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TREATMENT OF FLUID FLOWS

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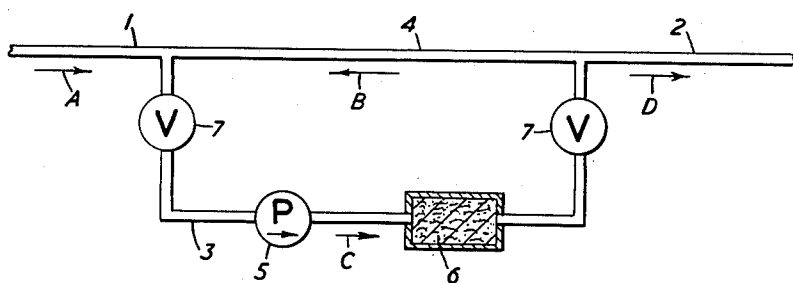


FIG. 1.

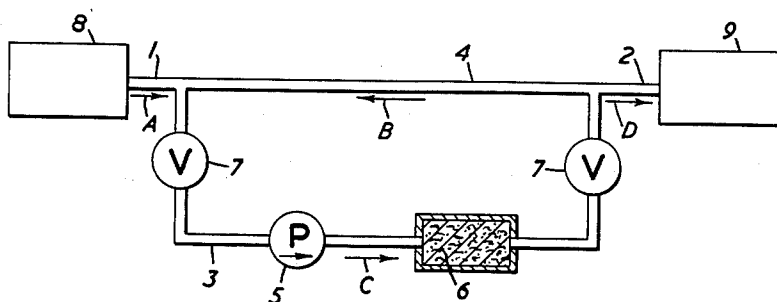


FIG. 2.

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TREATMENT OF FLUID FLOWS
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This invention relates to treatment processes incorporated in fluid flows, and is particularly concerned with a means and method for effecting such treatment processes.

In many processes a specific treatment of a fluid flow, for example filtration to remove an unwanted component, is of secondary importance to the maintenance of the fluid flow. In some cases it is essential from the point of view of safety that the flow should be maintained even at the expense of temporary cessation of the treatment.

Hitherto when fluid flow treatment means, for example a filter section, has been introduced into a pipeline used for a process in which the maintenance of flow is of importance, normally either two sections of such means have been connected in valved parallel branches of the pipeline or one section has been connected in parallel with a valved by-pass. In the former case, when blockage of the section in use occurs, it is isolated for clearing and the parallel section brought into use, whilst in the latter case the section can be isolated and the by-pass brought into use. Even more complicated arrangements have been used, for example the provision of two or more sections in parallel with a valve by-pass.

In all such arrangements partial or complete blockage of the section in use affects the process flow and the blockage may not be noticed and corrected for some time. In particular, where the section has to incorporate fluid displacement means to overcome the resistance to flow presented by the treatment means, the action of the fluid displacement means, as they are directly in line with the process flow, affects the pressure conditions of the flow and if the fluid displacement means breaks down the process flow is obstructed. As the section handles the main flow of a process the continuity of which is essential, either blockage or breakdown of the fluid displacement means can represent a dangerous hazard as a no-flow condition can arise. It must be borne in mind that the process flow itself may take any one of many forms, and may for example result from chemical action alone or be produced or assisted by means of a pump, fan, ejector or the like. It may be continuous or batchwise, and it may be straight-through or recycling via a reservoir.

The treatment process may involve one or more of a wide range of unit operations, such as filtration, clarification, absorption, softening and like component separation processes. Where the treatment involves or can involve a significant resistance to flow, the treatment process may require the use of a treatment section incorporating its own prime mover and fluid displacement means, and defects in the section can cause an undue pressure rise in the process flow before the treatment section or an undue pressure drop or suction after it, either of which conditions may adversely affect the main process or even introduce a hazard.

The main object of the invention is to provide a fluid flow treatment means and method with which, in the event of complete or partial blockage of the treatment section, continuance of the flow normally treated is assured. A further object is to provide such a means and method with which such complete or partial blockage produces substantially no additional impedance to full flow or additional resistance opposing the flow.

According to the invention means for the treatment of fluid flows comprises a pump or other fluid displace-

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ment means connected in series with treatment apparatus, the pump having a rate of fluid displacement, against the normal total working resistance of the treatment section, greater than the normal maximum rate of said fluid flow, and a normally open by-pass connected in parallel with the pump and apparatus.

In normal operation the volume of fluid displaced by the fluid displacement means in excess of said fluid flow is recirculated around the by-pass, the flow of this excess through the by-pass being in the opposite direction to that which applies when a flow is being permitted to pass through a valve by-pass as in the prior art. Thus, the treatment means automatically adjusts itself to compensate for any partial or complete blockage of the apparatus or breakdown of the pump, and in the event of complete blockage the full fluid flow passes through the by-pass in the normal direction of the prior art but without the necessity for opening a valve. Thus a hazardous no-flow condition cannot occur, even momentarily or during the gradual transition during a blockage build-up when the flow through the by-pass automatically reduces, reverses and then increases, finally reaching the full flow condition at the complete blockage stage.

