed in the conduit for the reception of the elements of the photoelectric means and in which they are slidably disposed with their ends flush with the wall of the conduit, and a valve member rotatably mounted within each housing operable when an element is withdrawn from the housings to close the associated bearing aperture.

The invention will now be described in detail with reference to the accompanying drawings which illustrate what is now considered a preferred embodiment of the invention. In the drawings:

Fig. 1 is a diagrammatic layout of a pressure system in which there are pressure creating means, a conduit for conducting air under pressure from the pressure creating means to a catalyst tower and valve means in the conduit for preventing back flow of catalyst in the system;

Fig. 2 is a section on the line 2—2 of Fig. 1 showing the mounting for the photoelectric elements;

Fig. 3 is a section on the line 3—3 of Fig. 1 showing the valve closing means;

Fig. 4 is a section on the line 4—4 of Fig. 3 showing the closure valve in a closed position;

Fig. 5 is a section through a pilot valve, the position of which is controlled by reduction of the oil pressure in the turbine oil pressure system;

Fig. 6 is a section through a pilot valve, the position of which is controlled by the presence of solid matter in the conduit;

Fig. 7 is an elevation, partly in section, on the line 7—7 of Fig. 6;

Fig. 8 is a transverse section through one of the housings for removably attaching the photoelectric elements to the wall of the conduit, showing an element in position; and

Fig. 9 is a similar section showing the element removed and the valve closed.

Referring to Fig. 1 the system is illustrated as comprising a conduit 10 which is connected at one end to a blower or fan 12 and leads therefrom to a catalyst tower a fragmentary portion of which is shown at the right-hand side of Fig. 1. The blower 12 is driven by a turbine 14 which is supplied with steam from a pressure line 16. Interposed in the conduit 10 between the fan 12 and the catalyst tower is a check valve housing 18 which, as shown in Figs. 3 and 4, contains a check valve 20. The check valve 20 has fixed thereto an arm 22 having integral with an end thereof a sleeve 24 (Fig. 3) which is mounted for free rotation on a shaft 26 so that the check valve is free to swing between open and closed positions.

In order that the check valve may positively be moved toward a closed position, however, one end of the sleeve 24 has diametrically disposed recesses 28 cut therein with which cooperate diametrically disposed shoulders 30 formed on a

bearing member 34 which is one of a pair of bearing members 32 and 34, in which the ends of the shaft rest and which support the shaft between the walls of the housing 18. By rotation of the bearing member 34 in a clockwise direction as seen in Fig. 4, one of the shoulders 30 may be brought into engagement with a forward wall at one end of the recess 28 which it occupies to apply a force to the check valve to close it and to hold it in a closed position. The bearing member 34, however, is normally held in an inoperative position, as shown in Fig. 4, wherein the shoulders 30 occupy a substantially horizontal position and when so held, because of the width of the notches 28, it is evident that the check valve is free to swing between a closed and an open position without interference.

Rotation of the bearing member 34 is effected as follows: Extending laterally from the bearing member 34 is a shaft 36 which, as shown in Fig. 1, is connected by an arm 38 to the upper end of a piston rod 40. The piston rod 40 passes through an end wall of a cylinder 42, a suitable gland 44 being provided for this purpose and has fixed to its lower end a piston 46. There is disposed between the upper closed end of the cylinder and the piston, surrounding the rod 40, a compression spring 48 which normally urges the piston toward the bottom of the cylinder and when urged in this direction urges the arm 38 in a clockwise direction as seen in Fig. 1, which in turn rotates the bearing member 34 in a clockwise direction so as to close the check valve 20 as hereinbefore pointed out.

The spring 48 however is normally held inactive by fluid pressure which is delivered to the underside of the piston 46 at the lower end of the cylinder 42 by oil delivered thereto under pressure through a conduit 50 which, as shown in Fig. 1, is connected into the oil pressure system of the turbine 14. As long as the oil pressure in the turbine oil pressure system remains normal the pressure against the underside of the piston 46 will be sufficient to oppose the force of the spring 48. If, however, through any reason the oil pressure in the turbine oil pressure system drops by reason of a reduction in speed of the turbine, for one reason or another, or of a shutting down of the system, the oil pressure below the piston 46 will be vented as will appear hereinafter and the spring 48 will force the piston 46 downwardly and hence move the check valve to a closed position.

