May 12, 1942. F. B. SCHNEIDER 2,282,889

FLOW CONTROL DEVICE

Filed March 20, 1941

Fig. 1.

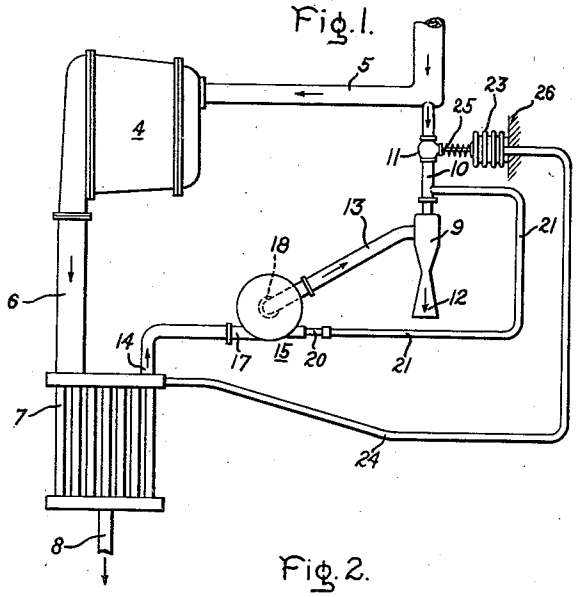


Fig. 2.

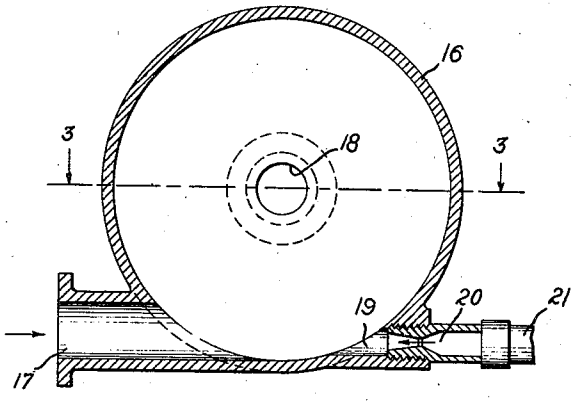
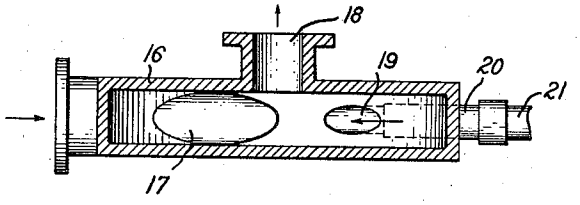


Fig. 3.



Inventor:
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UNITED STATES PATENT OFFICE

2,282,889

FLOW CONTROL DEVICE

Fred B. Schneider, Wesleyville, Pa., assignor to General Electric Company, a corporation of New York

Application March 20, 1941, Serial No. 384,233

10 Claims. (Cl. 230—111)

The present invention relates to flow control devices for controlling the flow of fluid through conduits.

The object of the invention is to provide an improved construction and arrangement in a flow control device, and for a consideration of what I believe to be novel and my invention, attention is directed to the following specification and the claims appended thereto.

An application of my invention is in connection with steam power plants for controlling the flow of air and other non-condensable gases from a condenser to an air ejector pump. The air ejectors of conductors transport mostly wet air; in some cases almost the total flow is steam. Although this flow control device can be operated in conjunction with a motor driven air pump, the described application shows the greatest advantages with a high pressure steam driven air ejector. It is this application of my invention which I have elected to illustrate and describe. It is to be understood, however, that this is only by way of example and that the invention may be used wherever found applicable.

In the drawing, Fig. 1 is a diagrammatic view of a power plant embodying the invention; Fig. 2 is a vertical sectional view through my flow control device, and Fig. 3 is a sectional view taken on line 3—3, Fig. 2.

Referring to the drawing, 4 indicates diagrammatically an elastic fluid turbine to which elastic fluid, for example steam, is supplied by conduit 5 from a suitable source, such as a steam boiler. Elastic fluid from turbine 4 exhausts through a conduit 6 to a condenser 7, the condensate flowing out to a suitable well through conduit 8. The turbine is shown only diagrammatically, the valves for controlling the flow of elastic fluid to the turbine and other parts being omitted as they form no part of the present invention. 9 indicates an air ejector pump connected to conduit 5 by pipe 10, a suitable valve 11 being located in pipe 10 to control the flow of elastic fluid through it. The discharge end 12 of the air ejector pump may be connected in any suitable manner to an ejector condenser as is well understood. The elastic fluid entering the ejector through pipe 10 is the pumping fluid. The fluid to be pumped enters the ejector through pipe 13. In the present instance, the ejector is used to remove air and other non-condensable gases from condenser 7, and to this end the pipe 13 through which the fluid to be pumped is led to the ejector is connected to the top of condenser 7, as is indicated at 14.

