

July 11, 1933.

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1,917,522

ELECTRICAL PRECIPITATION APPARATUS

Filed June 20, 1932

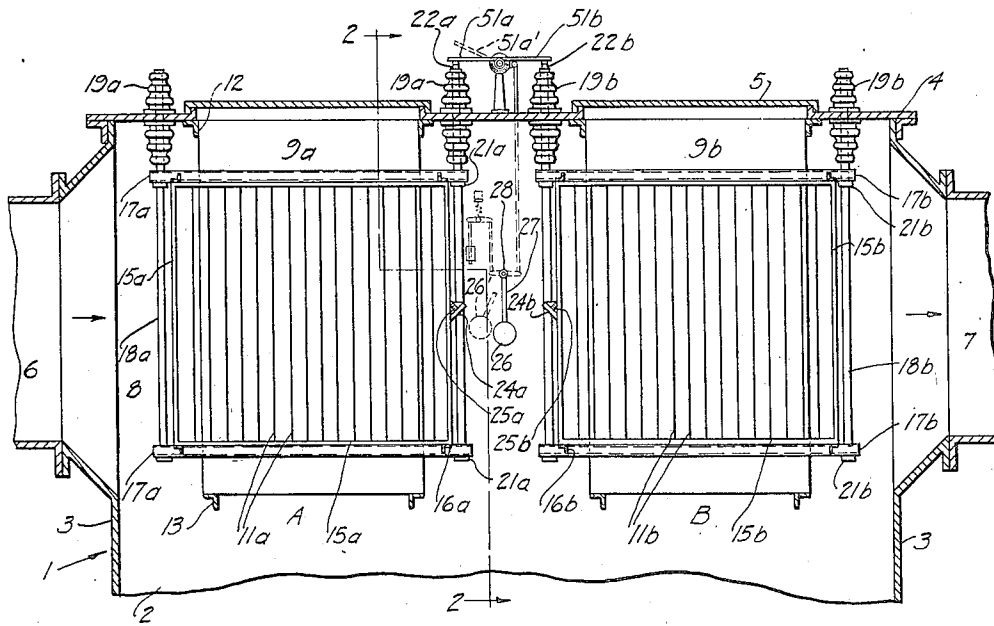


FIG. 1

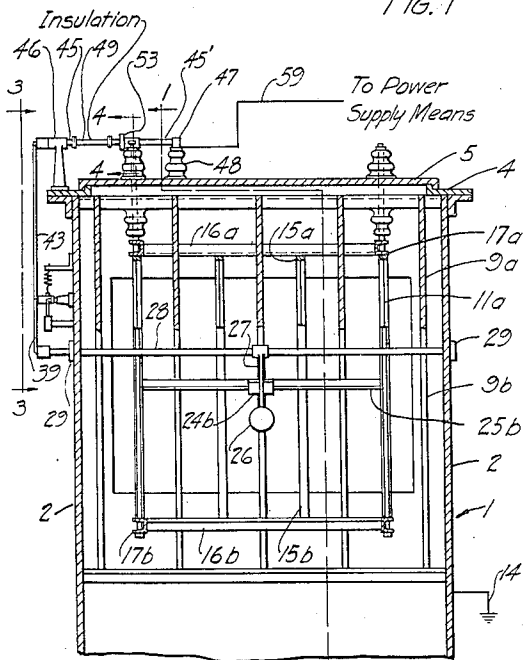


FIG. 2

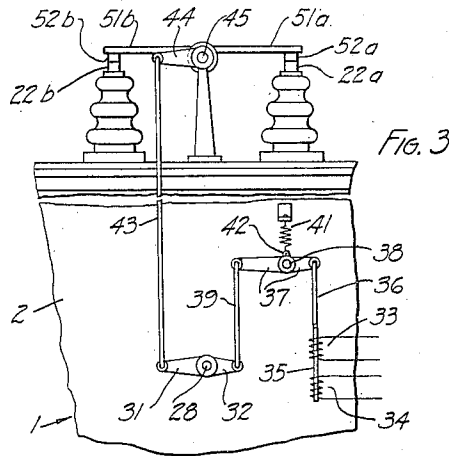


FIG. 3

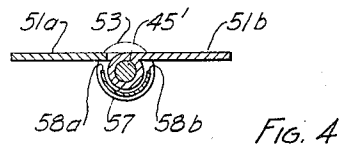


FIG. 4

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ELECTRICAL PRECIPITATION APPARATUS

Application filed June 20, 1932, Serial No. 618,327, and in Germany July 1, 1929.

This invention relates to apparatus for electrical precipitation of suspended particles from gases, and particularly to means for rapping or jarring the high tension electrodes of such apparatus for the purpose of removing precipitated material therefrom.

