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Ebert

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[54] **APPARATUS FOR CLEANING GASES THROUGH IONIZATION**

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[52] **U.S. Cl.** **55/118**, 55/122, 55/136, 55/139, 55/146, 55/149, 55/150, 55/154, 55/DIG. 38

[51] **Int. Cl.** **B03c 3/78**

[58] **Field of Search** ..... 55/108, 118, 120, 55/122, 128, 129, 130, 136, 137, 138, 139, 146, 149, 150, 152, 14, DIG. 38, 154

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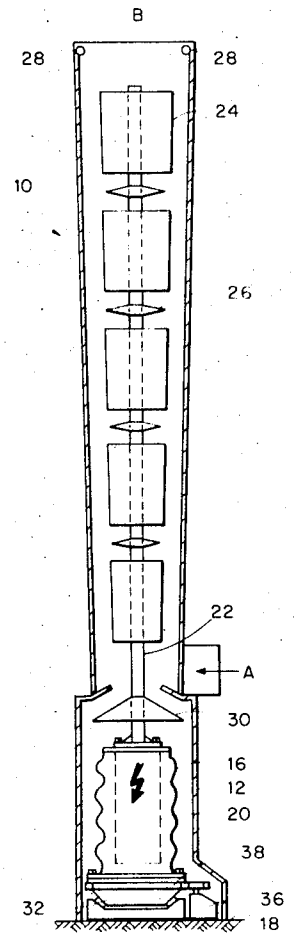
[57] **ABSTRACT**

An electrostatic precipitator for cleaning exhaust gases through ionization, including a high voltage generator installed in a stationary insulator within a chimney flue. The stationary insulator supports a carrying axle onto which a number of hollow high potential discharge electrodes are mounted and which has a direct electrical contact with the high voltage generator output. The carrying axle conducts a voltage produced by the generator to the mounted electrodes. The chimney flue serves as a discharge channel in which a collecting electrode is provided in the form of a continuous film of water flowing down along the inside walls of the chimney flue.

9 Claims, 2 Drawing Figures



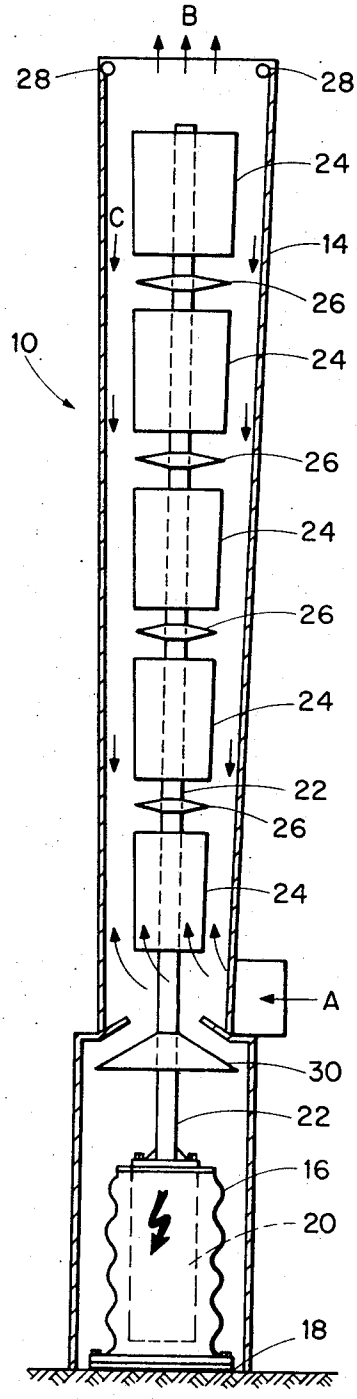


Fig. 1.