Located in pipe 13 is my improved flow control device indicated generally by reference character 15. It comprises a flat circular or disk shaped casing 16 of suitable diameter and width having a tangentially arranged inlet opening 17 and a centrally located axially directed outlet opening 18 in one of its side walls. Inlet opening 17 is connected to the condenser and outlet opening 18 is connected to the inlet of the air ejector pump 9 as shown in Fig. 1. Opposite tangential opening 17 is a second tangential opening 19 in which is arranged a nozzle 20 connected by a pipe 21 to pumping fluid conduit 10 between valve 11 and ejector air pump 9. The valve 11 in pipe 10 has its stem connected to the upper movable end of a Sylphon bellows 23, the interior of which is connected by pipe 24 to the upper end of condenser 7. This means that the interior of bellows 23 is subjected to the pressure obtaining in condenser 7. Surrounding the valve stem of valve 11 is a spring 25 which acts in a direction to effect opening of valve 11, being arranged between the valve body and the head of the bellows. The bellows is supported at its outer end on a fixed abutment 26. With this arrangement, pressure in condenser 7 tends to close valve 11 and as such pressure decreases the valve is gradually opened by spring 25 to supply pumping fluid to the ejector 9, part of which is by-passed through conduit 21 to the control device 15.

The operation is as follows: Assuming that valve 11 is closed and that therefore the ejector pump 9 is not in operation, except to permit the passage of a flow of fluid from conduit 13, any such fluid entering the flow control device through inlet 17 and being discharged from it through outlet 18. Because of the tangential arrangement of inlet 17, fluid entering it will assume a circular path of flow tending to flow around the wall of the casing 16. As a result a whirl will be set up in casing 16 whereby the fluid will have to travel a considerable distance before it reaches outlet opening 18. As a result, there will be but a limited flow through the flow control device. In other words, due to the tangential arrangement of the inlet opening 17, the fluid entering through opening 17 rotates in the disk-like chamber, thereby creating a large pressure drop which is determined by the ratio of the diameters of the outlet opening 18 and the casing 16. This resistance prevents effectively a large flow of fluid through the fluid control device. It thereby decreases to a minimum the amount of fluid being lost to the atmosphere

by flowing through conduit 13 and the ejector pump 9. If, now, valve 11 is opened pumping fluid is admitted to the air ejector pump 9 and also through conduit 21 to nozzle 20. The fluid from nozzle 20 impinges against the fluid entering through tangential inlet 17, thereby preventing the whirling action of the fluid in casing 16. As a result, the fluid finds its way directly to outlet opening 18 with little disturbance. Accordingly, there is but a small drop in pressure through the flow control device which means that flow can take place through it readily, thereby greatly assisting the operation of the ejector 9. The amount of fluid admitted through nozzle 20 can be adjusted to counteract in varying degrees the flow through admission opening 17 whereby the control can be made to have different degrees of effectiveness. Generally the pumping fluid flowing from conduit 5 through conduits 10 and 21 to the ejector and to the flow control device is under much higher pressure than the fluid to be pumped through conduit 17. In actual construction therefore the nozzle 20 can be made considerably smaller than the conduit 17. This reduces to a minimum the amount of back flow from the control device 15 through conduit 21 to the ejector when the ejector is not operating. In other applications where the nozzle 20 may be almost as large as the inlet area 17 a check valve may be installed in conduit 21 which prevents the described back flow.

In the particular application of my invention illustrated in Fig. 1, it is desired that when the pressure in condenser 7 is above atmospheric pressure the ejector pump 9 should pump or pass little if any vapors from condenser 7 in order to prevent their large and unnecessary loss to the atmosphere. Accordingly, the arrangement is such that the pressure supplied through pipe 24 to the bellows 23 is sufficient to hold valve 11 closed until a vacuum has been established in condenser 7. After such vacuum is established, valve 11 is opened to operate the air ejector pump 9 and to supply fluid to nozzle 20, thus decreasing the resistance to flow of the flow control device 15 and permitting the air ejector pump to effect withdrawal of air and other non-condensable gases from the condenser.

The arrangement has the advantage that the flow control device has no moving mechanical or electrical parts which means that it is not likely to get out of order. Also, it is entirely automatic in operation. Whenever the air ejector pump 9 is operating the resistance through the flow control device is a minimum and as soon as the air ejector pump 9 stops working the resistance through the flow control device increases automatically to a maximum. The fact that it has no mechanical moving parts makes it especially desirable for use in the handling of corrosive fluids such as may be met with, for example, in chemical plants. The flow control device can be mounted not only vertically as shown in Fig. 1 but also horizontally or at any other angle without affecting its operation.