The principal object of the invention is to provide means for rapping the high tension electrode means and simultaneously interrupting the electrical connection of said electrodes to the high tension conductor through which said electrodes are normally energized, in such manner as to minimize the time during which said connection is thus interrupted. More specifically, it is the object of this invention to make the period of interruption of the connection of the high tension electrode system to the source of power supply sufficiently short to produce little, if any, appreciable decrease in the effectiveness of the electrical precipitator.

Electrical precipitation apparatus, in general, comprises two opposing electrode systems between which the gas to be cleaned is passed, one of said electrode systems being ordinarily maintained at ground potential, and the other electrode system being maintained at a high potential, say 10,000 volts or more, with respect to the first-named electrode system. The grounded electrode system ordinarily comprises collecting electrode means of relatively extended surface, while the high tension electrode system ordinarily comprises discharge electrode means of small surface and sharp surface curvature so as to facilitate electrical discharge therefrom. In apparatus of this type, the rapping means of this invention is intended for application to the discharge electrode system, but it will be understood that it may be applied to any electrode system in an electrical precipitator, which is maintained at high potential with respect to ground.

Due to the high potential existing between the high tension electrode system and the collecting electrodes, housing, supporting structure and other adjacent parts, the cleaning of these high tension electrodes presents certain difficulties. In some cases this has been accomplished by inserting insulating mem-

bers in the operating mechanism of the rapping system. However, such insulating members, which are usually formed of porcelain or the like, do not stand up well under the severe jarring to which they are subjected in the operation of the rapping means. In other cases, it has been proposed to omit these insulating members and to entirely disconnect the high tension electrode system from the source of high tension conductor leading from the source of current, throughout the entire period of operation of the associated rapping mechanism. This, however, is disadvantageous because the period during which the electrodes are to be energized is relatively long, and it is therefore necessary to interrupt the flow of gas through the precipitator, or through the particular section in which the discharge electrodes are to be rapped, during this period of de-energization, in order to prevent an objectionable amount of uncleaned gas being discharged from the system.

In the apparatus of the present invention the high tension electrode means are provided with one or more impact-receiving members constituting either a part of the discharge electrode means or a member secured thereto, and one or more rapping members are provided, said rapping member or members being mounted for movement between a position free of engagement with the impact-receiving member or members and a position of engagement therewith, while means are also provided for opening the circuit leading to said high tension electrode means during only the time when said rapping member or members are in position adjacent said impact-receiving member or members. More specifically, means are provided which are operable coincidentally with the rapping means during each movement thereof to and from position of engagement with the impact-receiving means, so as to open the circuit of the high tension electrode means during each movement of the rapping means toward such position and hold said circuit open during the moment of impact, and to again close the circuit during the return movement of said rapping means. In installations

where two discharge electrode units are provided, for example, in successive sections of an electrical precipitator, a single rapping means may be provided, adapted to be moved alternately into position of engagement with impact-receiving means on the respective discharge electrode units, and also to a position free from engagement with both of said impact-receiving means, and suitable means may be provided for interrupting the circuit leading to each of said high tension electrode units during the time when said rapping means is in proximity to the impact-receiving means of that unit.

It will be understood that the interruption of the electrical connection to the high tension electrode means during each movement of the rapping means toward engagement with said electrode means should occur before said rapping means approaches sufficiently close to said electrode means to cause short circuiting or discharge therebetween, and that the reclosing of said electrical connection during the return movement of said rapping means should occur after said rapping means has passed beyond short circuiting or discharging distance with respect to said electrode means, these distances depending upon the voltages employed and to some extent upon the shape of the rapping means and impact-receiving means.

The accompanying drawing illustrates electrical precipitation apparatus embodying this invention, and referring thereto:

Fig. 1 is a longitudinal section of an electrical precipitator, embodying said invention.

Fig. 2 is a transverse section on line 2—2 in Fig. 1.

Fig. 3 is a partial side elevation, taken in the direction indicated by the line 3—3 in Fig. 2.

Fig. 4 is an enlarged sectional view on line 4—4 in Fig. 2.

The electrical precipitator is shown as comprising a housing 1 including side walls 2, end walls 3 and top wall 4, which may be provided with removable cover members 5 permitting access to the interior of the precipitator and also permitting insertion and removal of the electrode means hereinafter described. Said housing is also provided with inlet means 6 and outlet means 7 for passage of the gas to be cleaned through the precipitating chamber 8 within said housing. Said precipitator may also be provided with any suitable means below said precipitating chamber for receiving the precipitated material. The precipitator is shown as comprising two sections A and B arranged for successive passage of gas therethrough. Collecting electrodes, such as vertical plates 9a and 9b extending parallel to the direction of gas flow, and discharge electrodes such as vertical wires 11a and 11b disposed in rows be-

tween said collecting electrodes, are provided in the respective precipitator sections. The collecting electrodes 9a and 9b are supported within the housing in any suitable manner, for example, by means of bars 12 and 13, and are electrically grounded, for example, through the housing 1, as indicated at 14.