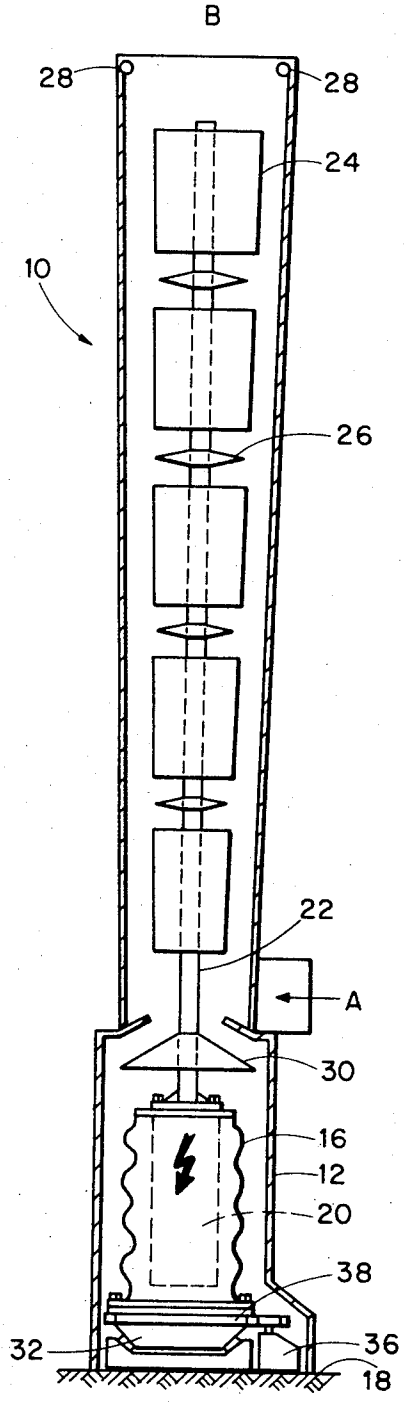


Fig. 2.

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APPARATUS FOR CLEANING GASES THROUGH IONIZATION

DESCRIPTION OF THE INVENTION

This invention relates generally to the cleaning of gases through ionization and particularly to an electrostatic precipitator mounted inside a chimney flue adapted to serve as an ionic discharge channel comprising high potential discharge electrodes and a grounded wet collecting electrode.

There are known devices for cleaning exhaust gases or air for ventilation systems through ionization which utilize an ionization centrifuge fed with high voltage and installed in a chimney flue. The operation of the ionization centrifuge causes a turbulent motion of the gas to be cleaned through ionic discharge and the resultant ionic bombardment effects the separation of the contaminating particles which are deposited on a collecting electrode surface and flushed away by spraying water or another gas-absorbing liquid thereon.

Although such installations yield good results both on test runs and under normal operation, it is still difficult to obtain a high voltage supply line with a long term reliability when utilizing these installations. Normally it is necessary to install the high voltage generator separately and distant from the electrostatic filter in order to satisfy inspection and safety regulations. Thus, fairly long conducting cables are needed to connect the high voltage generator to the electrostatic filter. High voltage cables are, however, relatively much more expensive when compared to low voltage cables and in case of damage, they have to be replaced over the whole length. With regard to the considerable length of the high voltage cable connecting the output of the generator to the electrodes, it is necessary to provide the high voltage generator with an additionally strengthened travelling wave protection.

If for any reason the high voltage cable is not affixed firmly enough in the generator or it becomes loosened, a resulting electric arc could destroy the generator.

Another failure of these prior art installations utilizing a high voltage generator distant from the electrodes could take place at the installation and connection of the high voltage cable within the electrostatic filter itself. It is very difficult to avoid contamination of the conducting cable or of its current passage by spray water, moisture of condensation or electrically charged particles which result in creeping distances and voltage losses.

In view of the foregoing limitations of presently available apparatus for cleaning gases through ionization, it is a general object of the invention to provide a simplified apparatus having a highly reliable high voltage supply line connecting the high voltage generator output to the discharge electrodes.

It is another object of the invention to provide an apparatus for cleaning gases through ionization having a relatively short and inexpensive high voltage supply line safely attached to the generator output on one end and to the electrodes on the other end.

It is another object of the invention to provide an apparatus for cleaning gases through ionization operating with voltages of at least 100 kv.

It is a further object of the invention to provide an apparatus for cleaning gases through ionization suitable for separation of SO_2 and SO_3 contained in exhaust gases.

It is still a further object of the invention to provide an apparatus for cleaning gases through ionization with provision for creating a uniform electric field, preventing formation of electric arcs and keeping the high potential electrodes clean.

These and other objects are met by an apparatus for cleaning gases through ionization installed within a gas flue, comprising a high voltage generator mounted directly inside a stationary insulator of a high potential electrode carrying axle placed in the geometrical axis of the chimney flue and electrically connected directly to the generator output and to the electrodes, which are mounted on and surrounding the axle concentrically. Within the chimney flue an electrically grounded wet collecting electrode is provided by a continuous film of water flowing down along the inside walls of the chimney.

