This invention is a Venturi type scrubber wherein, in a throttling part above a throat part, an inner tube having a flow passage area smaller than the cross-sectional area of said throat part is provided so as to come into contact with the internal surface of the throttling part so that, when said inner tube is moved vertically in the same direction as the gas flow along the axis, the flow passage area in the throat part may be varied to make the gas flow velocity constant.

BACKGROUND OF THE INVENTION
Field of the invention

This invention relates generally to a Venturi type gas scrubber and more particularly to a wet type gas scrubber wherein, when the volume of a gas introduced from a gas produced in a blast furnace or the like fluctuates, the velocity of the gas in the cross-section of the throat part can be always kept constant in response to said fluctuation and the gas can be scrubbed by perfectly atomizing water.

Description of the prior art

Generally, in a Venturi type gas scrubber, it is known that the cross-sectional area of the throat part can be varied in response to the volume of flow of the gas. That is to say, a regulator for a variable cross-sectional area is provided in the throat part of a scrubber so that the volume of flow of the gas passing through the throat part may be varied. One apparatus for carrying out such a method is a wedge type Venturi scrubber. However, unnecessary eddy currents will be generated in the gas flow after passing through the throat part, the pressure loss in the expanded part will be very large and the operation of a controlling device based on the correlation between the volume of flow of the gas and the regulator will be difficult. Further, generally, the dust removing efficiency in a Venturi type scrubber will be influenced by the velocity of the flow passing through the throat part and the amount of water poured in and therefore, in a case a Venturi type scrubber is used as a gas scrubber, the volume of the produced gas will vary depending on the operating conditions as, for example, a blast furnace, in order to always obtain a high scrubbing efficiency the passage area in the throat part must be varied in response to the fluctuation of the volume of the produced gas so that a passing flow velocity above a fixed value may be secured in the throat part.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a wet type gas scrubber wherein the generation of unnecessary eddy currents in a gas flow after passing through the throat part as is mentioned above can be prevented, the pressure loss can be reduced, and the correlation between the volume of flow of the gas and the passage area in the throat part can be established so that the passage area in the throat part may be varied in response to the fluctuation of the volume of flow of the gas and control can be carried out on the basis of such correlation.

In order to attain the above mentioned object, according to the present invention, in a throttling part above a throat part, a hollow inner tube having the same taper as its throttling part and having a passage area smaller than the cross-sectional area of the throat part is provided on a shaft so as to contact the internal surface of the throttling part so that, when said inner tube is moved in the same direction as the flow of the gas along the axis, the passage area of the throat part may be varied by said inner tube and throttling part.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings shall be briefly explained.

FIGURE 1 is a vertically sectioned view of a Venturi type scrubber of a circular cross-sectional to which the present invention is applied.

FIGURE 2 is a sectional view on line A—A in FIGURE 1.

FIGURE 3 is a vertically sectioned view in which the inner tube in FIGURE 1 has moved.

FIGURE 4 is a sectional view on line B—B in FIGURE 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention shall be described in detail in the following with reference to the accompanying drawings.

According to the present invention, as shown in the drawings, in a Venturi type gas scrubber, a shaft 4 is provided so as to be vertically movable in a throttling part above a throat part 1 and a frusto conical inner tube 3 having an internal cross-sectional area 11 at the smaller end smaller than the cross-sectional area of the above mentioned throat part 1 and having an internal cross-sectional area at the larger end larger than the cross-sectional area of the throat part and having a taper such that it will come into contact with the internal surface of the throttling part 2 is fixed to said shaft 4 so that, when said inner tube 3 is moved in the same direction as the flow of the gas by the above mentioned shaft 4, the opening area of the above mentioned throat part 1 may be varied.

In the above, the shaft 4 is held so as to be vertically movable by a plurality of arms 7 having bearing means 7a on the inner ends thereof and fixed to the Venturi body. Further, a water pipe 6 is arranged around the throat part 1 and is provided with many water injecting ports so that water may be injected into said throat part 1. The above mentioned inner tube 3 is provided with proper supporting frames 10 to enable it to be fixed to the shaft 4. Below the above mentioned throat part 1 is diverging a part 5.

