Dec. 25, 1923. 1,478,798

A. A. SCHMIDT

APPARATUS FOR ELECTRICAL TREATMENT OF GASES

Filed May 27, 1919 2 Sheets-Sheet 1

Fig. 1.

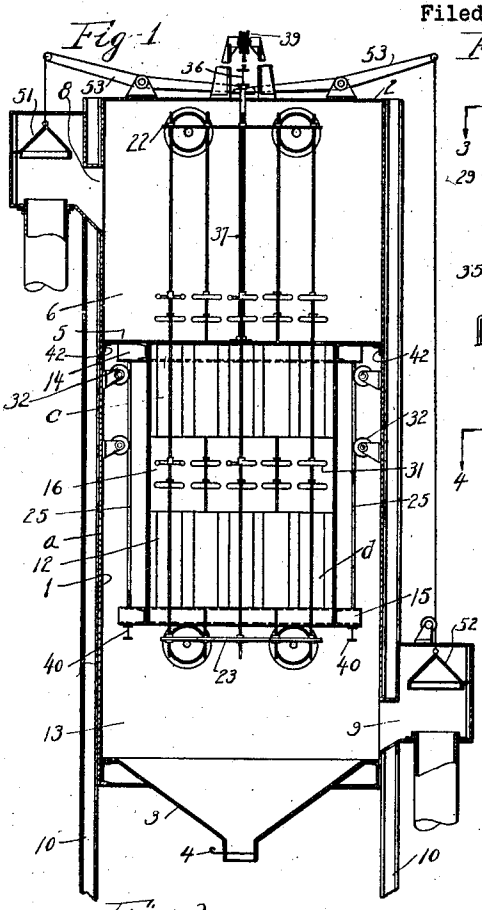


Fig. 2.

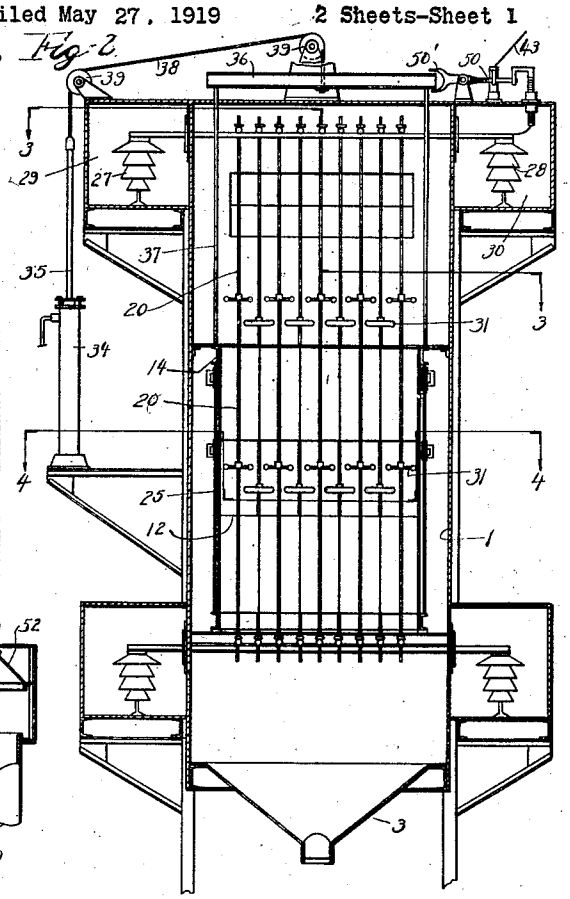


Fig. 3.