In addition, when treatment means according to the invention are utilised in a treatment process this and the main process are pressure independent. Any resistance to flow produced by the treatment apparatus is absorbed by the power and capacity of the pump during normal operation and any increase in resistance to flow arising during a build-up of the blockage in the apparatus is accommodated by the presence of the by-pass, so that in neither case has the resistance to flow of the treatment section any material influence on the pressure conditions in the main process flow.

Shut-off valves may be provided to isolate the pump and treatment apparatus for clearing in the event of blockage or breakdown, the operation of these valves leaving the by-pass open. The by-pass itself is preferably valveless so that there is no chance of it being inadvertently left closed.

The treatment section may be duplicated in parallel so that in the event of blockage of the section in use the alternative parallel section may be brought into service. These sections may share a common by-pass along which the full flow occurs in the interval before and during change over to the alternative section.

Preferably the by-pass is of die cross-section so that it provides a low or negligible impedance to flow therethrough and cannot conceivably block up, and it may conveniently be a short length of pipe of the same or preferably greater diameter than the pipe carrying said fluid flow to the treatment means. However, the valveless by-pass must not generally be shorter than approximately three times its diameter, as otherwise a certain amount of untreated fluid may short circuit the treatment section during normal operation of the treatment means.

The invention also includes a method of treating a fluid flow which comprises passing said fluid through a treatment zone at a rate greater than said fluid flow thereby to effect the treatment, and recirculating the excess along a substantially unrestricted flow path.

The invention will now be described with reference to the accompanying drawings which illustrate, by way of example, means for the treatment of fluid flows in accordance with the invention, and in which:

FIGURE 1 is a flow diagram of the means, and

FIGURE 2 is a similar diagram showing the means incorporated in a plant, for example an oil-gas plant.

The treatment means comprise an inlet pipeline 1 and an outlet pipeline 2 connected in series with a pipeline 3

in which is connected a pump or other fluid displacement means 5 and treatment apparatus 6. The latter is, for example, a filter. A valveless by-pass 4 in parallel with the pipeline 3 interconnects the inlet and outlet pipelines 1 and 2, and the pipeline 3 is valved at 7 to cut off the flow through the pump 5 and apparatus 6 for maintenance purposes.

The pump 5 has a normal rate of fluid displacement, against the normal total working resistance of the treatment apparatus 6, greater than the normal maximum rate of fluid flow through the pipelines 1 and 2. The direction of flow through the two latter pipelines is as shown respectively by the arrows A and D, and the flow through the pipeline 3 assisted by the pump 5 is in the direction of the arrow C; thus, the excess volume of fluid displaced by the pump 5 is recirculated around the by-pass 4 in the opposite direction, i.e. in the direction of the arrow B. As a result, the treatment means automatically adjusts itself to compensate for any partial or complete blockage of the apparatus 6 or breakdown of the pump 5, and in the event of complete blockage the full fluid flow passes through the by-pass 4 in the conventional direction, i.e. against the arrow B, without the necessity for opening any valves in the by-pass 4.

The system is thus self-compensating and a hazardous no-flow condition cannot occur, even momentarily, and the treatment process and the main process with which it is associated are pressure independent. Any resistance to flow produced by the apparatus 6 is absorbed by the power and capacity of the pump 5 during normal operation and any increase in resistance to flow arising during a build-up of blockage in the apparatus 6 is accommodated by the presence of the permanently open by-pass 4.

The means of FIGURE 1 can be incorporated in a plant as shown in FIGURE 2, in which a section of the plant producing the fluid flow to be treated is shown at 8 and a further section of the plant to which the treated flow is supplied is shown at 9.

One particular application of the invention is in the cleaning of carbon-laden gas produced by an oil-gas plant, corresponding to the section 8, before the gas enters a gas holder, corresponding to the section 9, for storage. In this case the treatment means comprise a fan 5 and filter 6 and as the gas flow is discontinuous, being interrupted between spaced "make" periods, the flow passed through the filter by the fan 5 in the direction of the arrow C is arranged to be greater than the maximum gas flow during a make period. During the make periods the treated excess is recirculated back along the by-pass 4 in the direction of the arrow B and in parallel with the fan 5 and filter 6, and in the intervening periods the complete volume displaced by the fan 5 recirculates through the by-pass 4 and pipeline 3 containing the filter 6.