It is to be observed that while the spring 48 is strong enough to move the check valve to a closed position, that is, to overcome any sticking of the valve on the shaft it is light enough so that its full force is insufficient to hold the check valve in its closed position against the normal air pressure in the system, the spring creating only relatively small back pressure on the check valve. For example, the following back pressures in pounds per square inch were observed for valves of the following diameters in inches:

	p. s. i.
16" valve	1.80
18" valve	1.29
20" valve	.95
24" valve	.57

Hence, if the check valve is accidentally closed, it is not held in a closed position with sufficient pressure to shut down operation of the system.

A fall in pressure in the turbine oil pressure system is caused to by-pass, that is vent the oil

in the lower portion of the cylinder 42 through a passage 52 leading therefrom to a passage 54 formed in a pilot valve housing 56 (Fig. 5), the pilot valve housing and cylinder being secured together with the passages 52 and 54 in registration by suitable flanges surrounding the same. The pilot valve housing 56 has in it a slide valve 58, the lower end 60 of which is adapted to engage a valve seat 62 at the inner end of a passage 64 opening into a chamber within the valve housing with which the passage 54 communicates. As shown in Fig. 1 the outer end of the passage 64 is connected to a short leader 66, the latter being connected to a return duct 68 which carries the oil back to an oil reservoir 70 of the turbine. The valve 58 is normally held against its seat by oil pressure in the turbine oil pressure system conducted thereto through a conduit 72 which enters the upper portion of the valve housing at 74 and acts on the upper surface of an enlarged head 76 formed integral with the pilot valve 58. When the pressure in the turbine oil pressure system falls, however, a spring 78, disposed around the slide valve between the head 76 and lateral shoulders 80 formed internally of the housing, moves the slide valve upwardly to lift its end 60 from the seat 62 so as to permit oil from the lower part of the cylinder 42 to pass from it into the valve housing 56 and out through the passage 64.

Although the aforesaid means will provide for closing of the check valve 20 upon shutting down of the turbine or upon material reduction of the speed thereof, this invention however contemplates the use of additional and more sensitive means for closing the valve 20 which depends solely upon the presence of solid matter in the conduit indicative of flow back, and as illustrated herein comprises photoelectric means adapted when actuated to vent the oil pressure in the cylinder 42 in a manner somewhat similar to that just described. Accordingly, and as illustrated in Fig. 6, there is bolted to the opposite side of the cylinder 42 by means of suitable flanges a valve casting 84 (Fig. 6) having a lateral passage 82 therein leading to a central longitudinal chamber 90 within which there is disposed a slide valve 86. The slide valve 86 has a lower end 88 arranged closely to engage the chamber 90 and to cover the lateral passage 84 leading into it. The lower end of the chamber is open and a flange 92 formed on the valve casting surrounding the same provides means for bolting thereto the flanged end 94 of the conduit 68 (Fig. 1) so that movement of the slide valve 86 in the chamber 90 to uncover the passage 82 will permit venting of the oil from the cylinder 42 to the return duct 68 of the turbine oil reservoir. The slide valve 81 is connected to the lower end of a valve rod 94 which has fixed to its upper end a cap 96 arranged to slide telescopically in an enlarged recess 98 formed in a hollow post fixed to the top of the valve casting and between which and the bottom of the recess there is disposed a spring 100. The valve stem 94 has an annular shoulder 102 formed thereon by turning it down in diameter, and this annular shoulder is adapted to be engaged by a shoulder 104 formed on a shaft 106, by cutting a slot 108 halfway through it from side to side. The shaft 106 is journaled at its opposite ends in bearings 110 formed laterally of the post and has fixed to one end an arm 112 (Fig. 6) which is arranged to be held in engagement with one end of a plunger 114 of a solenoid 116, the latter being fixed to a bracket extending laterally from the casting. A spring 118 (Fig. 7), surrounding a reduced portion of the shaft 106 and seated in a recess 122 formed in one of the bearings, serves yieldably to hold the arm 112 in contact with the plunger 114. In the full line position shown in Fig. 6 the shoulder 104 is in engagement with the annular shoulder 102 and thus holds the valve 86 in a closed position in opposition to the spring 100. Upon excitation of the solenoid 116 however, the arm 112 is moved to the dotted line position, thereby withdrawing the shoulder 104 from the shoulder 102 so that the spring 100 raises the valve rod 94 and hence opens the valve 81 to permit venting of the oil from beneath the piston 46. The slide valve may be closed after the condition in the system has been remedied by manually pressing the cap 96 so as to reengage the shoulder 102 with the shoulder 104.