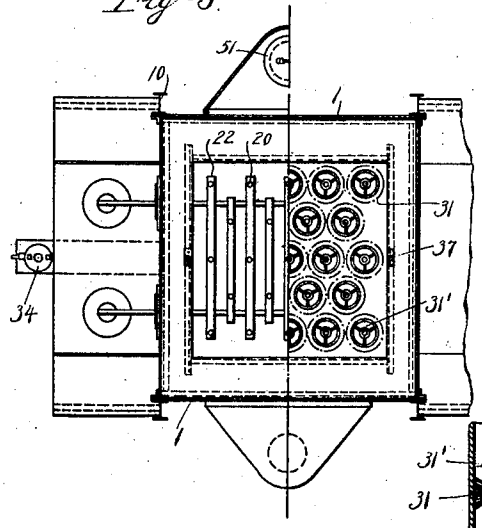
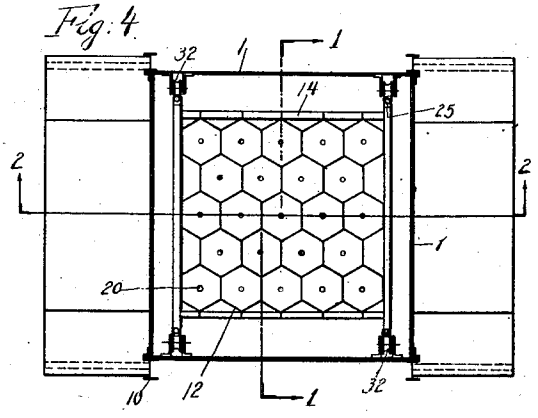


Fig. 4.



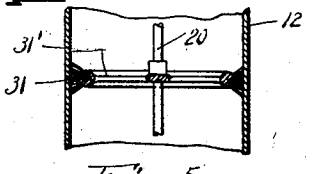


Fig. 5.

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Fig. 7.

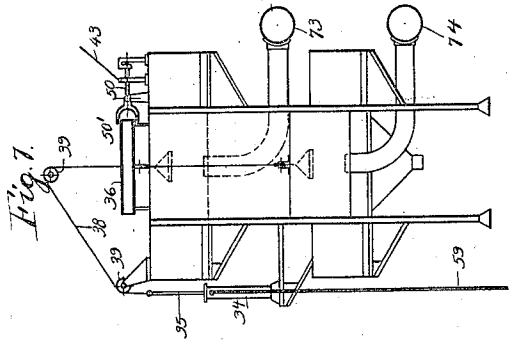


Fig. 9.

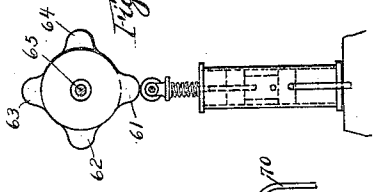


Fig. 8.

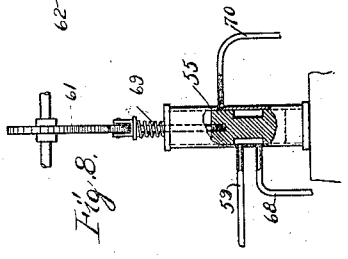


Fig. 6.

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Patented Dec. 25, 1923. 1,478,798

UNITED STATES PATENT OFFICE.

ARTHUR A. SCHMIDT, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO INTERNATIONAL PRECIPITATION COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

APPARATUS FOR ELECTRICAL TREATMENT OF GASES.

Application filed May 27, 1919. Serial No. 300,186.

To all whom it may concern:

Be it known that I, ARTHUR A. SCHMIDT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Apparatus for Electrical Treatment of Gases, of which the following is the specification.

This invention relates to the art of separation of suspended particles such as smoke, fume, etc., from furnace gases, or other gases, by the action of an electric field. In such apparatus the gas to be treated is passed between suitable electrodes between which a high potential difference is maintained, under such conditions that the material suspended in the gases is caused to be precipitated on certain of such electrodes, usually referred to as collecting or receiving electrodes. Such collecting or receiving electrodes in apparatus of this character are generally constituted by the walls of the chambers or passages through which the gas is conducted. The main object of the present invention is to provide an electrical precipitator of improved construction wherein the walls constituting the collecting electrodes are constructed in such manner as to provide a maximum collecting surface for a given size treater. A further object of the invention is to provide improved means for equalizing the flow of the gases through the multiplicity of passages in the electrical precipitator.