In controlling flow, the device may be used as a means for apportioning the flow between two fluids, for example where it is desired to uniformly mix two fluids at different rates of flow. Under such circumstances, with a certain rate of flow through nozzle 20, there will be a certain rate of flow through inlet 17 and the total flow of the two fluids can be increased and decreased proportionately by increasing and decreasing the flow through nozzle 20.

According to the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to be the best embodiment thereof. It is to be understood, however, that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A flow control device comprising a casing having an inlet opening at an edge wall facing in a direction to direct fluid entering through the inlet opening around the walls of the casing, an outlet opening at its central portion, said casing being free of obstructions between said inlet opening and said outlet opening and a second inlet opening in an edge wall of the casing oppositely disposed with respect to said inlet opening to direct fluid into the casing in opposition to fluid entering through said inlet opening to oppose flow of fluid around the wall of the casing and effect flow of it directly to the outlet opening.

2. A flow control device comprising a circular casing having an inlet opening arranged tangentially to the surrounding circular wall of the casing, an outlet opening in a side wall, said casing being free of obstructions between said inlet opening and said outlet opening and a second inlet opening arranged tangentially to the surrounding circular wall in opposed relation to said first inlet opening and through which fluid may be supplied to the casing in opposition to fluid entering through said first inlet opening.

3. A flow control device comprising a flat circular casing having a discharge opening in a side wall, and opposed tangentially arranged inlet openings in the surrounding wall, said casing being free of obstructions between said inlet opening and said outlet opening means for supplying fluid, the flow of which is to be controlled, to one of said inlet openings, and means for supplying controlling fluid to the other of said inlet openings.

4. A flow control device comprising a flat circular casing having a discharge opening in a side wall, and opposed tangentially arranged inlet openings opposed relatively to each other in the surrounding wall, said casing being free of obstructions between said inlet opening and said outlet opening means for supplying fluid, the flow of which is to be controlled, to one of said inlet openings, means for supplying controlling fluid to the other of said inlet openings, and means controlled by an operating condition appurtenant to the fluid to be controlled for regulating the supply of controlling fluid.

5. The combination with a pump an operating fluid connection to said pump and a conduit connected to the inlet of the pump, of means for controlling flow through said conduit comprising a casing having a centrally located outlet in one wall, an inlet arranged tangentially to another wall of the casing through which fluid to be pumped is admitted to the casing, said casing being free of obstructions between said inlet and said outlet a second inlet arranged in opposed relation to the first named inlet, and means for supplying controlling fluid to said second inlet in proportion to the flow of operating fluid to said pump to regulate the flow of fluid from said first inlet to said outlet.

6. The combination with a pump having a suction inlet and a supply conduit for supplying pumping fluid to the pump, of a flow control de-

vice comprising a casing having a centrally located outlet opening in a wall thereof, a conduit connecting such outlet opening to said suction inlet, an inlet arranged tangentially to another wall of said casing through which fluid to be pumped flows to the control device, a second inlet arranged in opposed relation to the first named inlet for the admission of controlling fluid, a source of fluid supply, and valve means controlled by an operating condition appurtenant to the fluid to be pumped for regulating the fluid supply to said supply conduit and to said second inlet.

7. In combination, a condenser, an ejector pump having a suction inlet, a flow control device comprising a casing having a centrally located outlet opening connected to said suction inlet, and opposed tangentially arranged inlet openings, a conduit connecting one of said tangentially arranged inlet openings to said condenser, and valve means controlled by the pressure in the condenser for regulating the supply of pumping fluid to the ejector pump and of actuating fluid to said second tangentially arranged inlet opening.

8. In combination, a condenser, an ejector pump, a conduit for supplying operating fluid to said ejector pump, a conduit connecting the condenser to the suction inlet of the pump, and a flow control device in said conduit having a tangentially arranged inlet, an outlet in spaced relation thereto, and a second inlet arranged opposite to said first inlet for supplying fluid to the casing in opposition to fluid entering through said tangentially arranged inlet in proportion to the operating fluid supplied to said ejector pump.

9. In combination, a condenser, an ejector pump, an operating fluid supply valve for said pump, means responsive to the pressure within said condenser for controlling said fluid supply valve, a flow control device connected between said ejector pump and said condenser, and means responsive to variations in the flow of operating fluid through said supply valve for varying the flow in said device.

10. In combination, a condenser, an ejector pump, an operating fluid supply valve for regulating the fluid supply to said ejector pump, means to regulate said fluid supply valve in response to the pressure within said condenser, a fluid control device connected between said condenser and said ejector pump arranged to provide normally a high resistance to fluid flow between said condenser and said ejector pump, and means responsive to operating fluid supplied to said ejector pump for reducing the resistance to flow of said fluid control device.

FRED B. SCHNEIDER.

CERTIFICATE OF CORRECTION.

Patent No. 2,282,889. May 12, 1942.

FRED B. SCHNEIDER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 14, for "conductors" read --condensers--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of June, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.