In the present apparatus formed as mentioned above, when the inner tube 3 is in close contact with the inside surface of the throttling part 2 as shown in FIGURE 1, the passage area of the throat part 1 will be throttled to the area 11 of the opening at the bottom of the inner tube 3 and will have the minimum value. As an extreme example, if the opening of the inner tube 3 is eliminated and the inner tube 3 is made as a cone of a closed cross-section, if the inner tube 3 is brought into close contact with the inside surface of the throttling part 2, it will be possible to completely interrupt the passage of the gas. When the inner tube 3 is then gradually moved in the direction indicated by the arrow by the shaft 4, the passage area of the throat part 1 will be the sum of the opening area 11 of the inner tube 3 plus the clearance between the inner tube 3 and the throttling part 2 and will...
3 gradually increase in proportion to the distance the inner tube 3 is moved. When the inner tube 3 has moved to the illustrated position from the throat part 1 as shown in FIGURE 3, the influence of the inner tube 3 on the throat part 1 will be substantially nil and the opening area of the throat part 1 will be the maximum value and will not be throttled by the inner tube 3. Inherently, in the case of handling a high pressure gas, a Venturi type scrubber of a circular cross-section is more advantageous with respect to the strength. But, in case the volume of gas is larger, the diameter of the throat will have to be larger and therefore the injection of water toward the center part of the throat part will deteriorate. Further, it is also possible to form the present scrubber so that a plurality of throttled parts of the throat part may be provided.

In the above, there has been described in detail the manner of applying the present invention to a Venturi type scrubber in which the cross-section of the throat part is circular. But, the present invention can be applied also in the same manner to a Venturi type scrubber of a square or any other cross-section. In such case, too, an inner tube 3 having the same taper as the throttling part 2 and having an opening area smaller than the cross-section of the throat part 1 may be set in the throttling part 2 so as to be movable in the direction of the shaft 4.

As described above, in the present invention, a constant flow velocity of a gas can be always obtained in response to any large fluctuation of the volume of the gas by simply mounting an inner tube 3 of a very simple structure in the throttling part 2 of a Venturi type scrubber so as to be movable in the direction of its mounting shaft. It is simple to handle and easy to maintain.

An example of using the present invention in a small Venturi type scrubber shall be described in the following. Table 1 shows the relations among the volume of flow (in m.3/min.), throat part opening area (in cm2) and throat part passing flow velocity (in m./sec.) when the inner tube shaft was moved vertically along the axis while the pressure loss was kept constant at 465 mm. Hg. When no water was injected. When the movement of the inner tube shaft was 0 mm., the inner tube 3 was in close contact with the inside surface of the throttling part. When the inner tube 3 moved by 10, 20, 30 mm. . . . from said position in the upward direction of the shaft 4, the opening area and volume of flow increased. The passing flow velocity in such case is shown.

**TABLE 1**

<table>
<thead>
<tr>
<th>Inner tube shaft movement (in mm.)</th>
<th>Throat opening area (in cm2)</th>
<th>Volume of flow (in m.3/min.</th>
<th>Throat passing flow velocity (in m/sec.)</th>
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<tbody>
<tr>
<td>0</td>
<td>24.08</td>
<td>16.2</td>
<td>100.6</td>
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<td>20</td>
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<td>30</td>
<td>69.32</td>
<td>41.6</td>
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<td>50</td>
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</tr>
<tr>
<td>70</td>
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</tr>
<tr>
<td>80</td>
<td>100.49</td>
<td>60</td>
<td>114.4</td>
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</table>

From the above results, it is found that, for example, in the case of controlling the volume of flow as desired in response to the fluctuation of the volume of flow of the furnace top gas in the high pressure operation of a blast furnace, by vertically moving the shaft 4 of the inner tube 3, the opening area of the throat part 1 may be varied and thereby the volume of flow of the gas may be varied so that the velocity passing through the throat part 1 may be kept constant.

By carrying out the above described present invention, there can be obtained such remarkable effects that:

1. No eddy current will be generated at a partial opening.
2. The throat part can be fully opened with a slight stroke of the inner tube and the control of the volume of flow can be made easy.
3. Further, the relation between the volume of flow and the opening area in the throat part is substantially proportional and the controllability of the volume of flow is very high and,
4. The pressure loss is very low.

Therefore, the present invention is best adapted to a Venturi type scrubber for a fluctuating volume of gas specifically in switching from the high pressure operation to the ordinary pressure operation of a blast furnace or vice versa.

I claim:

1. A Venturi type scrubber comprising a Venturi having a throat part, a converging part leading into said throat part and a diverging part opening out of said throat part, a shaft mounted in said converging part and movable along the axis of said converging part, a frusto-conical hollow open-ended inner tube having an internal cross-sectional area at the lower end smaller than the cross-sectional area of said throat part and having an external cross sectional area at the upper end larger than the cross-sectional area of said throat part, said inner tube being mounted on said shaft for movement with said shaft, the exterior of said tube having the same configuration and being tapered with the same taper as the converging part and contacting the internal surface of said converging part when in the position closest to said throat part, whereby when the inner tube is moved by moving said shaft, the effective cross sectional area of said venturi throat part can be varied and means on said throat part to inject a scrubbing fluid into said scrubber.

2. A Venturi type scrubber as claimed in claim 1 in which said shaft has arms thereon attached to the inner surface of said hollow tube for supporting said tube on said shaft.

3. A Venturi type scrubber as claimed in claim 1 in which said Venturi has a plurality of arms therein having bearing means on the inner ends thereof in which said shaft is mounted.

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