Another object of the invention is to provide improved means for removing the precipitated material from the walls or surfaces constituting the collecting electrodes.

The accompanying drawings illustrate an embodiment of my invention, and referring thereto:

Fig. 1 is a vertical section of the apparatus taken on line 1—1, Fig. 4.

Fig. 2 is a vertical section taken on line 2—2, Fig. 4.

Fig. 3 is a horizontal section taken on line 3—3, Fig. 2.

Fig. 4 is a horizontal section taken on line 4—4, Fig. 2.

Fig. 5 is a vertical section of one of the cleaning brushes.

Fig. 6 is a side elevation and Fig. 7 an end elevation of a plurality of treaters provided with means for automatic operation of same in cyclic order for precipitation and for removal of the precipitate.

Fig. 8 is a partly sectional side elevation and Fig. 9 an end elevation of one of the valve devices for controlling such cyclic operation, said Fig. 9 being taken on line 9—9, Fig. 6.

The apparatus shown comprises an outer casing *a* having vertical walls 1, a closed top 2, and a hopper shaped bottom 3, provided with suitable means such as gate 4 for removing collected material. A horizontal partition 5 extends across the outer casing to form a top header or chamber 6 into which opens a conduit 8 for conducting the gas to or from the apparatus. Another conduit or flue 9 leads from the lower part of the casing. In the following description the gases will be assumed to enter at the upper conduit 8 and be discharged through the lower conduit 9, but the direction of the gas stream may be reversed if desired. The outer casing 1 may be mounted on suitable supporting columns 10.

A plurality of vertical gas receiving flues 12 are mounted in connection with the transverse horizontal partition 5, aforesaid, said flues being open at their lower ends to communicate with the space 13 at the lower part of casing *a* and open at their upper ends to communicate with the upper header 6. For the sake of compactness, I prefer to form these vertical flues of hexagonal shape, as shown in Fig. 4, assembled in close order in such manner as to give a cellular or reticulate construction similar to that of a honeycomb structure. The walls of these hexagonal flues may be formed of sheet metal and may be fastened together in any suitable manner and are preferably connected at their upper and lower ends to frames 14 and 15 for mounting the same. If desired, these flues may be formed in a plurality of sections *c* and *d*, separated as indicated at 16. These collecting electrodes or flues may be rigidly mounted in stationary position in casing *a*, but to facilitate cleaning the same I prefer to mount the said flues in such manner as to enable them to be raised or lowered as hereinafter described. The hopper or receptacle 3 is permanently connected below the said electrode flues, so that any material

falling from the said electrodes, whether at the times of cleaning, or at other times, will fall into said receptacle.

Discharge electrodes 20 extend vertically and axially in the respective flues 12, said discharge electrodes consisting, for example, of metallic wires or rods of suitable fineness to permit electrical discharge therefrom at the potential difference under which the apparatus is to be operated; said discharge electrodes being held rigidly between upper insulator frame bars or beams 22 and lower insulator frame bars 23, connected to the upper and lower ends of the discharge electrodes. The supporting bars 22 and 23 are mounted on suitable insulators 27 and 28 which are secured in fixed position in suitable insulator chambers 29 and 30 alongside the outer casing (*a*).