This arrangement makes it possible to feed the electrodes with voltages of 100 kv or more. Electrostatic wet filters operating with such high level voltages were until now unknown. Measurements have shown that under the conditions achieved by the invention it is possible to separate SO_2 and SO_3 contained in the exhaust gases remarkably well.

For some applications the stationary insulator carrying the axle with the high potential electrodes thereon and having the generator, is supported on a base which rotates by means of a drive. By this arrangement, a more uniform electric field is formed within the discharge channel, formation of electric arcs is prevented and the surfaces of the high potential electrodes are kept cleaner.

Further objects and advantages of the present invention will become apparent in the following detailed description taken in conjunction with the accompanying drawings of which:

FIG. 1 is a schematic longitudinal section view of the preferred embodiment of the invention with the high voltage generator installed inside the stationary insulator; and,

FIG. 2 is a schematic longitudinal section view of another embodiment of the invention in which stationary insulator is rotatably supported on a base.

Referring now to FIG. 1, the inside wall of chimney flue **10** has a substantially cylindrical bottom part **12** and an upwardly extending truncated conical part **14.** Inside the bottom part **12** a hollow stationary insulator **16** is firmly mounted to bottom **18** of the chimney. Inside the hollow space of insulator **16** a high voltage generator **20** is installed. The generator is submerged in oil or sealed, in accordance with the particular requirements of safety regulations. Inside the chimney flue a carrying axle **22** is disposed concentrically with the inside walls of the chimney flue. The carrying axle, which is preferably a tube, is supported in the stationary insulator and its lower end has a direct electrical connection to the output of high voltage generator **20** and is firmly attached thereto.

High potential discharge electrodes **24** are mounted on carrying axle **22.** The electrodes are spaced from each other and in the space between two adjacent electrodes, a conical deflecting blade **26** is disposed which is also rigidly mounted on the carrying axle. Electrodes **24** are hollow generally truncated conical elements concentrically surrounding the carrying axle, and having their outside surfaces substantially parallel with the truncated conical upper part **14** of the inside wall of the

chimney 10. The connection of the high potential electrodes to the carrying axle is such as to provide a good and reliable electrical contact and at the same time, a firm mechanical support, which can be achieved e.g. by pressing the electrodes onto the axle (not shown), or utilizing any suitable known technology to achieve the desired result.

On the upper end of the chimney flue overhead distributors 28 are installed circumferentially around the inside walls for spraying water or another gas absorbing liquid continuously to the inside walls. The water flow can be controlled by adjusting the distributors.

In the space between the generator and the high potential electrodes a protective covering 30 is mounted on the axle 22 to protect the insulator against dirt and spray water.

FIG. 2 shows an alternate embodiment of the invention in which insulator 16 is mounted on a rotary base 32 supported e.g. on a bearing. A motor 36 is provided for driving the base 32. The motor has adjustable speed and its shaft engaged with the rotary base at 38. This arrangement makes it possible to rotate insulator 16, generator 20, and axle 22, electrodes 24, deflecting blades 26 and protective sheet cover 30, whereby a more uniform electrical field is formed.

The operation of the preferred embodiment of the invention as shown in FIG. 1 is as follows:

The gas to be cleaned enters the chimney flue at inlet A. The draft in the flue forces the gas to flow upwards as shown by arrows D and to exit at outlet B. As it was previously described, the generator supplies electrodes 24 with a high voltage of 100 kv or more, which is fed to the electrodes by means of carrying axle 22. The inside wall of the chimney flue is electrically grounded thus its potential is zero. Consequently, a high potential electrostatic field is formed between the electrodes 24 and inside wall 14. As a result, a corona discharge in the gas passing between these electrodes takes place around the high potential discharge electrodes and then gas ions formed within the corona move towards the collecting electrode transferring their charge to contaminating particles by collision with them. They in turn are attracted to and eventually deposited on the collecting electrode. The particles adhere to the collecting electrode and have to be removed therefrom. This is accomplished by spraying water or another suitable gas-absorbing liquid from overhead distributors 28 onto the collecting electrode 14. The water flows down along the collecting electrode 14, thus removing the deposited particles. The contaminated water is drained off at outlet 40 e.g. by a drainage channel (not shown).