The solenoid 116 is excited by photoelectric means 122 (Fig. 1) to which it is connected by way of a relay 124, suitable electric connections 126 being provided for connecting the photoelectric means, relay and solenoid to an outside source of electric power. The photoelectric means 122 consists of the usual light sensitive cell and light source and are mounted in diametrically opposed openings 128 (Figs. 8 and 9) in the wall of the conduit 10. As thus mounted the elements may be adjusted as to sensitivity so that the presence of a small amount of solid material in the conduit which would be indicative of counterflow in the conduit will cut off sufficient light from the light source to cause the light sensitive cell to function in a manner to actuate the relay.

In order that these photoelectric elements may readily be mounted and removed for cleaning purposes without reduction in the pressure of the system and so that the system need not be shut down while such cleaning is taking place, the elements are provided with a special mounting means which are illustrated in Figs. 8 and 9. As shown therein yoke-like plates 124 are welded to the opposite sides of the conduit 10 and have in them apertures 126 which are concentric with the openings 128 in the conduit 10. A housing 130, having a chamber 132 therein, a neck 134 at one end and a neck 136 at the other end and formed with a flange 138 adjacent to the neck 134, is secured to each yoke 124 by bolts 140 so that the neck 134 extends through the concentric apertures 126 and 128. Each housing 130 has internally of its neck portions bearing openings 142 and 144 (Fig. 8) which are also concentric with the apertures 126 and 128 for slidably receiving a tube 146 (Fig. 8) which has at its inner end a lens 148 which occupies a position which is substantially flush with the inner surface of the conduit 10. The tube 146 forms an extension of a shorter tube 150 projecting laterally from the light sensitive element or the light source as the case may be and with which it is telescopically engaged. A flange 151 on the outer end of the tube 146 provides means for securing it and hence the particular element to the housing, and for this purpose bolts 153 are shown as passing through the flange 151 and being threaded at their inner ends into the flange 138. Within the chamber 132 and surrounding the outer one of the bearing openings 142 there is an inclined annular valve seat 154 against which there is adapted to be seated a valve member 156, the latter being fastened to a shaft 158 which is journaled in the walls of the housing above the

opening and has on one end a lever **160** by means of which it may be swung into an open position to admit the tube **146**. The valve will fall by gravity automatically as the light sensitive element or light source when withdrawn together with the tube **146**, to close against the seat **154**, the closed position of the valve being illustrated in Fig. 9. A cover plate **162**, positioned at the top of the housing **130** and bolted thereto, provides means for covering the access opening **163** formed therein and through which the condition of the valve and its seat may be examined. A transparent cover plate **164** (Fig. 1) is also provided in the conduit **10** at the top thereof above the photoelectric means through which the condition of the plate glass lenses **148** may be observed without removing the elements from their housings.

There is also provided in the system a densometer **166** (Fig. 1) which is suitably electrically connected into the electric connections for the photoelectric means to indicate the density of concentration of particles in the conduit at any given time, the densometer being sensitive enough so that it will register on a dial the presence of particles in the conduit which are not sufficient in concentration to operate the photoelectric means. Preferably a signal in the nature of a red light may be operated by the densometer to indicate that there is an appreciable concentration of particles in the conduit.

In operation, assuming that the blower is developing sufficient pressure to hold the catalyst in suspension in the catalyst tower, the check valve **20** will occupy its wide open position, the piston actuated mechanism for closing it being held in an inoperative position by the oil pressure below the piston **46**. If now for some reason particles of the catalyst begin to creep back into the conduit, they actuate the photoelectric means **122** in the conduit which, through the relay **124**, solenoid **116**, latch **112**, and valve **88**, vents the oil from below the piston **46** thereby bringing about closing of the check valve **20**, irrespective of whether there has been a drop in pressure in the system of sufficient magnitude to bring about closing of the check valve through the pressure actuated valve **58**.