Any suitable means may be provided for cleaning the collecting electrodes or flues 12, but I prefer to employ the means shown, comprising brushes 31 mounted on the respective rods or wire 20 above the respective sections (*c*) and (*d*) in position to engage and brush against the walls of said flues when the latter are raised; said brushes being arranged in rows or sets above the respective sets (*c*) and (*d*) of flues. The said sets of flues (*c*) and (*d*), together with their upper and lower frames 14 and 15, and vertical connecting bars 25, constitute a rigid body, which is guided vertically by guide rollers or wheels 32 on which run the vertical frame bars 25. Any suitable means may be provided for raising the collecting electrode system to effect the cleaning thereof, for example, a hydraulic ram comprising a cylinder 34 and a plunger 35, connected by cable 38 running on sheaves 39 to a frame 36, from which depend bars 37 connected to the respective frames 14 and 15, so as to lift the collecting electrode system bodily by the action of the hydraulic ram. Brushes 31 may be formed in annular or polygonal shape to fit the walls of the collecting electrode flues and are mounted on spiders or open frames 31′, so as to permit passage of gas through same and also, in case of the lower brushes, to permit of the precipitated material passing downwardly through the brushes in cleaning of the apparatus. The collecting electrode system is normally supported on cross-beams 40 on which the lower frame 15 rests and a horizontal extension plate 5 constituting the transverse horizontal partition aforesaid is attached to the upper frame 14 and normally extends directly over flanges 42 on the walls of casing 1.

The discharge electrode system is connected to a wire 43 leading to any suitable source of current, for example, said wire may be supplied with current in the manner set forth in patent to F. G. Cottrell, No. 895,729, August 11th, 1908, in such manner as to maintain a unidirectional high potential difference between the discharge electrodes 20 and the collecting electrode flues 12, the latter being grounded and the current being completed through grounded connections at the source of current.

I prefer to provide for automatically cutting off the electric current supply and also the supply of gas to the apparatus during the cleaning operation, for this purpose an electric switch 50, connected to the supply circuit connection 43, is arranged to be operated in conjunction with the frame 36 (as by engagement of said frame with arms 50′, on the switch lever) or otherwise, so as to open the supply circuit when frame 36 is raised and to close said circuit when the frame 36 is lowered to normal position; and valves or dampers 51 and 52 are provided at the inlet flue or conduct 8 and outlet flue or conduct 9 of the apparatus and are connected to levers 53 engaged by frame 36 to close the dampers when said frame is raised and to open the dampers when the frame is lowered to normal position. The cleaning operation may be performed intermittently or periodically by time controlled mechanism, and, in case of a plurality of precipitators in a single installation, I prefer to provide for successive cleaning operations in the several precipitators in cyclic manner. Suitable means for this purpose is shown in Figs. 6 to 9, comprising a plurality of valves 55, 56, 57 and 58, connected by pipes 59 to ram cylinders 34 for the respective precipitators, and operated by cams 61, 62, 63, and 64, respectively, carried by a shaft 65, which is rotated at low speed by gearing 66 operated by motor 67. Each of said valves, when operated by the corresponding cam, opens connection from a water pressure supply pipe 68 to the corresponding pipe 59 and when the valve is returned to normal position by a spring 69, it opens connection from said pipe 59 to outlet pipe 70, to allow the ram plunger to return to normal position. The cams 61, 62, etc., are angularly displaced around shaft 65 so as to cause successive operation of valves 55, etc., and operation in cylic order of the cleaning means for the several precipitators, so that the precipitators are cleaned one at a time.

The operating of the apparatus is as follows:

The gas to be treated is supplied, for example, through flue 8 and passes downwardwardly through the successive sections *b* and *c* of the collecting electrode flues and then out through flue 9. Normally the collecting electrode system is supported on the supporting I beams 40 with the upper plate 5 extending from frame 14 resting on or lying directly over flanges 42 on the enclosing casing 1 so as to cause all of the gas to

be directed through the collecting electrode flues. A suitable high potential difference, say 50,000 volts or over, is maintained between the discharge electrodes 20 and the collecting electrode flues 12 and the suspended material or suspended particles are precipitated on the walls of the collecting electrode flues by the action of the electrical field so produced, in such manner that the gases which pass out through the outlet 9 are comparatively clean or free of suspended material. An important advantage of the construction described wherein the collecting electrode flues are made in a plurality of sections with open spaces between is that better equalization or distribution of the gases is secured between the parallel flues. In apparatus of this kind including a multiplicity of parallel flues there is generally a tendency for the gases to flow more rapidly through some of the flues than others, either on account of unequal heat distribution, resulting in difference in density or buoyancy of the gases, or on account of disturbances due, for example, to outside influences, such as wind or atmospheric currents; these disturbing or unequalizing influences generally increase with the length of the vertical flues and by dividing the flues in a plurality of sections opportunity is given for the gases to equalize themselves as regards velocity, pressure and temperature between the several flues.