Some of the gas could escape through the inside space of the hollow electrodes 24 instead of flowing between electrodes 24 and collecting electrode 14 and thus they could circumvent the ionic discharge path. In order to prevent this from happening, deflecting blades 26 are mounted on the axle 22, each in a space between electrodes 24. They prevent the gas from passing through the inside space of hollow electrodes 24 and also they conduct the gas continuously to the film of water at the collecting electrode.

The operation of the alternate embodiment of the invention shown in FIG. 2 is the same as that of the above-described preferred embodiment. However, the advantage of the embodiment of FIG. 2 is that by rotation of the high potential discharge elements, a more homogeneous high potential electrostatic field is created around the discharge electrodes, thus the ionic discharge produced is more efficient. Also, formation of electric arcs is prevented by this arrangement and its further advantage is that it helps to clean contaminants from the high potential electrodes.

Although the invention is most clearly demonstrated in the above-described preferred embodiment, it has application to any other chimney or ventilation system for cleaning exhaust gases or air in which the gas passes through a gas flue.

The shape of discharge electrodes could be different from that in the preferred embodiment. Preferably, however, their outside surfaces are substantially parallel to the surface of the collecting electrode surrounding them.

Other modifications of the invention herein described will occur to those skilled in the art. All such modifications are considered to be within the spirit and scope of the invention as defined.

Having thus described my invention, I claim:

1. Apparatus for cleaning gases through ionization wherein the gases to be cleaned pass through a gas flue adapted to form an ionic discharge conduit in which a number of high potential discharge electrodes are mounted on an electrically conductive carrying axle extending axially through the gas flue and wherein the inside walls of the gas flue are adapted to form an electrically grounded wet collecting electrode, said apparatus comprising in combination: a hollow stationary insulator in the gas flue for supporting the carrying axle; a high voltage generator for feeding the discharge electrodes with a voltage of approximately 100 kv or more, the said generator being mounted inside the hollow stationary insulator, the said carrying axle being electrically connected and firmly attached to both said high voltage generator output and said discharge electrodes.

2. Apparatus according to claim 1 wherein said high voltage generator is submerged in oil inside said hollow stationary insulator.

3. Apparatus according to claim 1 wherein said high voltage generator is sealed inside said hollow stationary insulator.

4. Apparatus according to claim 1 wherein the discharge electrodes are hollow elements with a circular cross-section concentrically surrounding the carrying axle, said electrodes being spaced from each other axially along the carrying axle and having their outside surfaces substantially parallel with the inside wall of the gas flue.

5. Apparatus according to claim 4 wherein the wet collecting electrode is formed by a continuous flow of a gas absorbing liquid sprayed onto the inside walls of the gas flue.

6. Apparatus according to claim 1 wherein a conical deflector blade is mounted on the carrying axle in each space between discharge electrodes.

7. Apparatus according to claim 1 wherein a protective sheet covering is mounted on the carrying axle in the space between said generator and the discharge electrodes.

8. Apparatus according to claim 1 wherein said stationary insulator is rotatably supported on a base and wherein driving means are provided to drive said base, whereby rotation of said stationary insulator, high voltage generator, carrying axle and discharge electrodes is achieved.

9. Apparatus for cleaning gases through ionization wherein the gases to be cleaned pass through a gas flue adapted to form an ionic discharge circuit, said apparatus comprising: an electrically conductive carrying axle extending axially through the gas flue; a number of high potential discharge electrodes mounted on said carrying axle, said electrodes being hollow elements with a circular cross-section concentrically surrounding said carrying axle, said electrodes being spaced from each other axially along said carrying axle and having their outside surfaces substantially parallel with the inside wall of the gas flue; means for spraying a continuous flow of a gas absorbing liquid onto the inside walls of the gas flue to form an electrically grounded wet collecting electrode; a conical deflector blade mounted on said carrying axle in each space between said discharge electrodes; a hollow sealed insulator in the gas flue for supporting said carrying axle and containing oil; a high voltage generator for feeding said discharge electrodes with a voltage of approximately 100 kv or more, said generator being mounted inside said hollow insulator and submerged in said oil, said carrying axle being electrically connected and firmly attached to both said high voltage generator output and said discharge electrodes; a protective sheet covering mounted on said carrying axle between said generator and said discharge electrodes; a base for rotatably supporting said insulator; and means to drive said base and thereby rotate said insulator, high voltage generator, carrying axle and discharge electrodes.

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