In the event of breakdown of the fan 5, or blockage of the filter 6, the complete gas flow during the make periods passes substantially unrestricted in the opposite direction to the arrow B along the by-pass 4. With an application such as this, the cleaning of the gas, though highly desirable, is of secondary importance to the maintenance of gas flow. Any major restriction of the latter would result in the development of a dangerous overpressure in the gas plant 8.

Some examples of treatment processes with which the invention may very conveniently be used, and in which it is essential that partial or complete discontinuance of the main process flow to which they are subsidiary should not be allowed to occur, are: oil filtration associated with an engine lubrication system; filtration and humidification associated with an air conditioning system; and softening and clarification associated with a water supply system. Further examples, in which the subsidiary processes are of such nature that blockage thereof is rather unlikely, but where the invention may be employed where it is desired to guard against the danger which would

result if such blockage did occur, are: the removal of SO_2 associated with an ore smelting process; noxious gas removal associated with such processes as nitration and chlorination; and the removal of fly ash associated with a steam raising process.

I claim:

1. Apparatus for the treatment of a fluid flow comprising a fluid inlet; a fluid outlet; a fluid treatment section connected between the inlet and the outlet and comprising fluid displacement means and fluid treatment means having a normal resistance to fluid flow therethrough but being liable to exhibit an increased resistance to reduce or inhibit fluid flow therethrough, the treatment means being connected in series with the fluid displacement means; and a by-pass connected between the inlet and the outlet in parallel with the treatment section, the by-pass being permanently open during operation of the apparatus; wherein the fluid displacement means has a rate of fluid displacement greater than the rate of fluid flow through the inlet under normal operating conditions of the apparatus so that under said conditions the fluid displacement means draws fluid from both the by-pass and the inlet and wherein fluid passes from the inlet to the outlet along the by-pass upon an increase of said resistance above a pre-determined value.

2. Treatment means according to claim 1, wherein the by-pass is of wide cross-section so that it provides a low or negligible impedance to flow therethrough.

3. Treatment means according to claim 2, wherein the by-pass is a short length of pipe of the same or greater diameter than a pipe carrying said fluid flow to the treatment means.

4. Treatment means according to claim 3, wherein the pipe forming said by-pass is not shorter than approximately three times its diameter.

5. Treatment means according to claim 1, wherein said treatment apparatus comprises a filter.

6. Apparatus for the treatment of a fluid flow comprising a fluid inlet; a fluid outlet; a fluid treatment section connected between the inlet and the outlet and comprising fluid displacement means and fluid treatment means having a normal resistance to fluid flow therethrough but being liable to exhibit an increased resistance to reduce or inhibit fluid flow therethrough, the treatment means being connected in series with the fluid displacement means; shut-off valves between the treatment section and the inlet and outlet and operable to isolate the treatment section; and a by-pass connected between the inlet and the outlet in parallel with the treatment section, the by-pass being permanently open during operation of the apparatus; wherein the fluid displacement means has a rate of fluid displacement greater than the rate of fluid flow through the inlet under normal operating conditions of the apparatus so that under said conditions the fluid displacement means draws fluid from both the by-pass and the inlet and wherein fluid passes from the inlet to the outlet along the by-pass upon an increase of said resistance above a pre-determined value.

7. Apparatus for the treatment of a fluid flow comprising a fluid inlet; a fluid outlet; a fluid treatment section connected between the inlet and the outlet and comprising fluid displacement means and fluid treatment means having a normal resistance to fluid flow therethrough but being liable to exhibit an increased resistance to reduce or inhibit fluid flow therethrough, the treatment means being connected in series with the fluid displacement means; and a valveless by-pass connected in parallel with the treatment section between the inlet and the outlet so that the by-pass is permanently open during operation of the apparatus; wherein the fluid displacement means has a rate of fluid displacement greater than the rate of fluid flow through the inlet under normal operating conditions of the apparatus so that under said conditions the fluid displacement means draws fluid from both the by-pass and the inlet and wherein fluid passes from the inlet to the

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outlet along the by-pass upon an increase of said resistance above a pre-determined value.

8. Apparatus for the treatment of a fluid flow comprising a fluid inlet; a fluid outlet; a fluid treatment section connected between the inlet and the outlet and comprising a fan and fluid treatment means having a normal resistance to fluid flow therethrough but being liable to exhibit an increased resistance to reduce or inhibit fluid flow therethrough, the treatment means being connected in series with the fan; and a by-pass connected between the inlet and the outlet in parallel with the treatment section, the by-pass being permanently open during operation of

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the apparatus; wherein the fan has a rate of fluid displacement greater than the rate of fluid flow through the inlet under normal operating conditions of the apparatus so that under said conditions the fan draws fluid from both the by-pass and the inlet and wherein fluid passes from the inlet to the outlet along the by-pass upon an increase of said resistance above a predetermined value.

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