The material deposited or precipitated on the walls of the collecting electrode flues may be removed continuously or from time to time by any suitable means. With the construction shown in the drawing, such removal is conveniently effected by raising the entire collecting electrode system bodily at stated or required intervals by operation of the ram 34, or otherwise, causing each section of the electrode flues to be drawn up past the brushes 31 in such manner that the precipitated material is brushed or dislodged from the walls of the flues and descends by gravity to the bottom of the treater. To facilitate this operation, it is preferable to cut off the supply of current while the cleaning operation is being performed and the draft may also be cut off or reduced at such time. In this connection, it is to be noted that the introduction of the brushes within the respective collecting electrode flues tends of itself to diminish the effective cross-section of the flues as regards passage of the gases therethrough so that the draft through the inlet and outlet pipes will be automatically reduced during the cleaning operation, the brushes acting as partial dampers in the flues and then again on lowering the collecting electrode system the cleaning operation is repeated and the system finally comes to rest in normal position, being then supported on the beams 40. I prefer, however, to also provide positive dampers, as shown at 51 and 52 at the inlet and outlet, or both, and to operate said dampers concurrently with the cleaning means to ensure stoppage of the gas stream while cleaning is being effected.

In the case of a plurality of precipitators, arranged as shown in Fig. 6, the valves 55, etc., are operated successively by the cams 61, etc., to cause successive operation of the cleaning means for the respective precipitators and also to cut off the current to the corresponding precipitator by opening switch 50 and to stop the gas flow through to the precipitator, closing valves 51 and 52 so as to shut off communication with inlet flue 73 and outlet flue 74. This provides for automatic and periodic control of the cleaning means and for shutting off of the gas stream and of the electric current during the cleaning, and the expense of manual control is thereby obviated and it is thereby rendered practicable to effect cleaning at short intervals, (say of a few minutes' duration), and to thereby keep the collecting electrodes in relatively clean condition. This contributes materially to efficiency of precipitation, as electrical precipitation is far more effective when the collecting electrode is substantially clean than when a deposit of considerable thickness has been formed thereon.

While I am aware that it is not broadly new to provide flues of polygonal cross-section, I propose flues of hexagonal cross-section because the hexagonal system of collecting electrodes shown and described has the advantage of presenting an approximation to circular form with resulting approximate uniformity of electric field and maximum effective precipitating capacity for each flue, together with complete utilization of the treater spaces and elimination of waste spaces such as are generally found in the ordinary round pipe treaters by reason of the necessary separation of the pipes.

While the above described apparatus is intended particularly for electrical precipitation of suspended material from gases, some of the features of the invention, particularly, the hexagonal cellular electrode flue system and the arrangement of the electrode flue system in a plurality of successively acting sections spaced apart to permit equalization of the gases, are applicable generally to electrical treatment of gases for various purposes, such as electro-chemical reactions.

An important feature of the present invention, as applied to electrical precipitation, is the provision for removing the deposit from the collecting electrodes by means such as brushes, which are normally removed from the said electrodes so as not

to interfere with precipitation and to leave the precipitation chambers free for effective operation throughout the collecting surfaces. It will be understood that the term brushing means, as used herein, includes any suitable means for brushing, scraping or otherwise positively removing the deposit from the collecting electrodes. It will also be understood that the relative motion of the brushing means and the collecting electrode means required for the cleaning operation may be effected by moving either of such means. Thus, for example, the discharge electrode system may be mounted to move relatively to the collecting electrodes to bring the brushes into operative relation for cleaning and, preferably, at the same time, to open the circuit connection to the supply circuit, substantially as above described for the collecting electrode system.