The discharge electrode members 11a and 11b are shown as mounted within rectangular supporting frames 15a and 15b, and said frames are in turn carried by transverse bars 16a and 16b and by longitudinal bars 17a and 17b. The members 11a, 15a, 16a and 17a, in the first section of the precipitator, may be considered as constituting one discharge electrode unit, and the corresponding members in the second section of the precipitator as constituting another discharge electrode unit. Each of said units is carried on insulated supporting means, such as vertical rods or bars 18a and 18b respectively, which are suspended from insulating supports 19a and 19b respectively. The discharge electrode units are preferably so mounted on the respective insulated supporting means as to permit free upward movement thereof, thus permitting the discharge electrode means to be raised slightly by operation of the rapping means hereinafter described and increasing the effectiveness of vibration of said electrode means. For this purpose, the bars 17a and 17b are shown as resting loosely upon shoulders or collars 21a and 21b on the supporting members 18a and 18b respectively. The members 18a and 18b preferably extend up through the insulating supports 19a and 19b, and one of said supporting members for each discharge electrode unit is provided at its upper end with a contact member such as indicated at 22a and at 22b, so as to act as an electrical conductor from said contact member to the corresponding discharge electrode unit.

Each discharge electrode unit is shown as provided with impact-receiving means comprising, for example, an anvil or impact plate, shown at 24a and 24b respectively, rigidly secured to all of the discharge electrode frames 15a and 15b of that unit, as by means of a transverse bar 25a and 25b. The rapping member is shown as comprising a hammer 26 secured by arm 27 to a shaft 28 which is rotatably mounted in bearings 29 so as to permit pivotal movement of said hammer, to one side or the other into forcible engagement with the respective impact plates 24a and 24b, and also permit movement thereof to an intermediate or rest position, as shown, in which it is out of contact with both of said impact plates and sufficiently removed from both discharge electrode units to prevent short circuiting therebetween. Shaft 28 projects through the precipitator housing at one side and is provided with lever arms 31 and 32. Lever arm 32 is connected to suitable operating mechanism for effecting oscillatory rock-

ing motion of said shaft. While any suitable form of mechanism may be used for this purpose, the mechanism is shown as comprising two opposingly acting electromagnetic coils 33 and 34, acting on a core member 35 adapted to be alternately moved in opposite directions upon alternate momentary energization of said coils. Said core member is connected by link 36 to lever 37 pivotally mounted at 38, and the other end of said lever is connected by link 39 to lever arm 32 on shaft 28. While the weight of hammer 26 tends to restore said hammer to its intermediate rest position, and at the same time bring the core member 35 to an intermediate position such as shown, upon de-energization of the coils 33 and 34, I may, if desired, provide additional means for moving the mechanism to this position upon such de-energization, such means being shown as comprising a spring 41 connected to an arm 42 on shaft 38.

The lever arm 31 on shaft 28 is connected by link 43 to lever arm 44 on a shaft 45 rotatably mounted in bearings 46 and 47 on the top of the precipitator housing and extending between the contact members 22a and 22b. A portion of shaft 45, such as shown particularly at 45', is insulated from the grounded supporting structure, for example, by mounting the bearing 47 at one end of said shaft on an insulating support 48 and by providing an insulating section 49 in said shaft between said portion 45' and the other bearing 46. Said insulated portion 45' carries two contact arms 51a and 51b, which are rotatably mounted thereon and which are provided with contact members 52a and 52b, normally resting upon contact members 22a and 22b. Said insulated shaft portion 45' also carries a member 53 secured to rotate therewith and provided with an arc-shaped projection 57 extending beneath the contact arms 51a and 51b and having its ends 58a and 58b so disposed as to engage the respective contact arms and lift the same off of the corresponding contact members 22a and 22b at a suitable point in the rotation of shaft 45. The contact arms 51a and 51b may be connected in any suitable manner to the high tension side of a source of electric current at a suitable high voltage such as ordinarily employed in electrical precipitation apparatus. This connection may, for example, be made through the shaft portion 45' and bearing 47, from which a high tension lead or conductor 59 extends to said source of current. It will be understood that the other side of said source of current is connected to the low tension or collecting electrodes in any suitable manner, for example, through the ground connection 14.