I claim:

1. Apparatus for use in effecting catalytic reactions comprising a reaction tower in which a quantity of fine particles of solid catalyst are to be air-borne in suspension a blower and a conduit connected at one end to the blower and at the other end to the tower through which a current of air under pressure is delivered near the bottom of the tower by the blower of sufficient intensity to hold the major portion of the catalytic particles in suspension in the tower and, means for preventing gravitating particles from returning through the conduit to the blower, said last means comprising a check valve in said conduit between the tower and the blower, said check valve being free to move between open and closed positions and being normally held open by said air pressure in the apparatus, and means in the conduit between the valve and tower for initiating actuation of said valve to close the same in response to the presence of traces of solid matter in the air stream.

2. Apparatus for use in effecting catalytic reaction comprising a reaction tower in which a quantity of solid particles of catalyst are to be air-borne in suspension a blower and a conduit connected at one end to the blower and at the other end to the tower through which a current of air under pressure is delivered near the bottom of the tower by the blower of sufficient intensity to hold the major portion of the particles of catalyst in suspension in the tower and, means for preventing gravitating particles from returning through the conduit to the blower, said last means comprising a check valve in said conduit between the tower and blower, said check valve being free to move between open and closed positions and being normally held open by said air pressure, means connected to the valve operable to close the same and means in the conduit between the valve and tower responsive to traces of solid matter in the air stream for actuating said last named means to close the valve.

3. Apparatus for use in effecting catalytic reactions comprising a reaction tower in which a quantity of fine particles of solid catalyst are to be air-borne in suspension, a blower, and a conduit connected at one end to the blower and at its other end to the lower part of the tower through which a current of air under pressure is delivered to said tower by the blower of sufficient intensity to hold the major portion of the catalytic particles in suspension in the tower, and a check valve in said conduit between the blower and said tower operable to close said conduit, said check valve being free to move between a closed and an open position and being normally held open by the air pressure in the conduit, means movable from an inoperative to an operative position to close said check valve, a spring pressed piston connected to said first named means normally urging it toward its operative position, means for holding said spring pressed piston inoperative and photoelectric means in the pressure conduit between the check valve and the tower, operable by the presence of particles in said conduit to render said spring pressed piston operative.

4. Apparatus for use in effecting catalytic reactions comprising a reaction tower in which a quantity of fine particles of solid catalyst are to be air-borne in suspension, a blower, and a conduit connected at one end to the blower and at its other end to the lower part of the tower through which a current of air under pressure is delivered to said tower by the blower of sufficient intensity to hold the major portion of the catalytic particles in suspension in the tower, a check valve in said conduit between the blower unit and said tower operable to close said conduit, said check valve being hinged to move between a closed and an open position and being normally held open by the air pressure in the conduit, means movable from an inoperative to an operative position to close said check valve, a spring pressed piston connected to said first means normally urging it to its operative position, a source of fluid pressure in communication with said piston opposing operation of said spring, and photoelectric means in the pressure conduit between the check valve and the tower operable by the presence of particles in said conduit to vent the fluid from said source of fluid pressure.

5. Apparatus for use in effecting catalytic reactions comprising a reaction tower in which a quantity of fine particles of solid catalyst are to be air-borne in suspension, a blower, and a conduit connected at one end to the blower and at its other end to the lower part of the tower through which a current of air under pressure is delivered to said tower by the blower of sufficient

intensity to hold the major portion of the catalytic particles in suspension in the tower, a check valve in said conduit between the blower unit and said tower operable to close said conduit, said check valve being hinged to move between a closed and an open position and being normally held open by the air pressure in the conduit, means movable from an inoperative to an operative position to close said check valve, a piston connected to said first means, a spring constantly urging said piston in a direction to move the first means to its operative position, a source of fluid pressure in communication with the opposite side of said piston holding the spring inoperative, a valve for venting the fluid from behind said piston, and photoelectric means in the pressure conduit between said check valve and the tower operable to cause said valve to vent said fluid pressure.

6. Apparatus for use in effecting catalytic reactions comprising a reaction tower in which a quantity of fine particles of solid catalyst are to be air-borne in suspension, a blower, and a conduit connected at one end to the blower and at its other end to the lower part of the tower through which a current of air under pressure is delivered to said tower by the blower of sufficient intensity to hold the major portion of the catalytic particles in suspension in the tower, a check valve in said conduit between the blower unit and said place of particle suspension operable to close said conduit, said check valve being hinged to move between a closed and an open position and being normally held open by the air pressure in the conduit, means movable from an inoperative to an operative position to close said check valve, a spring-pressed piston yieldably urging the first means to an operative position, a source of fluid pressure in communication with the piston holding it in an inoperative position against said spring, a by-pass for bleeding fluid from said source of fluid pressure, a valve movable from a position blocking said by-pass to a position uncovering it, a spring normally urging said valve to an uncovering position, a latch holding said valve in a blocking position, and photoelectric means in said conduit between the check valve and tower operable by the presence of particles in the conduit to release said latch.