What I claim is:

1. In an apparatus for the electrical treatment of gases, a plurality of parallel discharge electrodes and a plurality of sections of collecting electrodes, each section of collecting electrodes comprising a plurality of parallel flues respectively surrounding said discharge electrodes, and said sections being spaced apart to permit interflow and equalization of the gases between the several flues of the sections, and means for conducting the gases to and from the said collecting electrodes.

2. In an apparatus for the electrical precipitation of suspended material from gases, the combination of a plurality of vertical discharge electrodes and a collecting electrode system, comprising a plurality of sections, each section consisting of a plurality of vertical collecting electrode flues surrounding the respective discharge electrodes, said sections being spaced apart vertically, means for conducting gases to one of said sections, and means for conducting gases away from another of said sections, whereby the gas is caused to pass successively through said sections and to be equalized between the different flues of each section.

3. In an apparatus for the electrical precipitation of suspended material from gases, the combination of a vertically extending discharge electrode, a vertically extending collecting electrode opposing the same, brushing means mounted in fixed position adjacent to said collecting electrode, means for reciprocating said collecting electrode in a vertical path to cause it to be brought into contact with said brushing means or out of contact therewith and a receptacle permanently located below said collecting electrodes to receive the precipitated material removed therefrom.

4. In an apparatus for the electrical precipitation of suspended material from gases, the combination of a vertically extending discharge electrode, a collecting electrode extending vertically opposite the discharge electrode, cleaning means mounted on said discharge electrode for removing precipitated material from said collecting electrode, and means for reciprocating said collecting electrode adjacent to said cleaning means to cause cleaning of the electrode by said cleaning means.

5. The combination of an electrical precipitator comprising electrodes and means for supplying said electrodes with high tension current, so as to maintain the electrodes at high potential difference; means for cleaning the electrodes; means for periodically operating said cleaning means, and switch means for controlling supply of current to the electrical precipitator, and means automatically operative to maintain said switch open during the operation of the cleaning means.

6. The combination of a collecting electrode, a discharge electrode, cleaning means for the collecting electrode, means for periodically operating said cleaning means, and an energizing circuit connected to said electrodes and including a switch constructed and arranged to be operated automatically so as to be open during the cleaning operation.

7. In an apparatus for the electrical precipitation of suspended material from gases, electrode means for effecting electrical action on the gas to precipitate suspended particles therefrom, a conduit for conducting the gas to be treated between said electrode means, damper means controlling the flow of gas in said conduit, automatic cleaning means for the removal of the precipitated material from the collecting electrodes, periodically operating means for controlling the operation of said cleaning means at definite intervals and means for effecting operation of said damper means simultaneously with said cleaning means to shut off the flow of gas during the cleaning operation.

8. In an apparatus for the electrical precipitation of suspended material from gases, a plurality of electrical precipitation units, each provided with automatically operated electrode cleaning means for removing the precipitated material, conduits for conducting the gas to be treated to the respective electrical precipitation units, periodically operating means controlling the operation of said automatic cleaning means successively for the respective electrical precipitators, damper means controlling the flow of gas through the respective conduits, and means for operating the damper means for the conduit leading to each electrical precipitation unit simultaneously with the operation of the cleaning means for such unit.

9. In an apparatus for removing sus-

pended particles from gaseous and fluid flow bodies, the combination with a stationary discharge electrode and a reciprocable collecting electrode of means arranged to contact with the collecting surface of said last named electrode to scrape said surface when said electrode is reciprocated.

10. In an apparatus for removing suspended particles from gaseous and fluid flow bodies, the combination with a stationary discharge electrode, and a reciprocable tubular collecting electrode surrounding said discharge electrode, of means arranged to contact with the inner periphery of said collecting electrode to scrape the same when said electrode is reciprocated.

In testimony whereof I have hereunto subscribed my name this 20th day of May, 1919.

ARTHUR A. SCHMIDT.