The operation of the above described apparatus as an electrical precipitator is believed to be sufficiently evident to those skilled in the art, in the light of the above descrip-

tion, without requiring further explanation. A portion of the precipitated material tends to accumulate upon the discharge electrode members 11a and 11b, and in order to remove this material from said electrode members the rapping member 26 may be operated at suitable intervals, by successively momentarily energizing the coils 33 and 34 so as to swing said rapping member successively into forcible engagement with the impact-receiving members 24a and 24b of the high tension electrode units. As said rapping member swings upwardly in either direction from its intermediate position, as indicated for example in dotted lines at 26' in Fig. 1, member 57 is rotated by shaft 45 and lifts the corresponding contact arm out of engagement with the corresponding contact member, as indicated for example at 51a', so as to interrupt the connection from the high tension supply line 59 to the high tension electrode unit toward which the rapping member is moving. The angular position of the ends 58a and 58b of member 57, in relation to the position of arms 51a and 51b, is such as to raise said arms and break the electrical connection in the high tension circuit, between contact members 52a and 22a or contact member 52b and 22b, while the rapping member 26 is still sufficiently removed from the corresponding discharge electrode unit to prevent short circuiting therebetween. After the circuit is thus interrupted, the rapping member continues its operative movement and forcibly engages the impact member such as 24a. The corresponding coil, such as 34 in the present instance, is deenergized substantially at the instant of impact, by any suitable switch means, not shown, and the rapping member returns to its initial position. Upon such return movement, after the rapping member has passed beyond discharging distance with respect to the high tension electrode means, the member 57 again releases arm 51a and allows it to again close the connection between contact members 52a and 22a. The operation may then be repeated in the same manner for the other high tension electrode unit.

It will be observed that the high tension electrode means, or each unit thereof, is entirely disconnected from the source of current during the entire time when the rapping member is in proximity thereto, that is to say, when said rapping member is within short circuiting or discharge distance. Furthermore, the total period of de-energization of each high tension electrode unit during each operation of the rapping means may be made quite short, as it is only necessary that this period be long enough to permit a quick upward movement of the rapping member to rapping position and return thereof to a safe distance from the discharge electrode means. This period may easily be made as

short as one-half second or less, and de-energization of the electrode means for this relatively short period will be insufficient to permit passage of any appreciable quantity of gas through the apparatus without being subjected to electrical precipitating action. This period of de-energization of each high tension electrode unit may easily be made less than the time required for passage of gas through the precipitating field of said unit. For example, if the length of gas travel through the electrical field of each high tension electrode unit is two meters, and the velocity of gas flow is two meters per second, any given portion of gas cannot pass more than one-half the length of said electrical field during any period of de-energization of said electrode unit whose duration is about one-half second or less, as above mentioned.

I claim:

1. In an electrical precipitation apparatus provided with high tension electrode means and an energizing circuit connected thereto, rapping means mounted for movement between a position free of engagement with said high tension electrode means and a position of forcible engagement therewith, and means operable during each movement of said rapping means to and from said last-named position to open said circuit during each movement toward said last-named position and hold said circuit open during the time of such engagement and to close said circuit during the return movement toward said first-named position.

2. In an electrical precipitator provided with oppositely charged electrode means defining a precipitation field, one of said electrode means being insulated from ground, and an energizing circuit connected to said electrode means so as to maintain said one electrode means at high tension with respect to ground, a rapping member normally free from engagement with said high tension electrode means and sufficiently removed therefrom to prevent short circuiting therebetween,

means for moving said rapping member quickly into and out of engagement with said high tension electrode means, and means associated with the operation of said rapping member for breaking said electric circuit during each movement of said rapping member toward engagement with said high tension electrode means and holding said circuit open during the entire time when said rapping means is within short circuiting distance with respect to said high tension electrode means and closing said circuit during each movement of said rapping member away from such engagement.

3. An apparatus as set forth in claim 2, in which the operating means for said rapping means is adapted to move said rapping means from a position beyond short circuiting distance into engagement with said high tension electrode means and to return said rapping means beyond said short circuiting distance, in a period less than the time required for passage of gas through said precipitating field.

4. In electrical precipitation apparatus two high tension electrode units, a source of electric current, separate electrical connections from the respective high tension electrode units to said source of current, a rapping member normally removed from both of said discharge electrode units, means for moving said rapping member alternately into forcible engagement with each of said high tension electrode units, and means operatively associated with said rapping means for breaking the electrical connection of each of said high tension electrode means to said source of current upon each movement of said rapping means toward a position of engagement with either high tension electrode unit and closing said connection upon the return movement of said rapping means to normal position.

In testimony whereof I have hereunto subscribed my name this 1st day of June 1932.

RICHARD HEINRICH.

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