7. Apparatus for use in effecting catalytic reactions comprising a reaction tower in which a quantity of fine particles of solid catalyst are to be air-borne in suspension, a blower, and a conduit connected at one end to the blower and at its other end to the lower part of the tower through which a current of air under pressure is delivered to said tower by the blower of sufficient intensity to hold the major portion of the catalytic particles in suspension in the tower, a shaft in said conduit, a check valve, an arm fixed at one end to said check valve and having a sleeve at its opposite end surrounding said shaft whereby said check valve is hinged to swing between open and closed positions in the conduit, said check valve being normally open, a member surrounding said shaft adjacent to one end of said sleeve, said end of the sleeve having a notch therein and said member having a shoulder projecting into the notch, means operable to rotate said member relative to the sleeve to cause said shoulder to engage an end of the notch to move the check valve to a closed position and photoelectric means between the valve and the tower operable by the presence of air-borne particles in the conduit to effect operation of said last-named means.

8. Apparatus for use in effecting catalytic reactions comprising a reaction tower in which a quantity of fine particles of solid catalyst are to be air-borne in suspension, a blower, and a conduit connected at one end to the blower and at its other end to the lower part of the tower through which a current of air under pressure is delivered to said tower by the blower of sufficient intensity to hold the major portion of the catalytic particles in suspension in the tower, a check valve in said conduit between the blower unit and said place of particle suspension operable to close said conduit, said check valve being free to move between a closed and an open position and being normally held open by the air pressure in the conduit, spring-pressed means urging the first means to an operative position, said spring-pressed means being held inoperative, and photoelectric means in said conduit between the valve and tower operable by the presence of particles in the conduit to release said spring-pressed means, said spring-pressed means being ineffective to hold said valve in a closed position against normal air pressure in the conduit.

9. In an apparatus including a blower unit, a catalyst chamber and a conduit extending between the two through which air under pressure is delivered from the blower to the lower end of the catalyst chamber for holding a finely divided catalyst in suspension therein, a valve interposed in the conduit which is adapted to be closed by a photoelectric means disposed between the valve and the catalyst chamber and photoelectric means, said conduit having apertures in its peripheral wall for the reception of said photoelectric means, means for removably supporting the photoelectric means in said apertures of the conduit, and means for automatically closing the apertures left by the photoelectric means when the latter is removed to maintain the pressure in the system.

10. In an apparatus including a blower unit, a catalyst chamber and a conduit extending between the two through which air under pressure is delivered from the blower to the lower end of the catalyst chamber for holding a finely divided catalyst in suspension therein, a valve interposed in the conduit which is adapted to be closed by a photoelectric means disposed between the valve and the catalyst chamber and photoelectric means, said conduit having apertures in its peripheral wall for the reception of said photoelectric means, a housing bolted to the wall of the conduit over each aperture, each housing having a bearing opening therein concentric with said aperture for the reception of an element of said photoelectric means removably to hold it flush with the inner wall of the conduit, and a valve in said housing automatically operable upon withdrawal of an element to close said opening.

11. In an apparatus including a blower unit, a catalyst chamber and a conduit extending between the two through which air under pressure is delivered from the blower to the lower end of the catalyst chamber for holding a finely divided catalyst in suspension therein, a valve interposed in the conduit which is adapted to be closed by a photoelectric means disposed between the valve and the catalyst chamber and photoelectric means, said conduit having apertures in its peripheral wall for the reception of said photo-

electric means, a housing bolted to the wall of the conduit over each aperture, each housing having spaced bearing openings therein concentric with said aperture in the conduit in which an element of the photoelectric means is disposed with its inner end flush with the inner surface of the conduit, the outer one of the bearing openings having a surrounding valve seat and a valve rotatably mounted in each housing gravitationally operated upon withdrawal of an element from the housing to engage said seat.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,311,374	Farmer et al.	Feb. 16, 1943